

Manufacturing in the 21st Century

Sections

17.1 Preparing for Manufacturing

17.2 Producing the Product

17.3 Selling the Product

What You'll Learn

- **Explain** the purpose of research and development.
- **Discuss** how products are designed.
- **Describe** a virtual factory.
- **Compare** CNC, CAM, and CIM.
- **Examine** the use of industrial robots and e-manufacturing.
- **Summarize** the roles of quality assurance and safety in modern manufacturing.
- **Define** the purpose of the marketing department.
- **List** several forms of advertising.
- **Identify** the difference between a wholesaler and a retailer.

Explore the Photo



Virtual Factory A computer-generated virtual factory allows the manufacturing engineers to try various layouts. *What is the advantage of setting up a virtual factory before setting up a real one?*





Launch the TECHNOLOGY LAB

Test Products

At the end of this chapter, you will test several brands of a single product and record the results to determine which product is the best buy. Get a head start by using this checklist to prepare for the Technology Lab.

PROJECT CHECKLIST

- ✓ Think of different products you might want to test.
- ✓ Research the kinds of tests researchers perform on different products.
- ✓ Make a list of materials you might need to test your product.

Preparing for Manufacturing

Reading Guide

Before You Read

Connect How do companies prepare for manufacturing?

Content Vocabulary

- R&D
- virtual factory

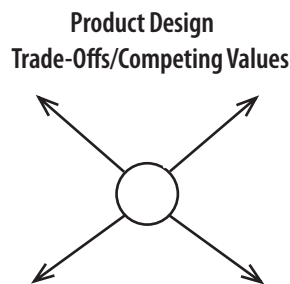
Academic Vocabulary

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

- concept
- acquire

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 8** Attributes of Design
- STL 10** Troubleshooting & Problem Solving
- STL 11** Design Process
- STL 19** Manufacturing Technologies

ACADEMIC STANDARDS

Social Studies

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*
- 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*

Manufacturing in the United States

How has the United States become a leader in manufacturing?

The United States has more than 400,000 factories. About 15 million people work in them and make everything from toys to locomotives. The United States produces more manufactured products than any other country in the world. Advances in technology have enabled American factories to manufacture large amounts of high-quality products. New technologies and products result from the demands, values, and interests of businesses and consumers.

As You Read

Predict What is the purpose of a virtual factory?



Something Old, Something New Research engineers look for new products or new ideas for old products. *Can you think of an example of how an older product evolved into a newer product?*

Research and Development

Where do new products and advancements in manufacturing come from?

Before manufacturing can begin, decisions must be made. What product will be manufactured? How will it be designed? How will the factory be set up to make it?

A company's **R&D** (research and development) department is where invention and innovation take place. That is where new products and methods are usually born. Research looks for new **concepts**. Development uses the research to create the new products and processes. The people who work in the research and development department enjoy trying new things and considering all ideas. They also consider that products have a life cycle of introduction, growth, maturity, and decline. They might often solve technological problems through experimenting.

R&D Case Study

Suppose, for example, that the research group at Z. Z. Zipper Company is told that people might be interested in buying a zippered folding boat. They look for a new soft plastic that could be made into a leak-proof zipper. The development group makes sure that the new plastic is strong enough. They choose a specific nylon fabric for the boat. The research group and the development group work together closely.



Reading Check

Describe What is the purpose of research and development?

Tech Stars

Henry Ford

Pioneer Automobile Manufacturer

Henry Ford was born in Dearborn, Michigan, in 1863. As a young boy, he enjoyed tinkering with various machines found on his family's farm. Part-time work in a Detroit machine shop and later at Westinghouse Engine Company, allowed him to further experiment with machinery. In 1896, Ford built his first horseless carriage, and by 1903, he founded the Ford Motor Company.

Ford's Model T debuted in 1908. It sold for \$950. During its 19 years in production, more than 15 million were sold. In order to keep costs down and cut manufacturing time, Ford invented the modern assembly line. This marked the beginning of the Motor Age. Cars evolved from being luxury items for the wealthy to an essential form of transportation for everybody.

Cranking Out Cars Ford's mass-production techniques allowed his company to manufacture one complete Model T every 24 seconds. Ford died in 1947, but his company remains one of the largest manufacturers of automobiles today.

English Language Arts/Writing Write an article for your school newspaper explaining how assembly lines work.



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



Culver Pictures, Inc./SuperStock

Product Design

What are some of the jobs performed by the engineering design department?

The design department works closely with the R&D department. Design engineers help decide what requirements a product should meet, such as how big it should be. They identify the criteria and constraints involving the color, the material, the shape, and everything else that is part of a new product's design. They also determine what trade-offs may be necessary among competing values. Values include such things as cost, availability of materials, desirability of product features, and waste.

The engineers at Z. Z. Zipper **acquire** the R&D department's information. They have to answer questions like:

- What should be the length of the boat?
- The nylon fabric will wrap around a frame, much like an umbrella. Should the frame be made of composite plastic or aluminum?
- Should the boat frame fold up or come completely apart for storage?

In today's factories, the engineers draw their plans with computer-aided design (CAD) and drafting equipment. The plans are stored in the computer's memory and are later used by the production department.



Reading Check

Explain How are products designed?

Planning the Factory

In what ways does product design affect factory design?

After a new product has been developed and designed, the factory itself must be planned. Some products are very complicated to assemble. A new automobile model, for example, might have 15,000 to 20,000 parts. The parts include everything from tiny screws to large door panels. It is sometimes difficult to figure out the order in which everything should be put together.

That is where the virtual factory comes in. A **virtual factory** is a three-dimensional image that appears only on a computer screen. It is not real. Virtual factory software allows manufacturers to “try out” different layouts. Animation lets them observe the work flow before they actually set up the factory or change the process. It is just one of the ways computers have changed manufacturing.

EcoTech

Appliance Upgrades

You can replace an old vehicle with a newer model that gets better gas mileage. In the same way, you can also upgrade old appliances. Newer televisions, refrigerators, and ovens are more efficient than old ones, and save energy and money.

Try This Identify appliances at home and school to see where energy can be saved by replacing them with new models.

section

17.1

assessment



After You Read

Self-Check

1. Explain the difference between research and development.
2. Name four factors involving a product's design that are the responsibility of the design department.
3. Identify the kind of factory that appears only on a computer screen.

Think

4. Suppose you are a design engineer working with outdoor furniture. Think of at least four questions you might have to answer about your product.

Practice Academic Skills



STEM Science

5. How innovative can you be? Recycle a plastic milk container into a useful item. Perhaps you can convert it into a planter for new seeds. Another idea might be to make a tiny hole to drip out water and use a float to make water clock.



STEM Mathematics

6. The design of a wheelchair requires the front casters to have a radius of 2.5 inches. What is their circumference?

Math Concept

Geometry Geometry problems can often be solved using formulas that show how the different features of a geometric shape are related.

1. The formula for the circumference of a circle is its diameter multiplied by pi: $C = \pi D$
2. Use 3.14 to represent π .



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

Producing the Product

Reading Guide

Before You Read

Preview What goes on during production in a modern factory?

Content Vocabulary

- schedule
- CNC
- CAM
- CIM
- troubleshooting
- standard
- robotics
- e-manufacturing
- OSHA
- NIOSH

Academic Vocabulary


- target
- contact

Graphic Organizer

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

Producing the Product

Acronym	Complete Phrase
CNC	
CAM	
CIM	

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

TECHNOLOGY STANDARDS

- STL 10** Troubleshooting & Problem Solving
- STL 11** Design Process
- STL 17** Information & Communication Technologies
- STL 19** Manufacturing Technologies

ACADEMIC STANDARDS

Science

NSES Content Standard E Understandings about science and technology

Social Studies

NCSS 8 Science, technology, and society

STL *National Standards for Technological Literacy*

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Computers and Manufacturing

How are computers used in modern factories?

As You Read

Connect What do you think are the most common uses for robots?

The production department is responsible for actually making the company's product. It must be a quality product and manufactured to a specific schedule. A **schedule** is a plan for what must be done by a certain time. Some production activities use computers to keep on schedule.

Figure 17.1 Just-in-Time Delivery System

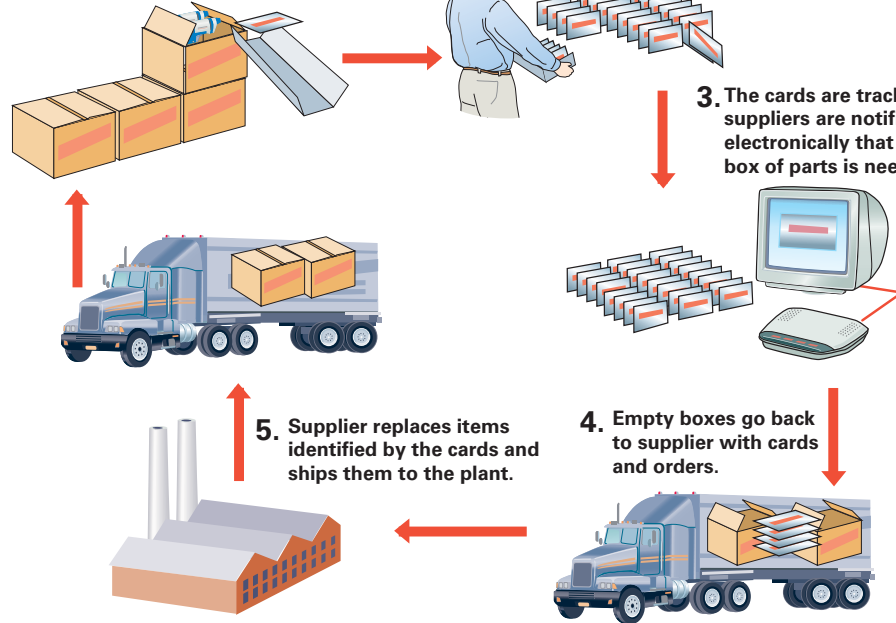
1. Supplies come into the plant with a laminated card listing name of part, number in box, and supplies. When an employee opens a box, he or she places the card into a chute.

2. A worker picks up the cards from the chute and takes them to a room where they are stored.

3. The cards are tracked and suppliers are notified electronically that a new box of parts is needed.

5. Supplier replaces items identified by the cards and ships them to the plant.

4. Empty boxes go back to supplier with cards and orders.



 **Delivered as Needed** Toyota's JIT delivery concept means its products are made and delivered only when they are needed. *Why do you think this process is efficient?*

CNC and CAM

CNC stands for computerized numerical control. With CNC, machine tools operate by commands from a computer. The operator types in the instructions, and the machine does the work. With **CAM**, or computer-aided manufacturing, machine-tool operators program computers to operate all the machinery.

CIM

CIM is computer-integrated manufacturing. All the computers in a company are linked together, or integrated. Design and production departments can communicate instantly. The purchasing department can tell just-in-time (JIT) suppliers when to deliver materials. See Figure 17.1. The marketing department can plan when to start advertising. Management can direct the entire company from one location. CIM is a company-wide process.

Lean Manufacturing

Lean manufacturing, or smart manufacturing, uses JIT delivery from suppliers. The company makes only what it can sell quickly and keeps only a few products in the warehouse.



Reading Check

Compare How do CNC, CAM, and CIM differ?



Quality Assurance

Can computers help guarantee quality?

Many companies use computers and special instruments to build quality products. One computer-controlled machine measures parts and compares the sizes with dimensions given on product plans. Microscopes and X-ray machines may be used as well.

Troubleshooting

If too many products are defective, a problem may exist in the system. **Troubleshooting** is the method used to identify the malfunction. Different processes are tested until the cause is found.

I, Robot Engineers can program robotic arms to perform many tasks in a factory. *What are some tasks a robot could do better than a human?*

Standards

A **standard** is a rule or guideline. Standards are used so certain products conform to a particular size, shape, or level of quality. The American National Standards Institute (ANSI) publishes standards for screws and other materials.

Important international standards are published by the International Standards Organization (ISO) in Geneva, Switzerland. ISO 9000 standard **targets** quality assurance.



Reading Check

Summarize What is the role of quality assurance?

Robots

What does an industrial robot look like?

Robotics is the technology of industrial robots. Industrial robots are being used more and more in manufacturing. An industrial robot usually has one mechanical arm and is classified as a machine tool. The end of the robot's arm might have a gripper to hold and move items, or it might have a tool or welding tip. Welding and painting are the most common functions for robots.

E-Manufacturing

What is e-manufacturing?

The term **e-manufacturing** means using electronic information in the manufacturing of a product. In one type of e-manufacturing, all machine tools are linked to the Internet. A person can connect to the machine with a laptop computer, a personal digital assistant (PDA), a cell phone, or other device from anywhere.

Almost all manufacturers have suppliers. Some have hundreds. With e-manufacturing, a company can stay in immediate **contact** with them. The company can manage different suppliers of the same product and keep inventories up to date using the Internet.

Safety

How are factories made safer?

Nothing is more important in a factory than the safety of the people who work there. Safety means freedom from injury or any danger of injury.

Protective Equipment

When you use a hammer, metal pieces might chip off. A face shield or safety glasses will protect your eyes. Other types of protective equipment include hard hats, earplugs, gloves, and safety shoes with steel toes. When the air contains dust or vapors, you should wear special filters over your nose and mouth.

OSHA and NIOSH

Many factory safety rules are required by federal or state laws. **OSHA**, the Occupational Safety and Health Administration, establishes safety rules and checks up on companies. **NIOSH**, the National Institute of Occupational Safety and Health, approves protection equipment such as hard hats and safety glasses.

Academic Connections Language Arts

Robots in the Slow Lane? Many people think robots are faster than humans, but this is not necessarily true. Most robots work at about the same speed as a human works. However, robots do not become bored and distracted, and their work is more accurate for repetitive tasks.

Apply Write a short story about a robot in a factory. Use at least ten of the terms you have learned in this chapter.

section 17.2 assessment

After You Read Self-Check

1. Describe e-manufacturing.
2. Tell what the acronyms OSHA and NIOSH mean.
3. Discuss industrial robots and why they are classified as machine tools.

Think

4. Companies sometimes claim, "Quality is built into our products." Explain what you think that means.

Practice Academic Skills

Social Studies

5. Count the number of minutes devoted to advertising during an hour of television. Make a pie graph showing how much time is devoted to advertising and to actual programs. Is this an appropriate distribution of time? Write a paragraph on your opinion.

STEM Mathematics

6. A company is trying to control its expenses for rents and leases. Company policy is that the monthly cost to lease one of their plants should be no more than 8 percent of the revenues generated by the plant. If the average monthly revenues of the plant are \$106,250, what should the rent be?

Math Concept Percents Percents can be thought of as parts of the whole.

1. Divide the part by the whole to get a decimal equivalent of the percent.
2. Multiply the decimal by 100 to get the percent.



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

Selling the Product

Reading Guide

Before You Read

Connect Have there been advances in the way products are marketed?

Content Vocabulary

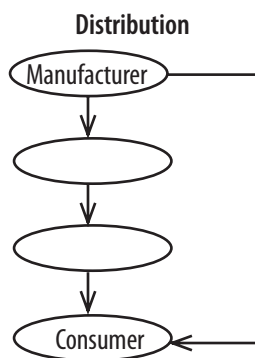
- advertising
- wholesaler
- retailer

Academic Vocabulary

- potential
- automate

Graphic Organizer

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



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TECHNOLOGY STANDARDS

- STL 2** Core Concepts of Technology
- STL 11** Design Process
- STL 17** Information & Communication Technologies
- STL 19** Manufacturing Technologies

ACADEMIC STANDARDS

Science

NSES Content Standard F Science and technology in society

English Language Arts

NCTE 6 Apply knowledge of language structure and conventions to discuss texts

STL *National Standards for Technological Literacy*

NCTM *National Council of Teachers of Mathematics*

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NSES *National Science Education Standards*

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Marketing

How is advertising done?

As You Read

Predict How are sales and marketing related?

The final steps in manufacturing are handled by the marketing department. Marketing is telling **potential** customers about the company's products and services in such a way as to make them eager to buy.

Advertising

Advertising is making a public announcement that your product is available. You have probably seen thousands of advertisements during your lifetime. You see ads on television, hear them on the radio, and read them in newspapers and magazines. Advertising can help create demand for a product.

Outdoor and Internet Ads

Companies also advertise outdoors. You can see it on the sides of trucks and other vehicles, and on clothing. Do you have a pair of designer jeans with the designer's name on them? If so, you are a walking advertisement for that designer's products.

The Internet is another way that companies can advertise their products. Some companies have their own Web sites. Others insert ads on related Web sites. Still others send e-mails to potential customers.



Outdoor Advertising

You have probably seen advertisements like this one on billboards and at bus stops. *Why do you think ads are placed at these locations?*



Reading Check

Name What are ways to advertise products?

Sales

What is the difference between direct and indirect sales?

Salespeople are responsible for closing the deal with a customer. Some sales are made directly to the person or people who will use the products. Other sales are made to a store of some kind.

Ethics in Action

Viral Marketing

Teens are some of the people advertisers want to reach. But teens have grown wise to their methods. They skip commercials with TiVo. They watch video clips on the Internet. But marketers are finding new ways to reach them.

Marketing in Cyberspace One method is called "viral marketing." Marketers use social networking sites like MySpace and Facebook to promote new movies, music groups, and products. They also use Internet chat rooms and forums to get teens interested.

English Language Arts/Writing


Word of Mouth When you see a movie because your friend recommends it, you are listening to "word of mouth." With viral marketing, marketers try to create word of mouth artificially.

1. Pretend you are an Internet marketer promoting a new movie.
2. Think of a movie to advertise.
3. Write a two-paragraph blog entry about the movie aimed at teenagers.

Imagine This...

A Historic Yet New Ship

Imagine building a new ship out of an old building. A U. S. Navy ship being built in New Orleans will use 24 tons of steel reclaimed from the World Trade Center Towers. Named the *USS New York*, it may have a crew of 360 sailors. The steel was placed in the bow (front) so it will lead the way as the ship carries out missions. *Do you think this is a good use for reclaimed steel? Explain.*

 Go to glencoe.com to this book's OLC for answers and to learn more about the *USS New York*.

For example, remember the Z. Z. Zipper Company? The production department assembled all the zippered boat parts and put them into a strong cardboard box. Twenty packed boxes of boats went to the company's warehouse every day. To sell the boats, the marketing department of the Z. Z. Zipper Company contacted the B. B. Boat Sales Company. This kind of selling is an example of indirect sales because it involves selling to a store.

Wholesale and Retail

B. B. Boat Sales Company is a wholesaler. A **wholesaler** is a company that purchases large numbers of products from a manufacturer and then sells smaller numbers those of products to retailers. A **retailer** is a company or store that sells products to consumers. Target and Wal-Mart are two examples of large retailers. Distributors move the products from the manufacturer to the retailer who sells it to the consumer.

Online Sales

The Internet has changed the way selling is done. Many steps have become **automated**. Other steps have been eliminated altogether. Stores and manufacturers have Web sites where you can order and buy products. Other sites, like Amazon.com, do all their business on the Internet. They do not have a store that you can visit. Another common sales technique uses the U.S. Postal Service mail to send information to possible customers.

section 17.3 assessment

After You Read Self-Check

1. Discuss the role of the marketing department.
2. Identify the difference between a wholesaler and a retailer.
3. Describe how the Internet has changed the way products are sold.

Think

4. Infer why manufacturers might want to sell directly to customers.

Practice Academic Skills

English Language Arts/Writing

5. Advertisements appear on TV, on the radio, in newspapers and magazines, and over the Internet. The nature of advertising is continually changing. As media technology changes, so does the way ads

appear on it. Choose a product that you use regularly and create an ad for it. Write a few sentences describing the audience you want to reach.

Science

6. Design and build your own protective container for shipping an egg. To test it, drop the container holding a fresh egg from a height of 6 to 10 feet onto the floor. Some recommended rules: (a) The container must be no larger than $4 \times 4 \times 4$ inches. (b) Everyone cleans up his or her own mess. (c) The egg will be put into the container before the test, so the container cannot be built around the egg. (d) Every container must have solid sides; wrapping it with foam rubber is not allowed. (e) To promote creative packaging techniques, no padding should be used.

Exploring Careers *in* Technology

Una Kim

SHOE COMPANY OWNER

Q: *What do you do?*

A: I am the CEO of a women's footwear and apparel company called "Keep." I oversee the operations of the business and creatively direct our products and our marketing.

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

A: I have a bachelor's degree in economics and a master's degree in business administration. School provides an important backbone, but getting out there and working on projects is the best preparation. This can mean working at other jobs that will give you relevant skills, but it can also mean your own projects. I worked in marketing, but I also organized music festivals, played in bands, and contributed to zines! Keeping up with the latest technology is important.

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

A: I love working with people I respect and who inspire me every day. I feel proud when I see my shoes and clothing come into being.

Q: *How did you become interested in your field?*

A: I've always loved bridging creativity with business. The process of taking an idea and bringing it to life is a fulfilling and challenging journey. Business is an avenue to bring cool ideas into the world to share with other people.



English Language Arts/Writing

Present a Product Write a description of new footwear using selling points such as technology and style.

1. Using a word-processor, write a product description of footwear of your choice, listing materials and other selling points.
2. On paper, draw the shoes, depicting their points of interest.
3. Using presentation software, show the footwear model to the class, presenting it as you would to a potential buyer.



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

Real-World Skills

Speaking, listening, problem-solving

Academics and Education

Mathematics, English language arts, industrial design, marketing

Career Outlook

Growth slower than average for the next ten years.

Source: *Occupational Outlook Handbook*

Chapter Summary

Section 17.1 In a company organization, the research and development department looks at new ideas and creates new products. After the company decides to make a new product, design engineers decide how it will look. After all the testing is finished, the production department decides how to manufacture the product.

Section 17.2 With CNC, machine tools operate by commands from a computer. When computers are programmed to operate all the machinery, CAM is being used. CIM stands for computer-integrated manufacturing. The completed product is inspected by the quality assurance department.

Section 17.3 The marketing department determines how to advertise the product. A wholesaler sells to retailers. Some manufacturers sell directly to consumers on the phone, through the mail, and over the Internet.

Review Content Vocabulary and Academic Vocabulary

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

Content Vocabulary

- R&D
- virtual factory
- schedule
- CNC
- CAM
- CIM
- troubleshooting
- standard

- robotics
- e-manufacturing
- OSHA
- NIOSH
- advertising
- wholesaler
- retailer

Academic Vocabulary

- concept
- acquire
- target
- contact
- potential
- automate

Review Key Concepts

2. **Summarize** the importance of research and development.
3. **Explain** how products are designed.
4. **Identify** some of the advantages of using a virtual factory.
5. **Define** CNC, CAM, and CIM.
6. **Discuss** the use of industrial robots and e-manufacturing.
7. **Describe** the role quality assurance plays in modern manufacturing.
8. **Identify** the purpose of the marketing department.
9. **Name** several forms of advertising.
10. **Compare** wholesalers and retailers.



Real-World Skills

- 11. Persuasion** Advertisements try to persuade you to buy a product. Pick an issue that you feel strongly about. Write a short speech about your topic in which you try to persuade your classmates to agree with your point of view. After you present your speech, ask if anyone changed their opinion.

STEM Technology Skill

- 12. Just-In-Time Delivery** Just-in-time delivery keeps only the supplies that are needed immediately in inventory.
- Search the Internet for companies that use just-in-time techniques. Use the search words “just in time” + (your state).”
 - Determine which companies in your state use these techniques. Write a paragraph explaining the advantages and disadvantages of using JIT.



WINNING EVENTS

Manufacturing Entrepreneur

Situation You are part of a group of entrepreneurs who work together to design, manufacture, package, and sell a product.

Activity Working with your team, make contact with two other teams outside your community who wish to participate. Determine what you want to produce and sell. Develop a plan and a timeline for each team.

Evaluation Your activities and product will be evaluated by these criteria:

- Communication skills
- Team skills
- Organizational skills—effective
- Product—well designed, packaged



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

Academic Skills



Social Studies

- 13.** Research artificial intelligence versus human decision-making, and impacts of AI on society. Write a paragraph.



Mathematics

- 14.** Terry has a job hanging billboard advertisements. The paste he uses comes in gallon cans. He is working on a billboard 16 yards long and 13 feet high. A can of the paste covers 100 square feet. How many cans will he need?



Area Measurement To determine the area of a rectangle, multiply its length by its width.

- Express measurements using the same unit of measure.
- The result of multiplying two numbers is the product. Express the product of length and width in square units.

Standardized Test Practice

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

- What is the surface area of a cube with each edge measuring 4 feet?
A 16 square feet
B 96 square feet
C 64 square feet
D 48 square feet
- OSHA is the agency that approves the use of protective equipment, such as safety glasses.

T

F

Test-Taking Tip Skim through the test before you begin, so you know how to pace yourself.

Test Products

A product manufactured by one company is usually a little different from the same product made by another company. Even though they all may meet the same standards, one company's product might be better than others. *Consumer Reports* tests and evaluates all kinds of products, including cars, door locks, and toothpaste, and publishes its recommendations in a magazine and on its Web site, consumerreports.org.

Tools and Materials

- ✓ Flashlight
- ✓ Three sets of the number of batteries that fit your flashlight: one set each of brand A, brand B, and brand C. Make sure they all have the same ratings printed on the outside (for example, "Size D Alkaline" or "Size AA Heavy Duty").
- ✓ One or two plastic grocery bags per experiment
- ✓ Clock

Optional

- ✓ Calculator
- ✓ Computer with spreadsheet software

Set Your Goal

For this activity, you will choose different brands of a single product and test them. You will record the test results and determine which product is the best buy.

Know the Criteria and Constraints

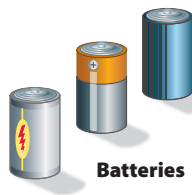
In this lab, you will:

1. Test flashlight batteries. Or, with your teacher's permission, choose a different product and test it.
2. Determine in advance what qualities of the product you will test. If the product comes with an instruction manual, read it to learn the correct way to use it.
3. Keep a record of the test results.

Design Your Project

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

1. Record the cost of each brand. Note the battery expiration dates. Write down all your information or use a spreadsheet.



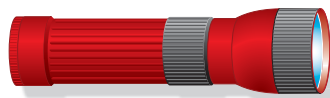
Batteries



Clock



Plastic bag



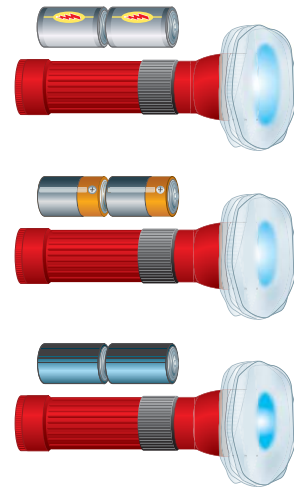
Flashlight

SAFETY

Reminder

Be sure to always follow appropriate safety procedures and rules so you and your classmates do not get hurt.

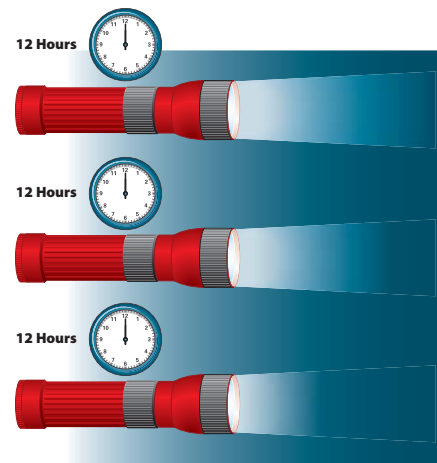
2. Determine your test procedure.
 - Your first test can be to find out which set of batteries produces the strongest light. One way to do this is to use white or light brown plastic bags from a grocery store.
 - See how many layers of plastic it takes to completely block the light from a flashlight that has brand A batteries inside.
 - Keep folding the plastic. You may need 20 or more layers.
 - Repeat the test using brands B and C.
 - Write down all your information or use a spreadsheet.
3. Another test is to find out how long it takes for the batteries to wear out.
 - Put new brand A batteries in the flashlight and turn it on. Write down the time you start. Keep the flashlight on until it no longer puts out much useful light.
 - Repeat for brands B and C. Write down all your information or use a spreadsheet.
 - When you are done, set the batteries aside for later disposal at a household hazardous waste facility. Do not throw them in the trash.



Evaluate Your Results

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

1. Based on your testing, which brand provided the most value? Why?
2. What other tests could you have conducted on the batteries?
3. Did you have any trouble reading the information you wrote down? How important was it to clearly write down all the information?



Academic Skills Required to Complete Lab

Tasks	English Language Arts	Math	Science	Social Studies
Record the cost of items to be tested.		✓		✓
Determine testing procedure.	✓		✓	
Perform a test on three different brands of a product.	✓	✓	✓	✓
Analyze results.	✓	✓	✓	✓
Find out how to dispose of batteries.	✓		✓	✓

Technology Time Machine

Evolution of the Factory

Play the Game This time machine will travel to the past to show you how manufacturing has changed from the days of crude cotton spinners to today's computer-run factories. To operate the time machine, you must know the secret code word. To discover the code, read the clues, and then answer the questions.

Clue 1

1700s The factory system was founded in Great Britain with engine-driven machinery producing various goods. The development of factory organization led to a huge increase in the production of goods—and the Industrial Revolution.

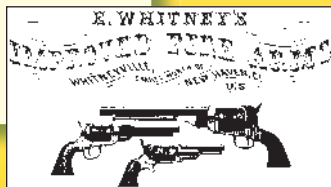


Clue 2

1790 Samuel Slater came to the United States with plans for a machine that would spin cotton. However, labor in this country was scarce, making the growth of factories slow at first.

Clue 3

1798 Another important innovation was the use of interchangeable parts. Prior to this time, parts were made individually. Eli Whitney and Simeon North, makers of small weapons, designed parts that could be used on any weapon they produced. Also, their workers were trained to specialize in one job. Both methods speeded up production.



Clue 4

1914 With interchangeable parts and special training came the moving assembly line. It was introduced by automobile maker Henry Ford. Workers in the assembly line added parts as the product moved past them on a conveyor belt. This was a major improvement.



Clue 5

1950s With automation, manufacturing methods changed again. The automated restaurant was an early form of the vending machine. Automatic controls over machines were also used to make



products. Automation relied on early computers. One result was industrial robots replaced human workers for certain tasks.

Clue 6

1970s In the United States, machinery and methods used in factories became outdated. Meanwhile, factories in Germany and Japan were using technology along with modern labor methods. They began to out-produce the United States, particularly in the automobile industry.



Clue 7

1980s Manufacturers in the United States introduced new factory systems using computers in the production process. Factories became more flexible and required fewer workers. Many products improved. These changes may lead to the factory of the future.



Crack the Code

On a piece of paper, write the answers to these questions:

1. What system began in Great Britain in the 1700s?
2. What relied on early computers in the 1950s?
3. Name the products that Eli Whitney and Simeon North produced.
4. What helped Germany and Japan out-produce the United States?
5. What was weapon-maker Whitney's first name?
6. What replaced humans for certain industrial tasks?

Now write down the first letter of each answer. Put them together to discover the secret code word!

Hint The assembly line meant manufacturers could make products like this.

unit 5 Thematic Project

Making Things Real

Manufacturing Products In Unit 5, you learned about how manufacturers use technology to create products. Taking classes in physics, machine shop, and CAD (Computer-Aided Design) in high school can lead you to a career in manufacturing engineering technology.

Things to Know To run a successful manufacturing company, you need knowledge in many fields. You also must answer questions about “logistics”: Where do you store parts? How do you get them to the production line? Where do you store the finished product? What do you do with waste?

The Faster Way When you mass-produce anything, it is faster and easier to use an assembly line. In today’s world robots are doing some of the more dangerous and/or repetitive jobs.

This Project In this project, you will research and design a manufacturing plant to make a product, such as a toy, T-shirt, or something of your choice.

Your Project

- Choose a product.
- Research how the product is manufactured.
- Design a manufacturing plant to make the product. Include storage, production lines, and traffic areas.
- Complete this bonus task for extra credit: Produce a toy your class or group could donate to a family shelter.
- Write a report on your product and plant.
- Create a presentation with posters, video, or presentation software.
- Present your ideas to the class.

Tools and Materials

- ✓ Computer
- ✓ Internet access
- ✓ Trade magazines
- ✓ Word-processing software
- ✓ Presentation software
- ✓ Video camera, digital camera, or cell phone with video
- ✓ Posterboard
- ✓ Colored markers

The Academic Skills You’ll Use

- Communicate effectively.
- Speak clearly and concisely.
- Use correct spelling and grammar.
- Conduct research using a variety of resources.
- Incorporate reading, writing, and speaking with viewing, representing, and listening.

English Language Arts

NCTE 8 Use information resources to gather information and create and communicate knowledge.

Social Studies

NCSS 8 Science, Technology, and Society



Step 1 Choose Your Topic

You can choose any manufactured product to research or a simple toy to produce. Examples include:

- Canned beans
- Printed greeting cards
- Crayons
- Wooden tops
- Bean-bag games
- Pom-pom dolls
- Simple puzzles

Tip! *If you are having trouble finding information, choose something else.*

Step 2 Do Your Research

Research your project. Your fact finding may include finding answers to the questions below:

- What types of machines are used to mass-produce this product?
- Could computers help the creation of this item? If so, how?
- How much will wages be for your workers?
- How can you keep the process eco-friendly?

Tip! *Ask adult relatives and friends who know about your topic.*

Step 3 Explore Your Community

Find someone in your community who knows something about your topic. Ask how his or her job connects to your product or manufacturing process. Ask for feedback on your process.

Tip! *Use any suggestions that will help you!*



GLOBAL TECHNOLOGY

Globe Making

At a globe factory, production revolves around world events. These spherical maps have to be constantly revised because war and politics can change borders. Nova Rico is a small Italian map-making company that has been making globes for more than 50 years. It is one of the biggest globe makers in the world, but the only one in Italy. It once received an order from a leader with instructions on where to place his country's borders!

Critical Thinking *How might a customer's special instructions affect the manufacturing of a certain product?*



Go to glencoe.com to the book's OLC to learn more and to find resources from **The Discovery Channel.**

Step 4 Create Your Project

Your project should include:

- 1 research project (design, blueprint, or model)
- 1 report
- 1 presentation

Project Checklist

Objectives for Your Project

- | | |
|---------------------|---|
| Visual | ✓ Make a poster, blueprint, model, or slide presentation to illustrate your project. |
| Presentation | ✓ Make a presentation to your class and discuss what you have learned.

✓ Turn in research and names from your interview to your teacher. |

Step 5 Evaluate Your Presentation

In your report and/or presentation, did you remember to:

- Demonstrate your research and preparation?
- Present plans for a manufacturing plant?
- Label your designs or test your process?
- Use facts and evidence to back up your ideas?
- Speak clearly and engage your audience?



Rubrics Go to glencoe.com to the book's OLC for a printable evaluation form and your academic assessment form.

Italian

<i>hello</i>	ciao
<i>goodbye</i>	arrivederci
<i>How are you?</i>	Come stai?
<i>thank you</i>	grazie
<i>You're welcome</i>	Prego