

ACTIVITIES

CROSS-CURRICULAR EXTENSIONS

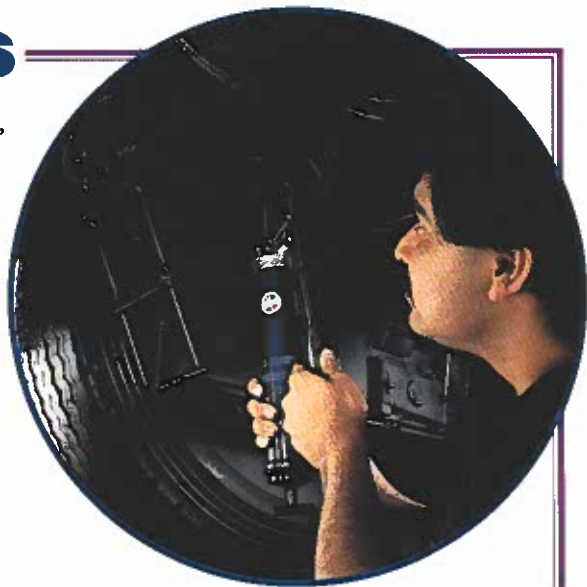
- 1. SCIENCE** Take a series of digital pictures that illustrates the growth of a plant.
- 2. MATHEMATICS** Use CAD or other graphics software to draw common geometric designs, such as a triangle, square, rhombus, parallelogram, or hexagon. Make a cover for your math book or folder.
- 3. COMMUNICATION** Use desktop publishing to make an announcement for a play or sports event at your school.

EXPLORING CAREERS

Some workers use computers to create information, such as drawings. Others use them to send information over a network or to program a machine. Here are two more of the many jobs that require the use of computers.

Network Administrator In many companies, if the computer network goes down, work grinds to a halt. The network administrator is the person who keeps everything up and running. Network administrators maintain hardware and software and analyze problems. They need good communication and troubleshooting skills.

Automotive Specialty Technician You have probably noticed that many auto service centers work on specific parts of a car, such as tires or mufflers. Automotive specialty technicians are trained to repair one system or component, such as brakes, suspension, or radiators. Understanding the mechanics of an automobile is important in this job, but so is using computerized diagnostic equipment.



ACTIVITY

Look through the employment ads in your Sunday newspaper and make a list of all of the jobs that require computer skills. Which jobs would you be interested in?

Inventing Things

SECTION

1 What Is Innovation?

2 Getting Ideas

ACTION ACTIVITY **Inventing New Tools**

3 Protecting New Ideas

ACTION ACTIVITY **Patenting Your Ideas**

What Is Innovation?

THINGS TO EXPLORE

- Explain what innovation is.
- Explore how serendipity affects innovation.
- Identify ways innovations affect our lives.

TechnoTerms
innovate
serendipity

To **innovate** is to create a new idea, device, or way of doing something. Innovation can take place in many ways. Usually it is the result of creative thinking.

How We Innovate

Sometimes innovation happens when people or companies work toward a goal using a combination of skill, creativity, and knowledge.

Fig. 6-1. At other times, valuable innovations may result from **serendipity**—having a lucky accident.

Teflon (a nonstick plastic), safety glass for car windshields, and even the process of making breakfast cereals like corn flakes were all lucky accidents. Inventors were looking for something else and accidentally came up with a new product.



Fig. 6-1. This Ford *Probe* concept car is a result of innovation. How does its appearance differ from cars sold today?



OPPOSITE Ideas are the “spark” that light the way to wonderful inventions.

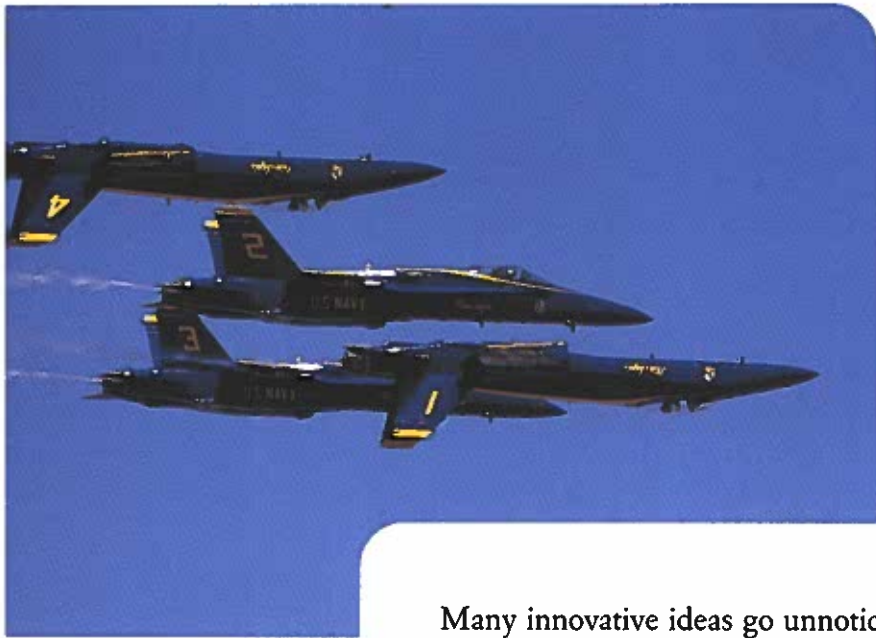


Fig. 6-2. Many of the parts in these Boeing F/A-18 Hornets and other modern planes are held together with adhesives. Look around your home and find at least five other items that are glued together. What other fasteners would work as well?

Many innovative ideas go unnoticed. For example, today many parts of cars are made of plastics to reduce weight and to prevent rusting. Many of your clothes are made of new kinds of plastics that don't feel or look any different from the fabrics that were used before. In the aerospace industry, adhesives (glues) are used instead of rivets to hold airplane wings together. Fig. 6-2.

TechnoFact

A USEFUL INVENTION Did you know that Teflon, a trade name for a special plastic, is used for many purposes besides nonstick frying pans? It is used in artificial heart valves and bone replacements for the human body, as well as for the outer layer of space suits.

Why We Need Change

Why do we need to continually make changes? The main reason is that what worked for us yesterday does not work for us today. Sometimes we simply want variety. We want new car styles, different exercise equipment, or new foods. At other times, we have a specific need. For example, today we don't know what to do with our nuclear waste products. We haven't found a way to store them safely for long periods. If someone like you could think of a way to use or recycle the materials, it would really benefit our world.

Innovation is necessary in every field from aerospace to education. For example, aerospace engineers working for NASA (National Aeronautics and Space Administration) designed a space vehicle in the 1960s that could hold only one person. The astronaut could not move very much and could not stay in space for long periods of time. Innovations were needed. The result is the Space Shuttle, in which several astronauts can exercise, eat, and move around freely. Fig. 6-3. What do you think the next innovations in space travel will be?



Fig. 6-3. Need often plays a part in innovation. Soon the cramped quarters of early spacecraft (left) were abandoned in favor of the roomier Space Shuttle (right). Have you ever spent a long time in a confined space? Describe your experience.

Innovation can make our lives easier. It can also save lives. In many cities and towns in the United States, you simply dial 911 to get emergency help. That is a recent innovation. You might even use a cellular or cordless phone to make that call—two more innovations.

TechnoFact

AUTO INNOVATION

How would you like to rent a special, one-of-a-kind Cadillac limousine available in Beverly Hills, California? It seats twelve and has a satellite dish, large-screen television, VCR, microwave oven, freezer, refrigerator, pinball machine, personal computer, telescope, and even a library. The roof can slide back, the seats will fold up, and you can soak in a hideaway hot tub!

SECTION 1

TechCHECK

1. What is meant by innovation?
2. Explain what serendipity is. Give two examples.
3. What are some innovations that have made your life easier?
4. **Apply Your Knowledge.** Research innovations that came about by serendipity and compare how they were discovered.

Techno**Terms**

fad
trend
visualizing

THINGS TO EXPLORE

- Explore ways inventors get ideas.
- Explain what trends and fads are.
- Practice visualization to help you invent a product.

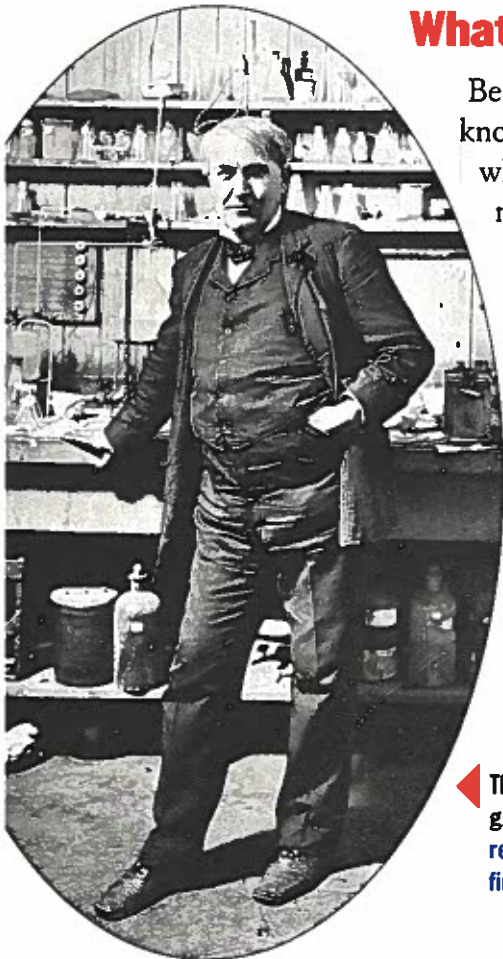
Many discoveries and inventions that have been improved on over hundreds of years can't be credited to any one inventor. Sometimes they occurred at a time when no records were kept. For instance, we don't know who discovered the uses of fire or invented the wheel. But we do know something about how inventors think.

What Makes Someone an Innovator?

Being innovative means you can do something new with your knowledge and experience. It also means you can recognize when something useful happens accidentally, even if you're not exactly sure what it is! Because innovation involves "new" things, it is usually tied closely to change. People who are innovators enjoy making changes.

Another thing that all innovators have in common is making good use of their brains. Inventors are good at **visualizing**, or picturing ideas in their minds. Often they can see a different way to do something that everyone else has missed. They can look at an everyday object and imagine new uses for it. Can you look at a regular pencil and visualize it being used for something other than writing?

◀ Thomas A. Edison was one of the greatest American inventors. Do some research on Edison's life. What was the first device he patented?



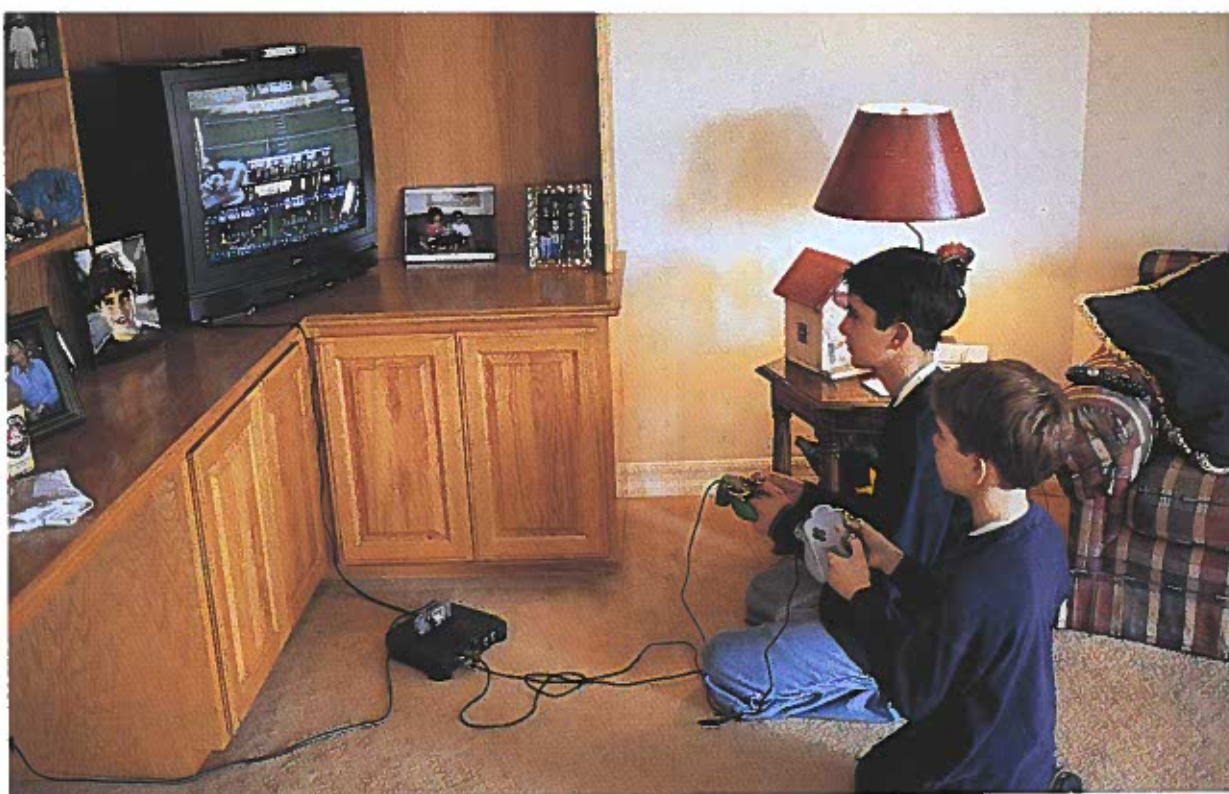


Fig. 6-4. Somebody has to be the first to come up with an innovative idea like a video game. Can you be innovative? Make a list of at least 10 new uses for an ordinary tennis ball.

Noland Bushnell is an example of a really innovative person. In the 1970s he created “Pong,” the first interactive video game, because he was bored with just “watching” television. He wanted to play with the television and have the television respond. His table tennis game was the start of the video games you play today. Fig. 6-4.

Some people, like the cartoonist Rube Goldberg, like innovation just for the pure fun of it. Goldberg invented complicated, funny ways to do simple jobs. Innovative ideas like his usually don’t become an actual product or service.

Thousands of inventions, such as television, have had important effects on society. Many others have not. You might not have heard of a device called an automatic hat-tipper, for example. It was invented at a time when most men wore hats and tipped them politely to every lady they passed. The people who helped invent the television set are remembered. The inventor of the hat-tipper is not. However, because we keep good records today, we can research hundreds and even thousands of inventions to find out who had the original idea. Fig. 6-5.

TechnoFact

HIGH-FLYER Powerful computer systems and complex graphics can create virtual (not real) environments where your dreams can come true. If you think you’d like to fly, you might like the HiCycle virtual environment by Autodesk. If you pedal a bicycle fast enough, you can “take off” and “fly” above a graphic landscape on the computer screen. You aren’t really flying, of course, but the goggles you wear help make you think so!

Fig. 6-5

Inventors and Inventions



Lewis Howard Latimer received several patents throughout his career. He is best known for his work on lightbulbs and lamps. In 1882, he received a patent for long-lasting carbon filaments that glowed when heated. He later worked with Thomas Edison.



Madame C. J. Walker was an inventor and entrepreneur. In 1906 she started a business that made cosmetics and hair care products. By 1919, her products were sold nationwide and her business was making nearly half a million dollars a year.



Beulah Louise Henry was a businesswoman and inventor. She invented over 100 devices and received 52 patents. Her first patent was for an ice-cream freezer. In 1924 she invented an umbrella with a set of snap-on cloth covers in different colors.



Garrett A. Morgan

received a patent in 1914 for a gas mask for firefighters. In 1916, he used it to rescue workers trapped in a smoke-filled tunnel under Lake Erie. He also invented a traffic light (patented in 1923) and many other useful products.



Katherine Blodgett

received a patent in 1938 for a process that makes glass nonreflecting, which means it won't have a glare. As a result, things like eyeglasses, telescopes, and camera lenses could allow images to pass through clearly.



Tuan Vo-Dinh

has invented several life-saving devices. His first patent was a small badge that detects exposure to poisonous chemicals. In 1996, he invented a laser technique to detect cancer without requiring surgery. By 2000, he had received 20 patents.



Ellen Ochoa

is an astronaut and inventor. She and her co-inventors have three patents related to optical systems. One of them can identify and “recognize” objects. In 1990, she was selected by NASA to be an astronaut and three years later became the first Hispanic woman in space.

Where Do Ideas Come From?

Where do ideas for inventions start? There really isn't a specific set of steps to follow. Lots of innovations are the result of looking at old ideas or things in a new way. For example, Johann Gutenberg combined two unconnected ideas, the coin punch and the wine press, to create a new product—a printing press that used movable type.

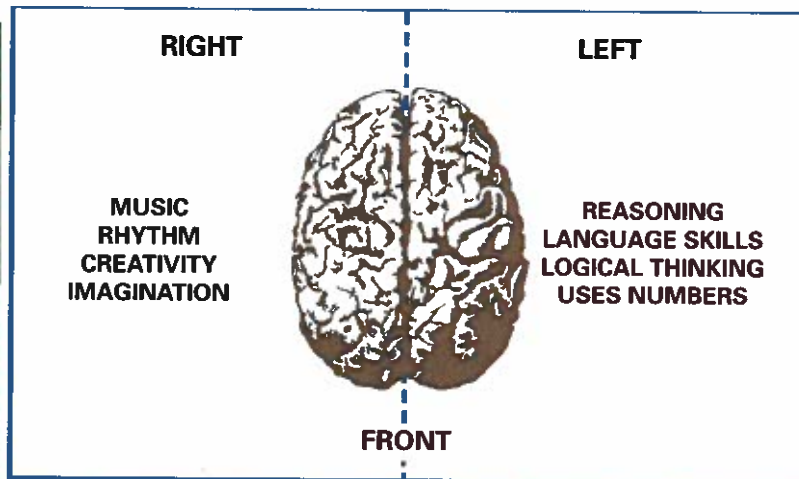
Other inventors set out to solve a specific problem. The search for cures for diseases like AIDS is ongoing in medical research laboratories. People also come up with ideas for inventions by serendipity—just being in the right place at the right time. Edward Jenner's smallpox vaccine was a result of serendipity. It has since saved millions of people from a horrible disease.

Fig. 6-6. Nothing is as trendy as clothing styles. Do you think clothes like these will ever catch on again? Give reasons for your answer.



SCIENCE CONNECTION

The Divided Brain

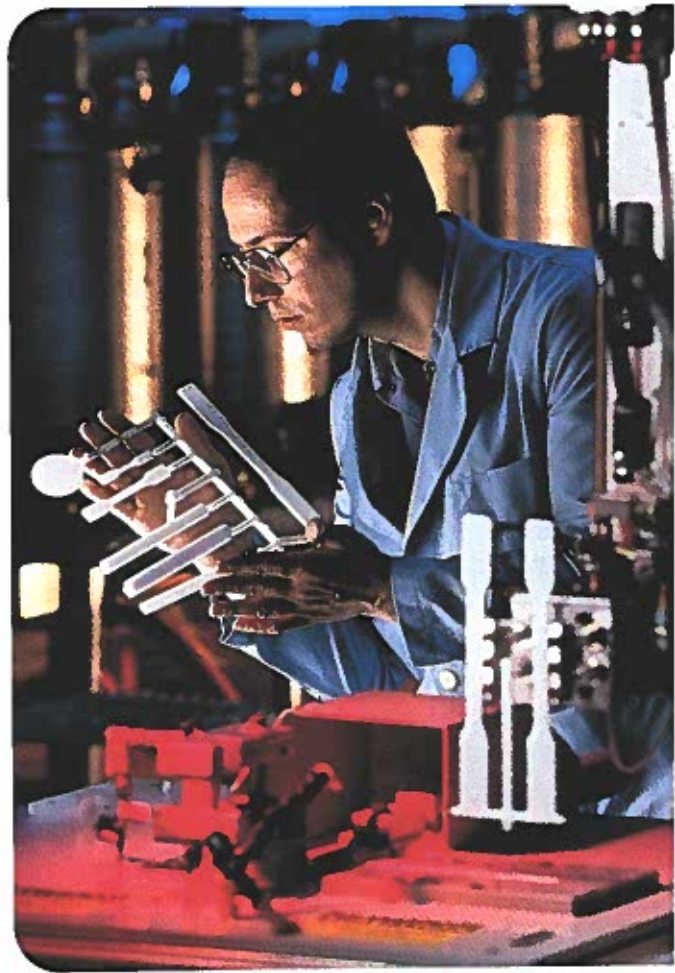


As recently as 500 years ago, most people did not even know what the brain did. Many people thought thinking and emotions were centered in the heart or abdomen because that's where you feel pain.

In manufacturing, innovation might involve a new product or a different way to make the same product. **Trends**, or current preferences that people have, help determine what changes companies will make in their products. Fig. 6-6.

Many companies have research and development (R & D) departments whose job is to develop new product ideas. How practical an idea is, how economical it is, and how it is marketed often determine whether you and I ever see it. Fig. 6-7.

Fig. 6-7. The research and development department of this manufacturing company tries to find new uses for plastics.



After years of research into how people think, there is still much to learn about the brain. However, scientists have discovered that the brain has two halves. The halves are linked together by a complex network of nerves called the corpus callosum.

The left and right halves of the brain work in different ways. In most people, activities such as thinking logically, dealing with numbers, reasoning, and using language skills are handled by the left brain. The right brain deals with imagination and creativity and activities such as music, art, and daydreaming. It has been found that great inven-

tors, such as Leonardo da Vinci and Albert Einstein, use more of their brains than most of the rest of us.

ACTIVITY

Read *Drawing on the Right Side of the Brain* by Betty Edwards. Report what you learned to the class.

For example, one product under development is the X-33. This is an experimental vehicle being developed by Lockheed Martin. It will fly 13 times the speed of sound. That's about 9800 miles per hour!

The X-33 is part of the Reusable Launch Vehicle (RLV) Technology Program, a partnership between industry and NASA. The program's goal is to develop a vehicle that can climb into orbit without booster rockets and can land like an ordinary airplane. Unlike the Space Shuttle, an RLV would be fully reusable and therefore less costly than the Shuttle.

TechnoFact

YESTERDAY'S

FADS Sometimes, fads come and go and come back again. Ask your parents or grandparents about the shag carpeting, lava lamps, and bell-bottom pants of the 1970s. Do they know of any other fads that made a comeback?

Fads

Some innovations result in **fads**—things that are temporarily popular. Because there is no real need for the product or idea, many fads disappear quickly. What are some fads of today?

Can you imagine a world where nothing changed? Innovations make your world exciting. Inventors have to try new ideas, change old ideas, and look for new ways to solve today's problems.

SECTION 2

TechCHECK

1. What is a fad?
2. How does visualizing help an inventor?
3. What is a trend?
4. **Apply Your Knowledge.** Make a drawing of a new eating utensil.

Inventing New Tools

Real World Connection

New products and inventions are often a combination of old ideas put together in a new way. In this activity, you will invent new tools that are a combination of tools you are already familiar with.

Inventors must be able to communicate their ideas in words and drawings. In this activity, you will make sketches and finished drawings that get your ideas across.

Be sure to fill out your **TechNotes** and place them in your portfolio.

Design Brief

Invent four new tools that are a combination of two or more existing tools. You may combine some of the tools shown in Fig. A or think of others, such as a spatula, egg beater, or spoon.

Materials/Equipment

- pencil
- paper
- Optional*
- computer
- graphics or CAD software
- clip art
- word-processing software
- printer
- tape recorder
- drawing tools
- sample tools

SAFETY FIRST

Follow the safety rules listed on pages 42-43 and the specific rules provided by your teacher for tools and machines.

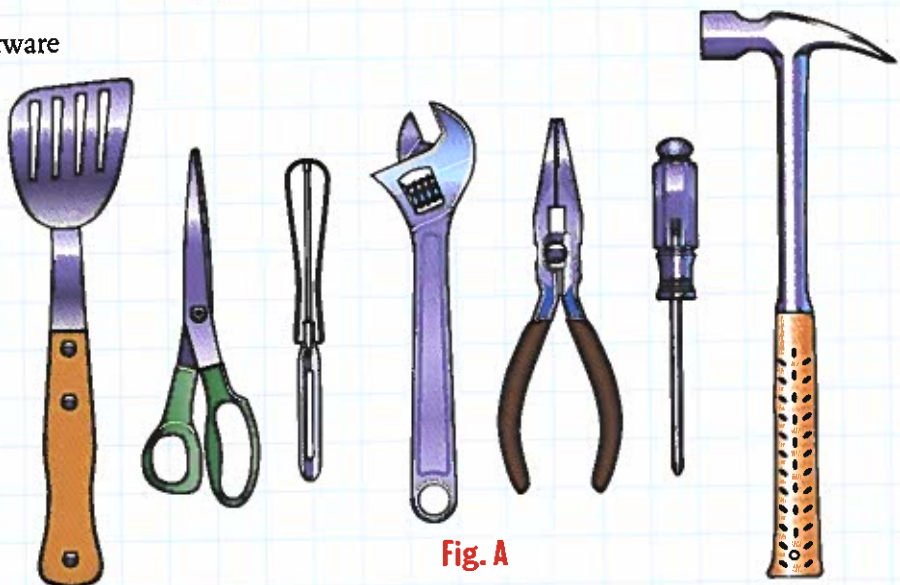


Fig. A

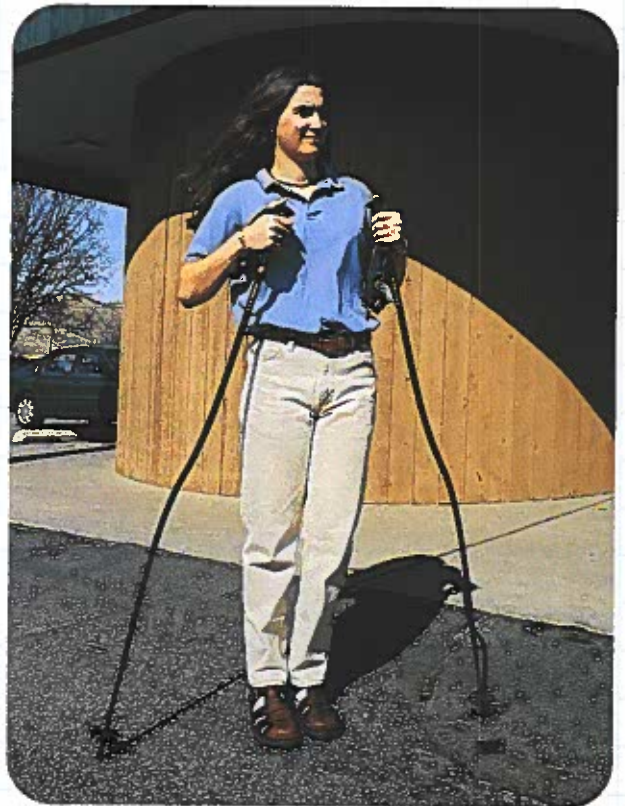
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**ACTION
ACTIVITY****Procedure**

1. Work with a partner. Brainstorm some possible ideas for a new tool.
2. Choose four of your ideas that you think have the most ability to succeed.
3. Make some rough sketches of your four tools. *Optional:* Use a computer and graphics software to make your drawings.
4. Refine your ideas, and show them to your parents, relatives, teachers, and friends. Listen to the reactions of others. This is called *feedback*.
5. Redesign your ideas with the feedback in mind.
6. Make finished drawings of all four of your ideas. *Optional:* Use a computer and graphics or CAD software to make your finished drawings.
7. Choose the idea that you like best. Write a script for a radio commercial to sell your product. If possible, use a computer and word-processing software. Include in your script your product's name, cost, possible uses, and where to buy it.
8. *Optional:* Record your commercial using an audio tape recorder. Play your commercial for the class. Ask the class to sketch what they think your tool looks like without showing them your design.

Evaluation

1. How many different tool ideas were you able to brainstorm? List them.
2. What was the hardest part of this assignment? What was the easiest? Explain your answers.
3. Did you consider whether or not your tool design was safe? Does it have dangerous pinch points or sharp edges?
4. **Going Beyond.** Produce a video commercial for your product.
5. **Going Beyond.** Find someone in your community who has designed a product. Ask that person to talk to your class, or interview the person on the phone.
6. **Going Beyond.** Think of other possible combinations of existing products. Some you might consider include athletic and sports equipment, camping gear, food products, and home appliances. Fig. B.

**Fig. B**

Protecting New Ideas

THINGS TO EXPLORE

- Explain what a patent is.
- Identify the five types of patents.
- Patent one of your ideas.

TechnoTerms
patent
prototype

A **patent** is a special government license that protects an invention from being copied for 20 years. When you patent an invention, anyone who wants to use your idea must get your permission and perhaps pay you. Fig. 6-8.

Applying for a Patent

Anyone can patent an invention, but getting a patent takes time and money. You must first prove your invention is new or the first of its kind. This means going back through the thousands of patents filed at the United States Patent and Trademark Office to be sure no one else has an existing patent for the same invention. Then you have to provide written plans and sketches that show how your invention works. You may have to make a **prototype**, or model. Fig. 6-9.

TechnoFact

TIMING IS

EVERYTHING

Alexander Graham Bell filed his patent application for the telephone on February 14, 1876. A few hours later, Elisha Gray also filed a document with the U.S. Patent Office. It stated that *he* was inventing a telephone. Lawsuits followed, but eventually the Supreme Court decided Bell was the sole inventor of the telephone.



Fig. 6-8. The person or company that developed this digital camera holds the patent on it. Someone who wanted to copy the design would have to get permission to use it. Use the Internet to find out how many patents are registered with the Patent Office.

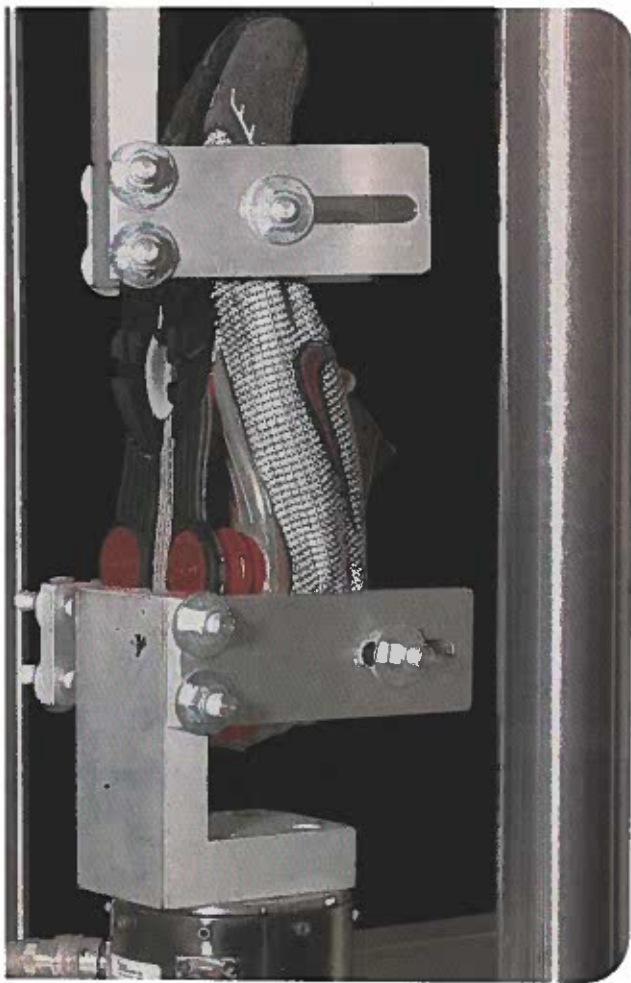


Photo courtesy of Nike, Inc.

Fig. 6-9. Running shoe prototypes are tested for performance. What qualities do you think this shoe is tested for?

Not every idea or device can be patented. Things that can be patented include processes or machines, manufacturing methods, and a new material or life form. Things that cannot be patented include naturally occurring materials, ways of doing business, and newly discovered scientific principles.

Types of Patents

There are three types of patents.

- **Utility patent.** The most common type of patent is a utility patent. This type of patent protects inventions considered to be “new and useful.” The invention must meet certain requirements to qualify.
- **Plant patent.** A plant patent protects the invention or discovery of new varieties of plants. This includes cultivated spores, mutants, hybrids, and newly found seedlings. The new plant must have been reproduced asexually, which means that the process did not involve the union of nuclei, sex cells or sex organs.
- **Design patent.** A design patent protects the invention of a new design for an item that will be manufactured. It protects the invention’s general appearance but not its structural or functional features.

Fig. 6-10. Every patent is given a number. How many patents were taken out on this product?

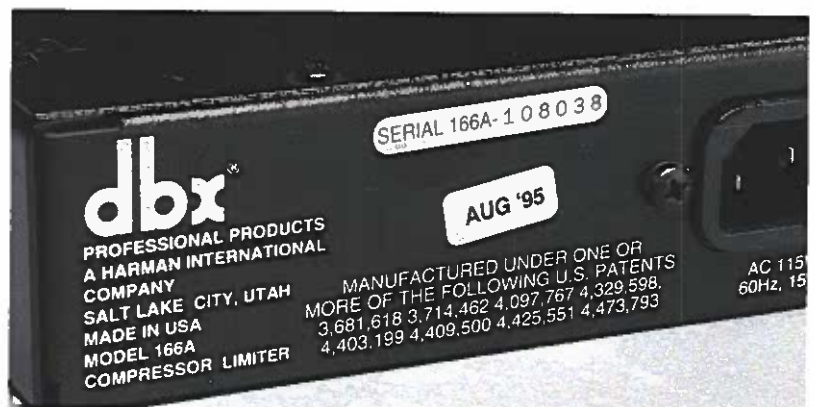
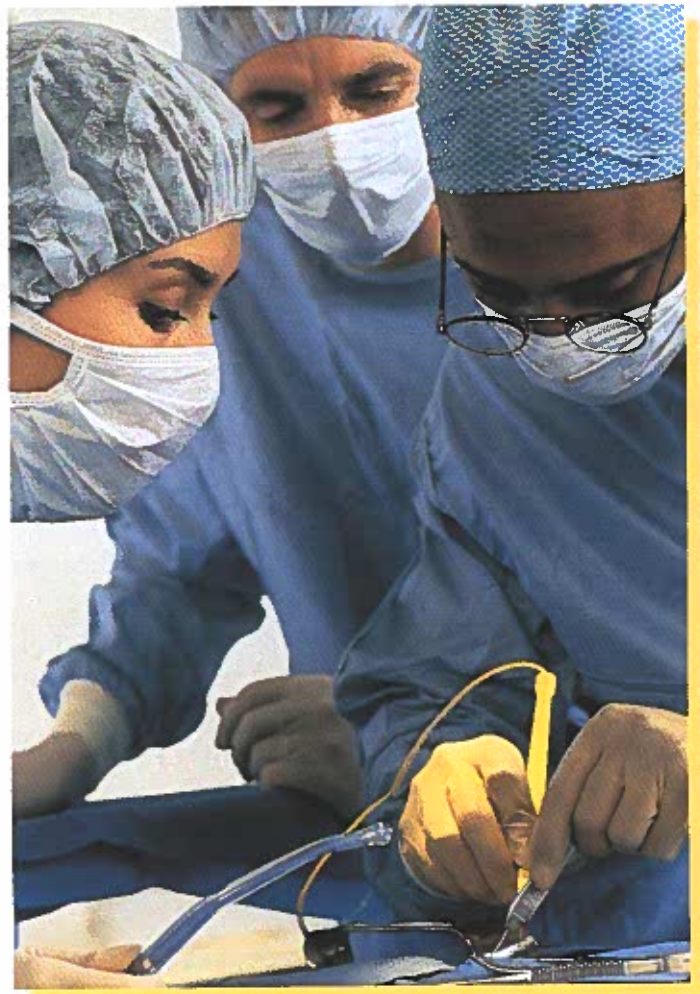


Fig. 6-11. Developers of lasers used in surgery protected their ideas with patents. **What standards would you use in deciding whether or not to spend money developing a product fully?**



A patent number appears on every patented product. Fig. 6-10. If you see the words “Patent applied for” or “Patent pending” on a product, it means the inventor has applied for a patent and is waiting to receive it. This is done because sometimes companies want to start making a product before the patent is given. It gives them some protection until the patent is approved.

It is important to protect inventions with a patent. You can imagine how disappointed you would be if you spent a great deal of time and money on an idea only to find out someone else already had a patent on something similar. The key is knowing when, or if, to move from a prototype to the real thing! Fig. 6-11.

SECTION 3

TechCHECK

1. What is a patent? List the three types.
2. Why might a product have the words “Patent pending” printed on it?
3. What is a prototype?
4. **Apply Your Knowledge.** Find someone in your community who has designed a product and applied for a patent. Ask that person to talk to your class, or arrange a phone interview.

Patenting Your Ideas

Be sure to fill out your **TechNotes** and place them in your portfolio.

Real World Connection

Your special ideas may be worthy of patents. In this activity, you will simulate applying for a patent to protect your ideas. After you have a better idea of how the process works, you may want to consider applying for a real patent on one of your inventions.

Design Brief

Design, test, and patent a package that will protect a raw egg from breaking. Your package or method will be tested by dropping the package with the egg in it from a 15-foot height to the ground. At least one-half of the egg must be visible at all times during the test.

Materials/Equipment

You may use any materials you like for the package, but they must be safe to drop from a second-story window. For example, you might use recycled packaging materials such as plastic, foam, or paper. Other supplies you will need might include string, tape, rubber bands, and scissors.

SAFETY FIRST

Follow the safety rules on pages 42-43 and the specific rules provided by your teacher for tools and machines. Ask your teacher for help on how to test your egg packages.

Procedure

1. Work in invention teams of two to four students. Your teacher will assign one group to represent the Patent Office.
2. Brainstorm ideas on how to meet the design brief requirements.
3. The students working in the Patent Office should write down the requirements for the design brief. They should then design a patent application form. A sample is shown in Fig. A.
4. With your team, decide on a design and complete the patent application.
5. If another team had an idea similar to yours, your patent will be denied. If this happens, your team must choose a different design. If your team is granted a patent, it will be given a patent number.
6. Make your egg-protection package according to your design. Be sure to put your patent number on your package.
7. When all the teams have finished, test each egg package by dropping it from a 15-foot height. Clean up any mess!

Evaluation

1. Have you ever found a product that was broken in the package? Explain how that package could have been made better.
2. Did the Patent Office evaluate your patent application fairly? Explain.
3. List five different packaging materials, and rate them from 1 to 5 (best is 1).
4. **Going Beyond.** If your egg package design succeeds in the first test, try dropping the package from a greater height. Then try tossing it down instead of just dropping it. What did it take to crack the egg?

Official Patent Application
Form 1-a

• Patent Office •

INSTRUCTIONS:

1. Complete this form.
2. Submit the form in person to the Patent Office.
3. You will be notified by a patent officer if your patent was approved or denied.

Patent Office Use Only:

Patent application date: ___/___/___

Patent application time: ___ a.m.-p.m.

Patent approval date: ___/___/___

Patent approval time: ___ a.m.-p.m.

Patent number _____

1. Complete the following information for each of the invention team members.

Invention Team Member 1:

•PLEASE PRINT•

NAME: _____
 LAST M.I. FIRST

Invention Team Member 2:

•PLEASE PRINT•

NAME: _____
 LAST M.I. FIRST

Invention Team Member 3:

•PLEASE PRINT•

NAME: _____
 LAST M.I. FIRST

Invention Team Member 4:

•PLEASE PRINT•

NAME: _____
 LAST M.I. FIRST

2. Describe your invention in the space provided below. Be specific.

3. List the quantities and types of materials used in your invention

QUAN	MATERIAL	QUAN	MATERIAL
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

4. Make a detailed drawing of your invention. Make the drawing on a separate sheet of paper and attach it to this form. Be sure to clearly draw and label each part.

Fig. A

REVIEW &

CHAPTER SUMMARY

SECTION 1

- To innovate is to use a new idea or approach in doing something.
- Having a lucky accident is called serendipity.
- Innovations may come from combining two existing ideas, looking at things in a new way, or from trying to solve a problem.

SECTION 2

- Research and development departments are always trying to create innovations or identify trends.
- How practical an idea is, how economical it is, and how it is marketed often determine whether most people ever see it.
- Some innovations are popular only temporarily; these are called fads.

SECTION 3

- Inventors may make a prototype, or model, of their invention.
- Inventors apply for patents to protect their inventions from anyone using them without their permission.
- Some companies produce a product before they have a patent. The product is then usually marked “Patent pending” or “Patent applied for.”
- All patented inventions are assigned a special patent number.

REVIEW QUESTIONS

1. What effects do trends have on the products that companies produce?
2. Why do we need innovations?
3. What is the job of research and development departments in companies?
4. What is the purpose of a patent?
5. Why don't we always know who some inventors were?

CRITICAL THINKING

1. What could you do with a newspaper besides read it? Make a list of innovative ideas.
2. Why do NASA engineers have to continually make changes in spacecraft designs or in the equipment astronauts use?
3. Choose an innovation and tell how it has made your life easier.
4. Why do you think some inventions become only fads?
5. What do you think is the world's most important invention? Explain your answer.