- Have students research and report on the invention of television. A great Web resource to begin their exploration is: www.inventorsmuseum.com/television.htm.

Suggested Print Resources

- Friedrichs, Peter. *Voice of the Crystal: How to Build Working Radio Components From Scratch.* Lindsay Publications, Inc. Bradley, IL; 1999.
- Reid, T.R., *The Chip: How Two Americans Invented the Microchip and Launched A Revolution.* Random House, NY, NY; 2001
- Townes, Charles H., *How the Laser Happened: Adventures of a Scientist.* Oxford University Press; 1999.

Internet Resources

Periodically, Internet Resources are updated on our Web site at www.LibraryVideo.com

- **www.aip.org/success/connectsworld/index.html**
  Physics Success Stories, developed by the American Institute of Physics, highlights the important links between physics and our world.
- **www.nobel.se/physics/educational/index.html**
  The Nobel e Museum Web site contains educational pages for high school students as well as well-presented information on the laureates.
- **www.bell-labs.com/history/laser/laser_uses.html**
  Bell Labs presents information on the invention of the laser and its evolution into a tool with a myriad of uses.

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Historical Background

In no other field of science do Nobel Prize winners touch our lives as closely as the groundbreakers involved in the field of electronic communication. Radio signals are electromagnetic waves in the range of about 10,000 waves per second to 100,000,000 vibrations per second. For the development in 1901 of a working transmitter and receiver designed to send radio signals across the Atlantic Ocean, Guglielmo Marconi and his colleague, Carl Braun, received a Nobel Prize in Physics. Braun also invented the cathode ray tube — a device that fires a stream of electrons towards a fluorescent screen, creating a spot of light.

Their exciting breakthroughs encouraged other innovators to expand upon their work. In 1906, Lee de Forest invented an amplifier set inside a vacuum tube that allowed a weak incoming radio signal to be boosted. This amplifier, known as a triode valve, made the magic of radio available to many people across the globe. This technology was eventually replaced by a reliable, rugged and small invention known as the transistor. For this achievement, scientists William Shockley, John Bardeen and Walter Brattain received the Nobel Prize in 1956. By the 1930s, the cathode ray tube invented by Carl Braun was used by scientist Vladimir Zworykin to invent the first practical TV camera, giving birth to modern television.

In the 1930s, early computers were created, using thousands of linked triode valves to perform calculations. These machines were huge and extremely slow. In 1958, scientist Jack Kilby invented the integrated circuit, also known as the silicon chip. This miniature wafer of silicon covered with tiny electrical circuits has revolutionized the world of communication, and Kilby was finally recognized with a Nobel Prize in Physics in 2000.

Charles Townes was recognized in 1964 with a Nobel Prize in Physics by sparking another revolution, the laser, which generates a beam of light that carries information around the world on an optical fiber superhighway.

Vocabulary

radio waves — Electromagnetic radiation that carries signals.

transmitter — A device that sends out a signal by radio waves.

receiver — A device that receives and converts radio signals into sounds or images.

triode valve — an amplifier set inside a vacuum tube used to increase the strength of radio waves.

AM (amplitude modulation) —Radio waves with the longest wavelength and a constant frequency of between 535,000 and 1,700,000 cycles per second. AM waves are ideal for transmitting signals over long distances.

FM (frequency modulation) — Radio waves with a shorter wavelength than AM and a frequency of between 88,000,000 and 108,000,000 cycles per second. FM waves are ideal for transmitting good quality signals over short distances.

cathode ray tube — A glass vacuum that fires a stream of electrons towards a fluorescent screen, creating a spot of light.

antenna — A metal rod or wire that can be used to send or receive radio signals.

(Continued)

transistor — A small, durable electronic device that either turns an electrical current on and off or amplifies an electronic signal, invented in 1947.

analog — A mechanism in which data is represented by continuously changing quantities. Analog computers work by translating constantly changing data into corresponding mechanical or electrical quantities.

digital — A mechanism in which data is represented by fixed numerical digits. Digital computers count in just two numbers, zero and one.

integrated circuit/silicon chip — A small wafer of silicon with many tiny transistors on its surface, developed in 1958.

microprocessor — Also called a central processing unit (cpu); an integrated circuit that controls the operations of personal computers, first introduced in 1971.

liquid crystal display (LCD) — A thin, lightweight sheet of a liquid crystalline substance between two sheets of glass or plastic. The liquid crystals block the light in areas where an electric current is applied, creating a dark spot on the sheet. LCDs are found in calculators, watches, microwaves and many other devices.

laser (Light Amplification by the Stimulated Emission of Radiation) — A device, invented in 1958, that creates and amplifies a narrow, intense beam of light.

optical fiber — Hairlike strands of encased glass that transmit information via laser beams.

Discussion Questions

1. What are radio waves?
2. How do radios work?
3. What is a transistor? How did transistors change society?
4. How does television work?
5. What is a "silicon chip"? What kinds of machines contain silicon chips?
6. How do lasers move information from place to place?

Activities

- Explore the history and science of radio by having students explore the life of Guglielmo Marconi and his contemporaries, and then construct a crystal radio from a kit.
- Ask small groups to take a student survey of favorite radio stations. Do students favor AM or FM stations, and why?
- Have students listen to AM radios during the day and after dark. Radio stations from hundreds of miles away that are not heard during the day may be heard at night because after the sun sets, it becomes easier for AM signals to travel through the atmosphere. Ask students to record the call letters of AM stations they are able to hear and listen during station breaks to hear and record the transmitting power in watts of different stations. An ideal reference to verify the call signs, frequencies and locations of the radio stations heard by students is the World Radio & Television Handbook.

(Continued)