Cape Cod
Teaching with Historic Places

National Park Service
U.S. Department of the Interior

Cape Cod National Seashore

Marconi 1903-2003 "Beyond the Horizon"

Celebrating History: to Educate, Promote and Preserve History

January 18, 1903, President Theodore Roosevelt, using Guglielmo Marconi's equipment, sent a message from the South Wellfleet Station on Cape Cod to King Edward VII at Poldhu Station (Cornwall, England). It was to be the first two-way trans-Atlantic communication and the first wireless telegram between America and Europe.

What remains of the site in South Wellfleet, Massachusetts is now part of Cape Cod National Seashore (CCNS). Resources from the archives at CCNS and other materials were adapted for this lesson based on the work of Marconi. Students using this lesson plan will learn about the development of wireless communication and the first trans-Atlantic wireless message sent from the United States. This lesson plan is available on the Cape Cod National Seashore web site: http://www.nps.gov/caco/education. For other National Park Service "Teaching with Historic Places" lesson plans, visit http://www.cr.nps.gov/twhp/about.htm.

Where it fits into the curriculum:

This lesson could be used in teaching units on U.S. history (inventions & biography), physical science, and technology/engineering. Students will discover how Marconi worked tirelessly and systematically to develop ideas and technology that led to wireless communication, the forerunner of radio as we know it today. Time period: mid-1800 through mid-1900.

Objectives for students:

- To identify benchmarks in the life of Guglielmo Marconi as he searched for a solution to trans-Atlantic wireless communication
- To explain how the early uses of Marconi's wireless led to the way we use communication technology today
- To analyze Marconi's working style by simulating the invention process
- To investigate the development of communication technology in their own community
- To identify basic concepts of radio transmission

Visiting the Park:

Cape Cod National Seashore stretches along the Outer Cape from Chatham to Provincetown. Take Route 6 to the Orleans rotary and proceed east on Route 6 to Eastham. Salt Pond Visitor Center is located at the intersection of Route 6 and Nauset Road in Eastham. The staffed center offers trip-planning information, films, a museum exhibit, nature trails, and sales of interpretive materials that contribute to understanding of Marconi and other park-related themes. **Note: A major rehabilitation of the visitor center began in spring 2003 and services will be reduced for 12-16 months. To visit the site of the former Marconi station, continue east on Route 6 to Wellfleet. Turn right at the first traffic light past the Wellfleet town line. Look for the brown and white entrance sign: Marconi Station Site. Facilities at the site include platforms offering commanding views of the Atlantic, a plaque commemorating Marconi's work, and a model of the former station. Visit the Cape Cod National Seashore website at www.nps.gov/caco.

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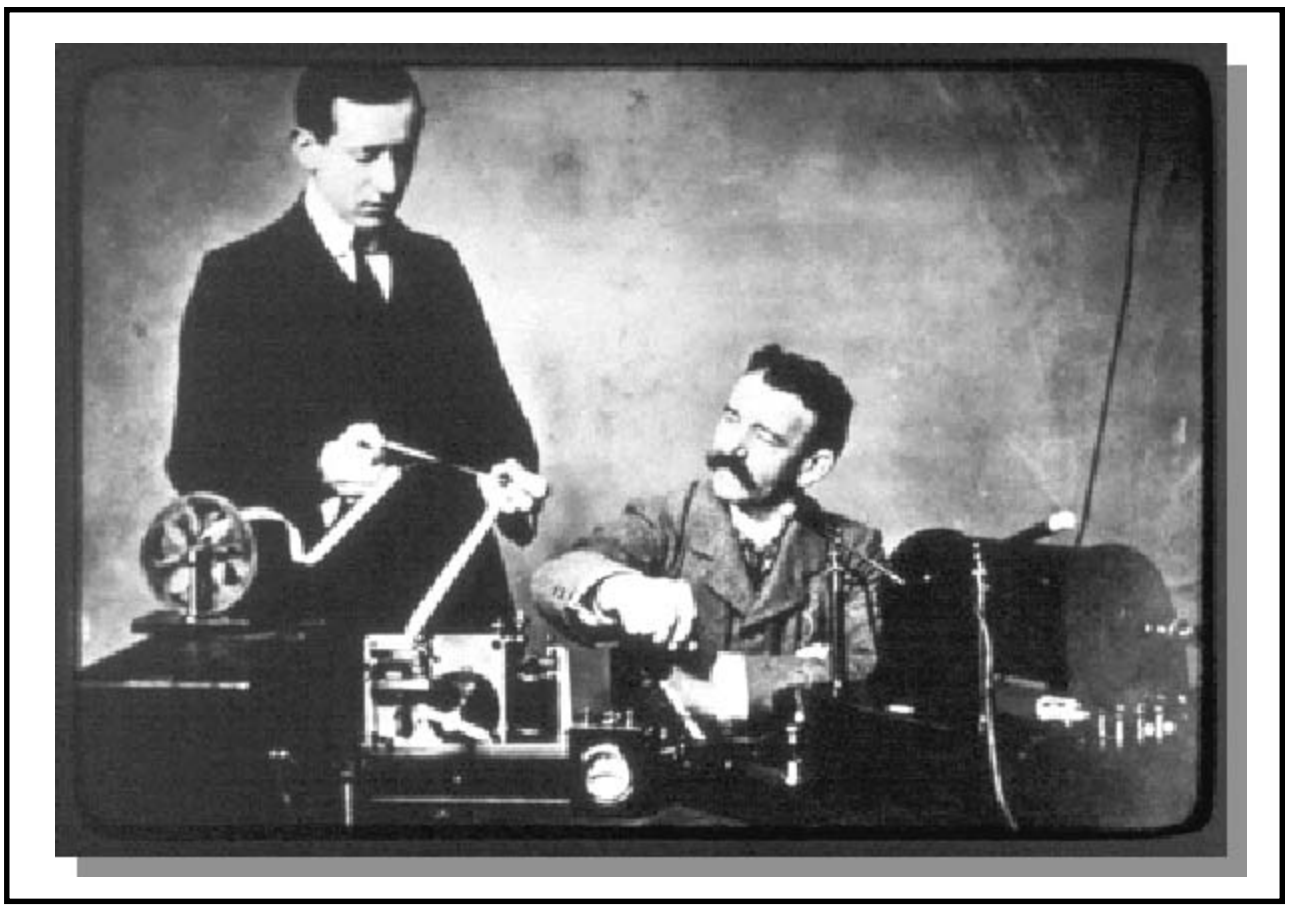


Marconi Company photo

Guglielmo Marconi: *Beyond the Horizon*

"It was an evening full of excitement. The air was literally charged with high voltage. Marconi went over to the wireless telegraph key to carry off the "big thing". Within four minutes it was done. Trans-Atlantic wireless communication between the United States and Europe was no longer an experiment, it was a reality! Who was the youthful "Wizard of Wireless" and what led him to South Wellfleet, Massachusetts on the night of January 18th, 1903?"

A lot of preparation went into that night's activity. Some say three years, others say a lifetime. The Cape Cod wireless station was built in 1901; twenty years later it was dismantled and what was left fell prey to the waves and souvenir hunters. What remains of the site is now part of Cape Cod National Seashore. Today, except for the sounds of wind, surf and gulls, all is silent. Below, the vast Atlantic Ocean stretches beyond the horizon. The echoes of a bygone era still linger and will likely linger for a long, long time for history was made here.

(Adapted from Michael E. Whatley, *MARCONI, Wireless on Cape Cod*[1987, Library of Congress Card # 87-461665] page 1.)

Getting Started

Inquiry Question

Marconi Company photo

What are these men trying to do and for what purpose?

Setting the Stage

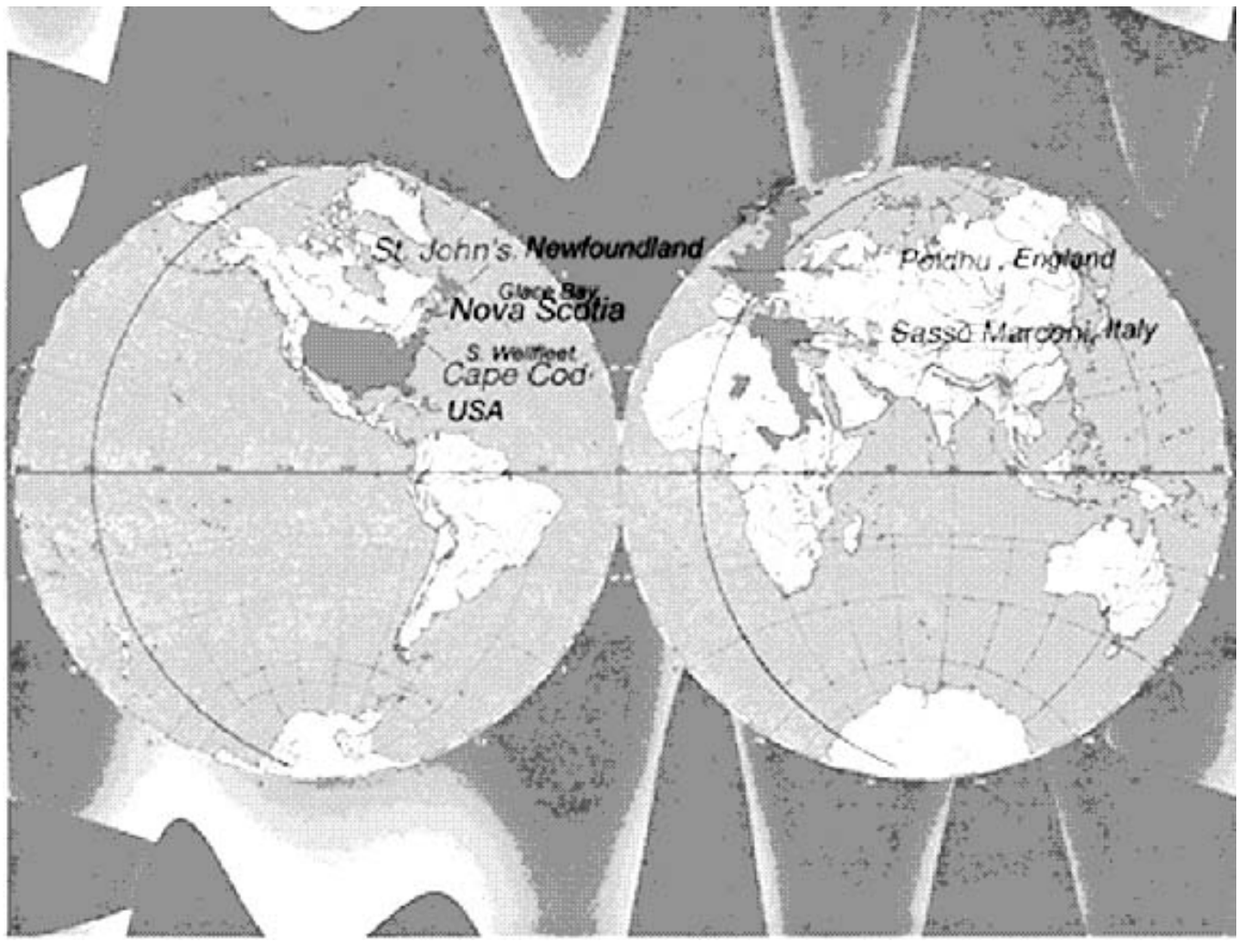
Explain to students how it all started: young Guglielmo Marconi, excited by Henreich Hertz's discoveries of electric and magnetic waves, began dreaming of a way to send messages from a transmitter to a receiver without wires. In 1894, he started experimenting in the attic of his family's villa in Italy. His first transmissions were from room to room with homemade equipment. He kept working and expanding his range, and by 1901, he achieved a 200-mile transmission. On January 18, 1903, he successfully completed the first trans-Atlantic wireless transmission.

This was an era of new achievements and new horizons. Wireless affected the way the world communicated. It brought new efficiency to daily life, business and politics. Marconi created the foundation that would lead to radio, radar, microwaves and cellular communication. At his death all wireless around the world was silenced for two minutes in his honor, a recognition no one had received before or since.

(Adapted from the CCNS Marconi Site brochure *Marconi and his South Wellfleet Wireless*, text by Glen Kaye and Mike Whatley, Cape Cod National Seashore 2002)

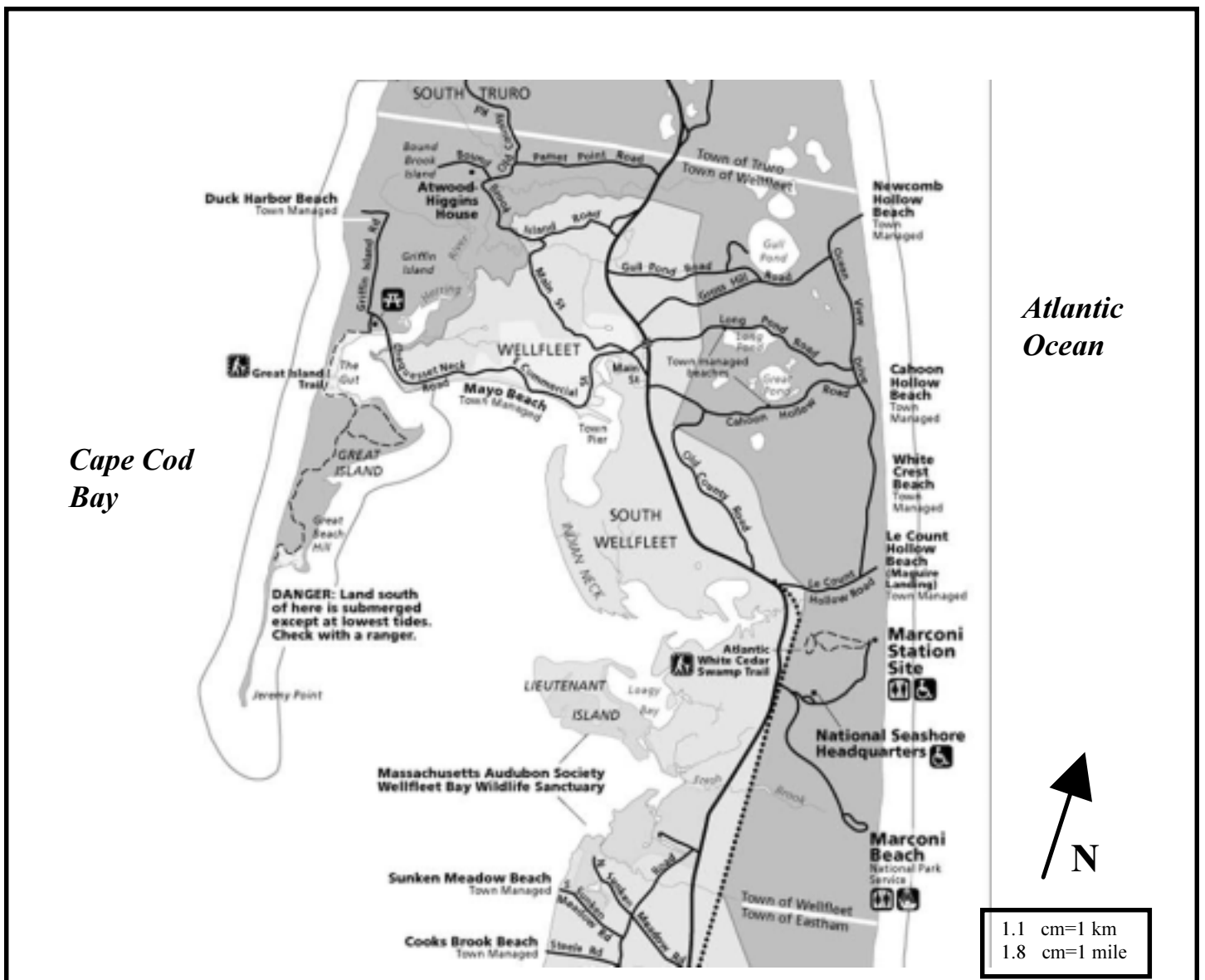
Locating the Site

Map 1: North Atlantic with Cape Cod, Nova Scotia, Newfoundland, England and Italy.



1. Locate Marconi sites at Poldhu, England; Saint Johns, Newfoundland; Nova Scotia; and Cape Cod, MA. Then locate Marconi's boyhood home in Sasso Marconi Italy.
2. What do the three station sites have in common that led Marconi to believe they would be good choices for his trans-Atlantic wireless radio experiment?
3. For years trans-Atlantic telegraphs had been sent via underwater cables. What advantages could wireless have over the cable?

Map 2: South Wellfleet Station, Cape Cod National Seashore, Massachusetts.



1. Identify and locate the following features on this map: Wellfleet, Cape Cod Bay, Atlantic Ocean, current location of Marconi headquarters, paved roads (solid black lines), a bicycle trial built over a former railroad (dotted line).
2. Which features do you think were there in 1901, when Marconi was building the station? How have they changed over the past 100 years?
3. If Marconi was building his station today, how might the changes have affected his work?

Reading 1: Marconi the Young Wizard

"What big ears he has!" It has been told that this was how people reacted when they first saw the Marconis' new baby. That baby was born April 25, 1874, and his name was Guglielmo Marconi. In time, those large ears would hear important "firsts" during the development of wireless communication. Guglielmo was the youngest of three sons born to Giuseppe Marconi, a highly successful Italian businessman. His mother, Annie Jameson Marconi, was an attractive and talented Irish woman who was influential in his mastery of English, music, and academic pursuits. This familial connection to Great Britain proved invaluable to Marconi later on when he was attempting to raise funds and support for his wireless experiments.

Marconi did not attend public schools as we know them. He had private tutors at his home, the Villa Grifone, near Bolonga, Italy from the age of five until he was fourteen. The tutor even traveled with the family. After learning to read he would spend hours in the Villa's library reading, studying, and drawing illustrations of experiments in his journal. By the age of 10 he was already interested in electricity and became a fan of Benjamin Franklin. Inspired by Franklin, Marconi later set up an experiment that involved a "spear-like zinc apparatus on the roof connected inside to a bell." He waited days for a thunderstorm constantly checking and rechecking his equipment. Finally a storm arrived and Marconi excitedly stood by until enough static electricity built up on the apparatus to ring the bell!

Marconi briefly attended grammar school when he was twelve but was uninspired by the lessons. He wondered why a person couldn't just wander around and find out things for himself. At the Technical Institute in Leghorn, Italy he discovered classes in physics and chemistry and he never looked back. His mother hired Professor Rosa to give him private lessons. He also learned Morse code from aging telegrapher Nello Marchetti, and subscribed to technical journals. Professor Augusto Righi, a famous Italian physicist and Marconi neighbor acted as mentor to Guglielmo. He noticed that Guglielmo would have intuitional flashes. He could see the theories of others and then make practical connections. He could see the obvious that others didn't, and then by working methodically, step by step, he could put it all together. The family had also recognized Guglielmo's talents and did what it could to foster them. Everything was done to satisfy his cravings to learn more about electronics. At the age of sixteen, he contrived a method of sending and receiving Morse code messages without wires in his parents' vegetable garden using two tin plates and other homemade electronic devices. He had the time and the resources, and thanks to his families' wealth, he didn't have to work to pursue his experiments. As a son of a wealthy man Guglielmo could have spent his time and resources frivolously. Instead, he decided to work tirelessly to develop his scientific ideas.

During a family vacation in the Alps Marconi happened upon an article in an electronics journal about Henrich Hertz. It described Hertz's "electromagnetic waves." He had discovered that "tiny sparks occurred in the gap of a loop of wire at one side of a room, when the scientist had radiated electromagnetic waves with an oscillator at the other side with no apparent connecting apparatus." This was the turning point, the motivating spark that ignited Marconi's intuition. He knew there could be more to Hertz's idea, that there was a practical application, and he, Guglielmo Marconi, would discover it and make electrical wave transmission available for all!

That year was 1894, and Marconi was only twenty, but intellectually mature. He read everything he could find about electricity and electromagnetic waves. He studied the theories and experiments of Michael Faraday, James Clerk Maxwell, William Thompson, Edouard Branley, Thomas Edison and Nikola Tesla. Within a year he would identify the missing element which would allow his apparatus to transmit from a few dozen meters to several kilometers. It was the concept of "grounding." By the end of the next year, young Guglielmo Marconi became an international celebrity as he began to unlock the secrets which would allow for the technology that would become commercial radio.

(Adapted from Douglas Coe, *MARCONI: Pioneer of Radio*, Juilian Messner Inc., NY 1943; D. R. Tarrant, *Marconi's Miracle*, Flanker Press Ltd., St. John's, New Foundland, Canada, 2001; Michael E. Whatley, *MARCONI: Wireless on Cape Cod*, Cape Cod, Massachusetts, 1987.)

Questions

1. How did Guglielmo Marconi's family help him in his scientific pursuits?

2. In what ways was Marconi's education different and the same as yours?

3. What was Marconi's working method? What could he do that others either couldn't or didn't do?

4. Who were some of the people named in the reading whose concepts Marconi used in the development of his wireless technology? Go to www.phy.hr/~dpaar/fizicari or www.encarta.com to find out what each was known for.

Reading 2: Wings to Words

Thomas Edison had determined that it was an impossible feat. Many others agreed. However, Guglielmo Marconi was undeterred. He continued developing his plans and the technology necessary to "jump the pond," that is, to complete the first Transatlantic wireless message.

So far he had been able to transmit at increasingly greater distances. He started with transmissions across the gardens of his family villa, then across the hills and mountains of Italy. He asked the Italian Department of Posts and Telegraphs to support his wireless experiments, but they refused. His mother arranged introductions for him in England where he went in 1896, met important people and could stay with relatives. However, while going through customs, the officials irreparably damaged his equipment. This was one major setback, but with his cousin's help Marconi found new materials and rebuilt the damaged equipment.

While in England, Marconi applied for and received his first patent for his "radio apparatus." With the help of the influential William Henry Preece, Guglielmo was able to continue developing his technology and gain supporters with his public demonstrations. In the spring of 1897, they used a kite to raise an aerial 300 feet and successfully transmitted a signal almost nine miles across the English Channel.

Marconi continued to extend the range over which he could transmit signals. In 1898 he installed a wireless system between Queen Victoria's residence on the Isle of Wight and her royal yacht *Osborne*. The Prince of Wales was recuperating from a broken leg, and they exchanged over 150 messages within sixteen days regarding his progress. Lord Kelvin sent the first "paid" wireless message when he donated a shilling after sending a message. On March 27, 1899, Marconi sent the first wireless between two countries, all the way across the English Channel to France. Then about a month later on April 28th his equipment was used in the first wireless rescue at sea. The East Goodwind Sands Lightship sent out a "CQD" distress call and lifeboats sent from shore rescued the crew.

Next, Marconi traveled to New York City. He used his previous experience reporting on British yacht races to send "eyewitness" reports on the race between the *Columbia* and the *Shamrock II*. He successfully demonstrated ship-to-ship transmissions from a distance of thirty-six miles. He tried to interest the US Navy in his radio technology, but they had concerns about the "reliability of transmitted messages." At that time anyone with a receiver could pick up any broadcast and if there were more than one broadcast the signals would interfere with each other so the messages wouldn't be understood. Marconi worked on this problem and came up with a solution. He was awarded the famous "four sevens" #7777 patent for his radio tuner device.

Now he was closer to trying the big jump. The two sites he chose on opposite sides of the Atlantic were at Poldhu, Cornwall on England's southwest coast and South Wellfleet, Cape Cod in the northeast United States. This site is now part of Cape Cod National Seashore. Both sites "thrust out into the Atlantic Ocean and offered clear transmissions with little chance of interference." In order for the signal to travel that distance there had to be enough power. The station at Poldhu was designed to transmit 100 times the power of any others at that time. It had a huge antenna system that was "supported by 20 masts each about 200 feet high arranged in rings within a 200 foot circle." Many were concerned that the antenna system wouldn't survive in high winds, and that the curvature of the earth would prevent transmission. However, the station successfully transmitted over 225 miles to Ireland thereby overcoming the curvature.

Once Poldhu was completed, Marconi came to Cape Cod to set up the "sister station." He met with local Ed Cook who helped him find an appropriate site. They looked at Barnstable first, but it was too far inland. Then they tried the highlands of Truro near Cape Cod Light. Here, the suspicious locals refused to sell any of their land. Finally, Cook offered to sell Marconi eight acres of his own land in Wellfleet for $250. This was an excellent site high on a bluff with a "completely unobstructed vantage point between Cape Cod and Poldhu."

The Poldhu station was used as a model for the Cape Cod station. When the giant antenna system was built Cape Cod locals made the same observations as their counterparts in Poldhu. They predicted the fierce northeast winds would blow the masts down. These predictions turned out to be accurate on both sides of the Atlantic.

The Cape Cod station was just about completed when a storm struck Poldhu on September 17, 1901, blowing down the towers. Marconi and his engineers redesigned Poldhu, but before they could change the Cape Cod station a storm struck there on November 25th blowing those towers down!

It was decided to receive the signal at Saint Johns, Newfoundland, Canada. This station was 600 feet above sea level with an unobstructed vantage point and about 1700 miles from Poldhu, lots closer than Cape Cod. They attempted to raise the antenna with hydrogen balloons but a severe wind damaged them beyond repair. Another attempt was made using a large canvas kite. Even though the winds were stronger the kite successfully raised the "aerial" up 600 feet. Meanwhile, the Poldhu station had started to send a pre-arranged signal on December 11, 1901. It was the three-dot Morse code signal for the letter "S". At 12:30 pm on December 12th Marconi thought he heard three faint dots.

"Shortly before midday I placed the single earphone to my ear and started listening. The receiver on the table before me was very crude—a few coils and condensers and a coherer—no valves, no amplifiers, not even a crystal. But I was at last on the point of putting the correctness of all my beliefs to test. The answer came at 12:30 when I heard, faintly but distinctly, *pip-pip-pip*. I handed the phone to Kemp: "Can you hear anything?" I asked. "Yes," he said. "The letter S." He could hear it."

Guglielmo Marconi
From *A Science Odyssey: People and Discoveries*
www.pbs.org

Marconi didn't stop with this success. He started new stations, another in Nova Scotia at Glace Bay and one at Siaconset on Nantucket. He made modifications to the existing stations as Poldhu had been overheating. He also was honored worldwide for his achievements in telecommunication and at the same time sued by the Anglo American Cable Company. However, he had a special plan for the Cape Cod station. He arranged an experiment that involved the president of the United States and the King of England to exchange messages. On January 18, 1903, Marconi went to the wireless telegraph to send a practice message to Glace Bay. They were shocked when it was Poldhu that acknowledged the message. The apparatus had spanned the Atlantic Ocean, a distance of over 3,000 miles.

His Majesty, Edward VII
London, Eng.

In taking advantage of the wonderful triumph of scientific research and ingenuity which has been achieved in perfecting a system of wireless telegraphy, I extend on behalf of the American people most cordial greetings and good wishes to you all and all the people of the British Empire.

THEODORE ROOSEVELT

Wellfleet, MA, Jan. 19, 1903

Sandringham, Jan. 19, 1903

The President,

White House, Washington, America

I thank you most sincerely for the kind message which I have just received from you, through Marconi's trans-Atlantic wireless telegraphy. I sincerely reciprocate in the name of the people of the British Empire the cordial greetings and friendly sentiment expressed by you on behalf of the American Nation, and I heartily wish you and your country every possible prosperity.

EDWARD R. and I.

Marconi himself sums up his feelings at his success: "I knew that all my anticipations had been justified. The electric waves sent out into space had traversed the Atlantic unimpeded by the curvature of the earth. The result meant much more to me than the mere successful realization of an experiment. As Sir Oliver Lodge has stated, it was an epoch in history. I now felt absolutely certain that the day would come when mankind would be able to send messages without wires not only across the Atlantic but between the farthermost ends of the earth."

(Adapted from Douglas Coe, *MARCONI: Pioneer of Radio*, Julian Messner Inc., NY 1943; D.R. Tarrant, *Marconi's Miracle,* Flanker Press LTD., St. John's, Newfoundland, Canada 2001; Michael E. Whatley, *MARCONI: Wireless on Cape Cod*, Cape Cod, Massachusetts 1987.)

Questions

1. What does "jump the pond" mean in this context? Why was it so important then?

2. Construct a timeline of Marconi's successes and setbacks as he developed the technology to make the first trans-Atlantic wireless communication.

3. If you were to describe Marconi what characteristics or attributes would you use?

4. In what ways has Marconi's prediction in the last sentence come true?

Reading 3: Radio Saves the Day

How many times have you been listening to the radio or watching television when the program has been interrupted to test the Emergency Broadcast System? What events in history led to this development that has become part of our daily life? The answer involves Marconi's wireless technology and the ill-fated ship *Titanic.*

One of the first uses of Marconi's wireless was for ship to ship and ship to shore communication. The Cape Cod station took on the role of being the main ship to shore wireless station for North America. In 1906 the Cunard liner *Lucania* was the first to offer commercial wireless. Passengers could send and receive messages, the so-called "Marconi-gram," for a fee of 50 cents per word. The Cape Cod station also sent out the "Nightly News" and stock quotations. Soon all passenger ships installed wireless offices for the convenience of their clients. However, the transmitters were large, poorly tuned, and noisy causing many on board to complain. At that time any use for emergencies was "incidental" and there were no regulations "governing both safety of life at sea or wireless." Most commercial ships did not install wireless equipment.

On the night of April 15, 1912, it was only about one hour after the nightly communication between the Cape Cod station and the *Titanic* when the ship hit an iceberg. Within sight of the *Titanic* at only ten miles away was the *Californian.* Its captain had already brought the ship to a stop when it entered the same ice field. Its lone wireless operator, Cyril Evans, had finished all his routine messages and went to bed after the *Titanic* told him to "shut up" as he was interfering with signals from Newfoundland. At 11:40 pm the *Titanic* struck the iceberg.

The First Officer of the *Californian* noticed white flares being shot skyward from the *Titanic*, but he thought they were part of a celebration as was customary at that time. He also thought it might be shooting stars. Since he wasn't sure, he did signal the *Titanic* with Morse code via a signal light, but received no response. Neither he nor the captain considered waking Evans to use the wireless. If they had, most likely all the passengers would have been rescued. There they were, only 10 miles away, but when hearing the news in the morning, they were the last to know. Meanwhile, the *Carpathia* was 58 miles away. Their wireless officer was about to shut down for the night when he decided to wire the *Titanic* that the Cape Cod station was trying to contact him. The *Titanic* promptly responded with its "CQD" distress call. The *Carpathia* turned around to head for the distressed ship. When they arrived at the scene there was no *Titanic* "only emptiness except for the lifeboats containing 705 passengers."

As a direct result of the *Titanic* disaster there was a call for an International Radio-Telegraphic Convention to meet July 5, 1912 in London. The purpose was "to establish regulations and procedures governing wireless services about ships and shore stations." Another conference was held on January 20, 1914. This "Safety of Life at Sea" meeting was considered "the turning point of communications as we know it." It was determined that "all countries with ocean going vessels would revise old laws and adapt to new conditions." The universal "SOS" signal as a distress call was enacted, as well as regulations for required numbers of lifeboats and lifejackets on board, wireless operators on board all ships 24 hours a day, flare use for emergencies only, and many others regarding ship construction and crew training in emergency procedures which are all still in effect today.

Immediately after the *Titanic* disaster wireless became the hero of the day. *Titanic* survivors presented Marconi with a gold medal for "saving their lives." Many felt that without the wireless on board all 2,200 passengers would have died. Marconi established the Marconi Wireless Schools throughout the world to provide trained wireless operators. Wireless was in all the news and many "enthusiasts were eager to join the elite group of pioneers."

(Adapted from Ray Minichiello, *TITANIC Tragedy Spawns Wireless Advancements,* www.marconiusa.org/history/titanic website for US National Marconi Museum 1995; Michael E. Whatley, *MARCONI: Wireless on Cape Cod*, Cape Cod, Massachusetts 1987.

1. Why was the "Safety of Life at Sea" conference considered a "turning point" in communication?

2. How would the new regulations have changed the outcome of the *Titanic* disaster?

3. How might modern radio, radar, computers, and cellphones which all have their foundation in Marconi's wireless technology have changed the outcome of the *Titanic* voyage? Consider how these technologies were used on 9/11 and compare.

4. Define "pioneers" as used in the last sentence of the reading.

Visual Evidence

Photo 1: Marconi, on far left, and assistants raising the kite aerial on December 12, 1901.

Marconi Company photo

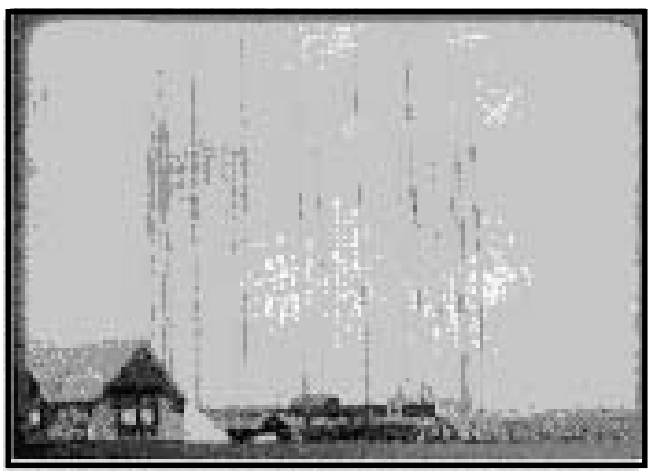
Marconi describes the experiment: "On Tuesday we flew a kite with 600 feet of aerial and on Wednesday we inflated one of the balloons. It was about 14 feet in diameter and contained about 1,000 cubic feet of hydrogen gas, quite sufficient to hold up the aerial wire weighing 10 pounds. The blustery wind ripped the balloon away from the wire and it sailed out over the sea. We concluded that perhaps kites would be better. On Thursday morning in spite of a gusty gale, we managed to fly a kite up to 400 feet. The critical moment had come. I was about to test the truth of my belief." At 12:30 pm local time Marconi could detect three faint dots, the letter s, transmitted from Poldhu, England across the Atlantic.
(From D.R. Tarrant, *Marconi's Miracle*, Flanker Press Ltd., St. John's Newfoundland, Canada, 2001, page 51.)

1. Why do you think Marconi chose this way to raise his antenna?

2. In what ways might people of the time have reacted to this scene?

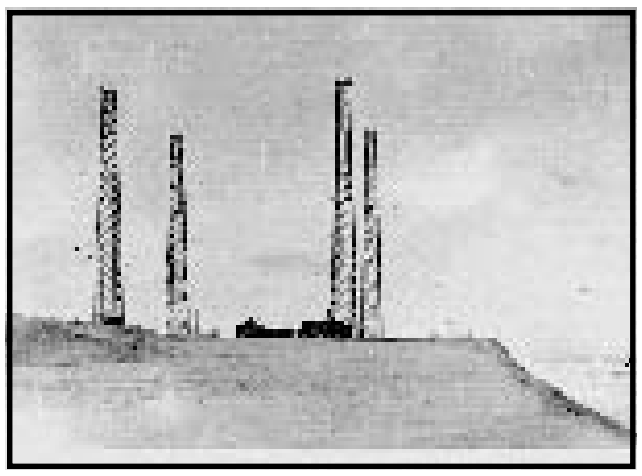
3. How would you describe Marconi after examining the evidence above?

Photo 2a: Circular towers at Poldhu, England



Marconi Company photo

Photo 2b: Wellfleet Wireless Station towers, which replaced the circular towers.



National Park Service photo

The towers were built as a way to raise and support the "aerial" or antenna. Local residents in Poldhu and Wellfleet predicted that the circular towers would blow down in high winds. They were right. The towers were rebuilt as shown in Photo 2b. Two hundred wires converged from the towers to the station transmitter house via a single lead-in wire.

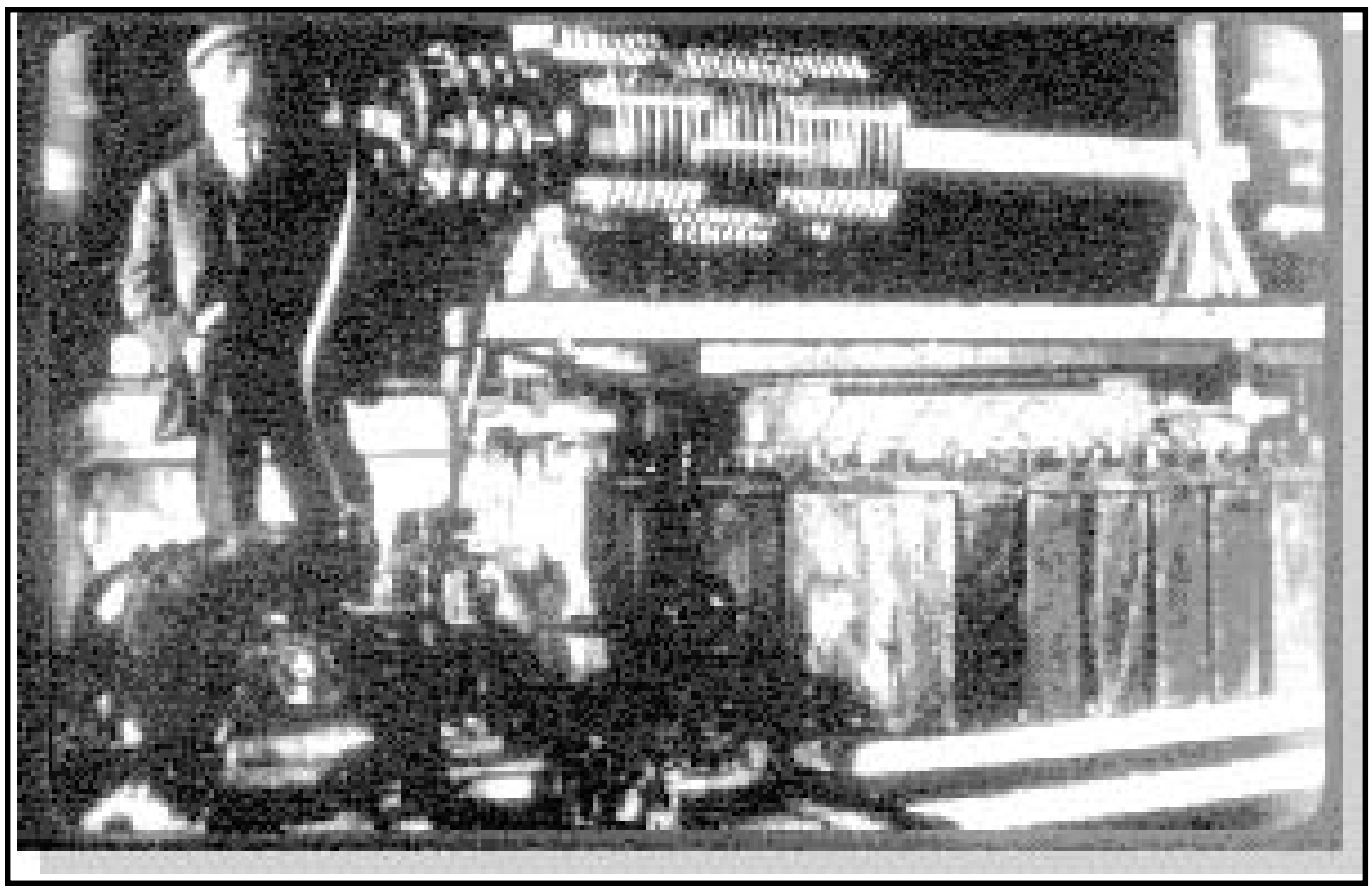
1. What are the differences and similarities in design between the two types of tower arrangements?

2. How do you think the "locals" knew the circular towers would blow down?

3. What makes the arrangement and design of the towers in Photo 2b better? Try building each array yourself with straws, dowels, erector set and string. Experiment with "wind" on each design. What conclusions can you draw?

4. Locate a cell tower in your community to compare and contrast with the Marconi station towers.

Photo 3: The Marconi Station transmitter



National Park Service photo

In this photo on the lower right is a bank of 33 ***condensers*** made from glass plates and metal sheets set in metal cans filled with oil. Above these are the ***inductors.*** In the lower left is the famous rotary ***sparkgap***, nearly three feet in diameter and revolving at 2100 rpm producing 35 ***kilowatts*** of radio-frequency power. This was the first sparkgap of its kind and size. No one could enter the room when the apparatus was on as it produced ear-splitting noise, blinding sparks, and was poorly ***insulated***.

1. Identify the condensers, inductors and sparkgap in the photo. Use the glossary to help define each component and why it was necessary.

2. Do you think these components are part of radio transmission today? Explain your answer.

3. What made the transmission room dangerous? In this context, what is the meaning of "poorly insulated?"

4. Go to this website to try a **radio transmission activity**: www.pbs.org/wgbh/aso/tryit/radio.

Photos 4a and Photo 4b: Moving equipment over the "Wireless Road" circa 1901.

National Park Service photo

Ed Cook sold Marconi eight acres of "mostly worthless" land overlooking the beach for $250. A horse and wagon were used to transport heavy equipment and supplies to the wireless station site from the train station in Wellfleet. Long distance, soft sand and steep hills made for rough going.

1. Compare the site in 1901, with information learned from Map 2. What are some of the differences? What, if anything, has remained the same?

2. What problems did Marconi encounter in building and supplying his station in 1901 that wouldn't be a problem today?

3. If he wanted to build a radio station today, what problems might he have that he didn't have in 1901?

National Park Service photo

Putting it all Together

Guglielmo Marconi used a location high above the Atlantic Ocean in what is now Cape Cod National Seashore to send his first transatlantic wireless message from the USA to England. Today at CCNS you might visit the Marconi site in South Wellfleet, try Braille on the Buttonbush Trail, or visit Nauset Lighthouse and Highland Light. All represent different forms of communication.

The following activities will help students to better understand how the desire to improve communication, especially telecommunication (*tele* means distant), led to the inventions of G. Marconi and others.

Activity 1: Let's Communicate!

Throughout human history people have continuously tried to improve on communication methods. Brainstorm with students some of the ways people have tried to communicate over distance: smoke signals, fire, drums, hand signals, flares, mirrors, flags, etc. What do all these methods have in common? Divide students into teams to explore the following: sign language, flashlight, drums. Ask each team to develop a code for their method. For example, three quick flashes of the flashlight could mean, "Help!" Then have each team demonstrate sending and receiving a message from a variety of locations. Afterwards discuss the pros and cons of each method. Next, brainstorm how technology has changed communication. What methods were invented to make telecommunication possible? (Examples: Samuel Morse with telegraph & code, Marconi with wireless) Divide the students into teams and distribute copies of the Morse code, pencils and paper. Have each team write a brief message in Morse Code to be exchanged with another team. Each team should decode the message and send a reply. What are the pros and cons of this method? Brainstorm present-day methods of communication. What types do students use or have access to daily? How do these methods compare to earlier forms of communication?

Activity 2: Go Fly a Kite

Marconi and his team tried repeatedly to develop the best "aerial" to deliver their electromagnetic signal. Two methods they used involved balloons and a canvas kite. In this activity the students will pretend to work for G. Marconi. Their assignment is to test at least 3 kite designs to determine which will carry the heaviest gauge wire as high as possible, then repeat the experiment with balloons, record and analyze the data, and finally, write a report to Marconi with their recommendation as to which he should use to raise his aerial and why. The report should consider lift, stability in the air, gauge of wire, length of wire, and weather conditions. The report can contain drawings and graphs. Try at least 3 kite designs, 3 gauges of wire, and 3 types of balloons. You can divide the class into teams so that each team experiments with one type of design, or use teams that try all the variables. After each team completes their experiments they can share data, then write one report to submit to Marconi. One person could play the role of Marconi while team representatives deliver and defend the report.

Safety Reminder: ***NEVER*** fly kites near power lines, airports, roads, or in storms.
Keep the flying area clear of people and check to see if there are any local prohibitions.

Activity 3: History of Communication in Your Community

Have students research their own communities to see how changes in communication technology have altered the landscape and the way people interact. Consider how the first people to live in your area communicated. Who were they, what time in history did this occur, how did they communicate? Who were the next group of people to arrive? Were there differences in how they communicated? Continue into the present. When and how did radio first come to your community? What changes have occurred in the past ten years? How has it changed your community in appearance and how people communicate? Include the types of antennae you can see. How are they the same and different? Who uses them and for what purpose? What clues, for example names like "Telegraph Hill", can you find in your community that indicate some type of communication was important, but may no longer exist. Libraries, local historical societies and museums, community websites and chambers of commerce are all good sources of information. Use your discoveries to make a display of the history of communication in your community. It could include comparisons to worldwide changes in communication in the same time periods. The display could be placed at school, the local library, town hall and/or in the lobby of a local radio or TV station.

Activity 4: *On the Air!* A Radio Play

Radio plays were one of the first types of programs available in the early days of radio. Explore this website to find examples: www.greatnorthernaudio.com, click on "radio theater craft workshop" and follow the links to topics. In this activity students will write, act, record and broadcast their own radio play about the life of Guglielmo Marconi. When developing the script consider his personality, his method of working, important events and discoveries, other relevant characters, and how his wireless technology was used at the time. Include appropriate sound effects and background music. Practice your play, then record it to check (by listening) for clarity & volume of each voice, flow of the story, proper timing of characters and sound effects. Refine your play until you have the best effort you can produce, and then make a final recording. You could play the recording on the school radio station or at a local radio station, or you could perform it live on the radio!

Glossary

condenser: in electricity, a devise for receiving and storing an electrical charge.

inductor: part of an electrical apparatus that which will produce an electrical or magnetic effect.

insulated: separated or covered with non-conducting material in order to prevent leakage of electricity.

kilowatt: a unit of electrical power equal to 1,000 watts.

spark gap: a space between two electrodes or pieces of wire that conduct the electricity up to the gap. Air is a pretty good insulator and does not normally conduct electricity. So, in order to jump across the gap, the electrical pressure or potential must be of sufficient voltage to jump the gap.

watt: a unit of electrical power.

(From Webster's *New World Dictionary*, 1966)

Supplementary Resources

The information in "Marconi: *Beyond the Horizon*" is only part of the story. In addition to the resources already cited, investigate the following to find out more.

www.alpcom.it/hamradio Called "100 Years of Radio", this site has dozens of links to radio history, the life of Marconi, and amateur radio.

www.enved.rochester.edu/wwwrlp/flags/flags This website will translate a text message into semaphore flags or international maritime flags.

www.geocities.com/Colosseum/4569/main This website has links to history, photos and more information about kites.

www.marconicalling.com This site has the best introduction and links to "the life, science and achievements" of Marconi.

www.soton.ac.uk/~scp93ch/morse This site lets you type in a text message, then gives a visual and auditory Morse translation.

This site has an unusual address. Type it as printed http://w1tp.com, scroll down to "General Information", then click on "how to build simple telegraph sets". There is also a link to Morse code.

"Fun Machines: Hands-on Science from the Smithsonian Institution, Gareth Stevens Publishing, 1993. This children's book has chapters on how to make a tin can telegraph and a crystal radio.