Teacher's Resource Guide

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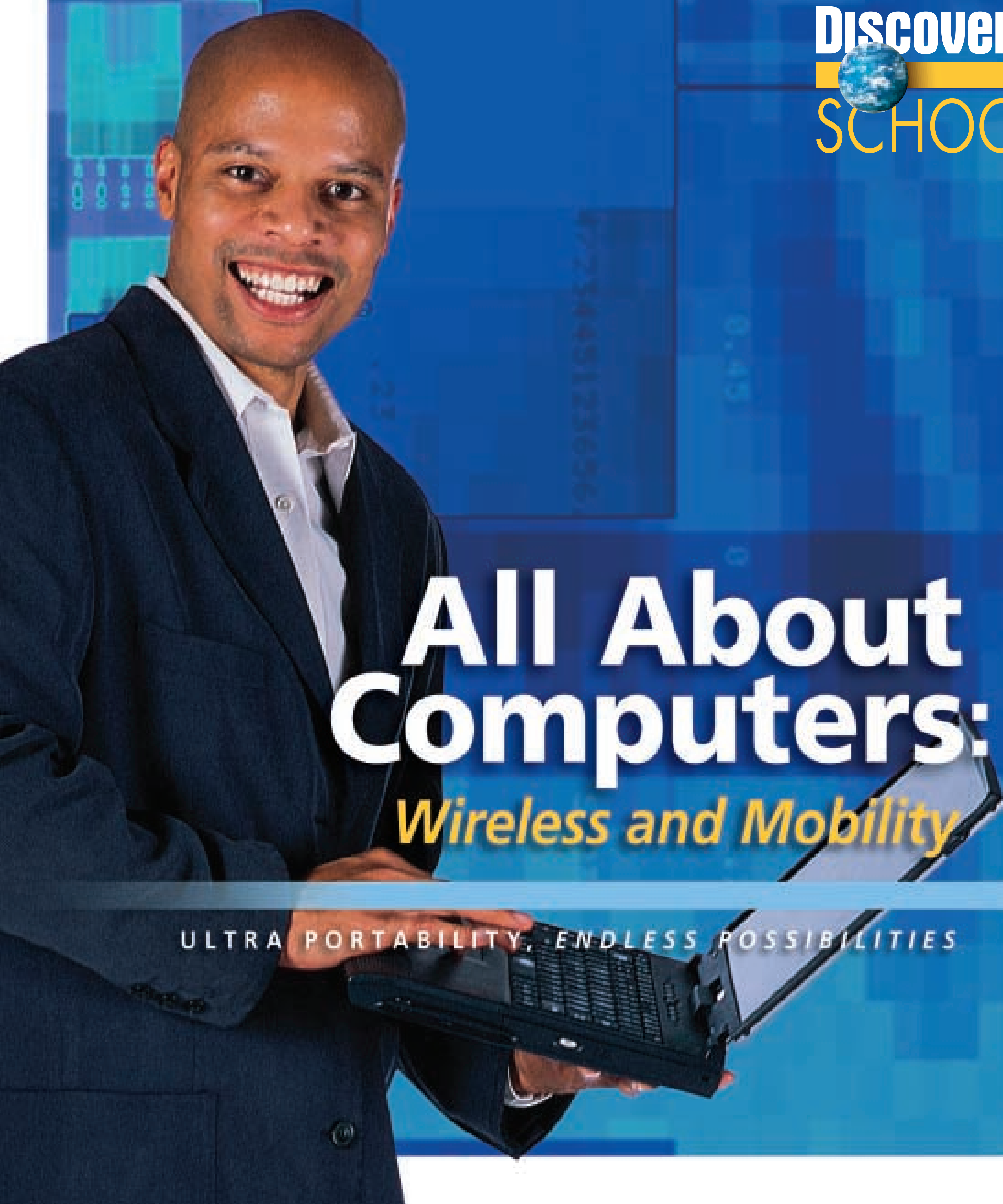
Discovery SCHOOL™



All About Computers:

Wireless and Mobility

ULTRA PORTABILITY, ENDLESS POSSIBILITIES

All About Computers:

Wireless and Mobility

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ULTRA PORTABILITY, *ENDLESS POSSIBILITIES*

Introduction

The interactive lessons, activities and discussions in this resource guide are designed for students in grades 6-8 as well as grades 9-12. They can be used for either or both age groups, and are adaptable through extensions and depth of coverage. Aligned with national technology standards, they also integrate critical concepts covered in Physical Sciences.

Lesson Plan 1 reviews the basics and Lesson Plan 2 reinforces them. Students will explore the underlying scientific principles that make mobile and wireless technology work. For some students, this will be a review. For many others, it's an important primer. As in all areas of learning, not everyone "gets it" the first time around. In science particularly, such misconceptions or gaps in knowledge can cause major stumbling blocks down the road.

In Lesson Plan 3, "Back to the Future," students examine the wonders of wireless; the distinction between wired and wireless; and, most importantly, how it all works.

For students to grow into intelligent users and consumers of technology in the digital age, they need to understand the history behind modern computing and communications; the scientific concepts behind important inventions and innovations; and the relationships among science, technology, society and the individual. This kit touches on all of these areas and provides ideas for engaging lessons, activities and discussions to deepen comprehension. Hopefully it will spark some ideas of your own and compel students to think about the purpose and possibilities of technology in the classroom—and beyond.

LESSON PLAN #1: *Back to Basics*

Length of Lesson:
One class period

Grade Level:
6-8 (Introductory)
9-12 (Review)

Subject Area:
Physical Science; Technology

Objectives:
Students will understand the following:

1) *Messages can be communicated from a sender to a receiver over large distances.*

2) *Messages need to be coded/translated and then decoded/translated back to be sent.*

3) *Messages can be encoded in many different ways.*

Suggested Materials:
Flashlights, black and white construction paper, notepads, pencils, index cards

Overview:

In the age of instant messaging, it's hard to imagine a time when vital information could take days to send and decipher. In this exercise, students engage in creative brainstorming—a vital part of the scientific process—to formulate and test their own "languages" and methods of long-distance communication. By encoding and decoding, they learn the universal components of a communications system.

Preparation:

1) Search the Internet for printable charts showing the Morse Code, the International Marine Signal Flags and the Semaphore flag alphabet. Use these as posters for reference, or pass out photocopies.

2) Prepare a list of famous messages, to be used in step 4, and write them on index cards.

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Procedure:

1) Spark a discussion by asking students to ponder the earliest forms of long-distance communication. Tell them that the telegraph was the first form of telecommunications; but before that, how did people transmit important messages from here to there? (examples: banging sticks or drums, ringing church bells, fire and smoke signals, the Pony Express).

2) Give historical examples like Paul Revere's lantern in the Old North Church steeple and wooden semaphores used during the French Revolution. Can students come up with any others? Introduce the idea of alphabet-based codes, such as Semaphore flag signaling.

3) Divide the class into teams of four: Each team should have a message writer, a message encoder, a message decoder and a message rewriter.

4) Distribute a selection of famous messages (e.g.,"The British are coming!") to teams. Instruct students to work with their team members to devise a signaling system of their own.

5) Have teams brainstorm how they will encode messages, using flashlights or black and white paper to devise a Morse Code-style "on/off" system.

6) Have teams demonstrate their unique long-distance communications codes.

Extensions:

1) Add an additional member who receives and transmits the encoded message. Use this device to show that faithful transcription of the message is key.

2) Research the history of cryptology (the science of encoding and decoding messages) or a specific code system. Examples: the "Caesar Code" used by the Romans; the "Enigma" code used by the Germans during WWII; the Navajo "code-talkers" and the use of other American Indian languages during both World Wars; Thomas Jefferson's secret poly-alphabetic code system.

Discussion:

- Discuss different levels of encoding—letter, word or entire message.
- Elicit from students ways in which messages can be incorrectly sent or received.
- Discuss how you might "encrypt" your message so that other people would not be able to read it.
- How is an encryption used in computer technology today?
- What is the difference between a code and a cipher?

Evaluation:

Three points—Students will devise a clear method to encode and decode many different messages and will successfully send and receive a message.

Two points—Students will devise a method to encode a specific message and send and receive that message.

One point—Students will not be able to devise a method to encode a message and will not be able to send it.

Standards Covered

Standard: Understands the nature of technological design

Benchmark 6-8

- Knows that the design process is a slow, methodical process of test and refinement
- Knows that the design process relies on different strategies: creative brainstorming to establish many design solutions, evaluating the feasibility of various solutions in order to choose a design, and troubleshooting the selected design

Standard: Understands the nature and uses of different forms of technology

Benchmark 6-8

- Knows the components of a communication system (i.e., a source, encoder, transmitter, receiver, decoder, and destination)

Standards Source: www.mcrel.org

LESSON PLAN #2: *Mini Science Fair*

Length of Lesson:
Scalable, depending on number of workstations

Grade Level: *6-12*

Subject Area:
Physical Science; Technology

Objectives: *Students will understand the following:*

1) Cutting-edge wireless and mobile technology is based on simple scientific principles

2) The scientific principles underlying wireless and mobile devices are the same as those for the telegraph, the telephone and radio

3) Electromagnetism—the interplay of electricity and magnetism—is the basis for radio, television, computer, and mobile and wireless communication technologies

Suggested Materials:

Discovery Schools' Magnetism CD-ROM v2.0

Crystal Radio Kit

Morse Code Kit

Student worksheet to record notes

Overview:

There is a wealth of information that could be covered on the history of early telecommunications and the scientific principles underlying it. This is simply a way to touch upon important milestones and technologies, for the sake of giving students the necessary sense of perspective. It also provides entertaining, interactive ways for them to connect with the content and increase comprehension of fundamental concepts.

Preparation:

1) Familiarize yourself with the content and navigation of the Magnetism CD-ROM included with this kit; test the experiments to make sure you can "build" them yourself.

2) Make a simple worksheet for students to record time spent at each station (start time and end time). This will help them with time management and will help you determine who needs to focus on what during session #2. Include a "notes" section for each workstation. Make photocopies.

3) Set up the workstations indicated below.

4) Launch the Internet on designated machines before class begins.

Procedure:

1) Begin with the following statement. Write the key words on the board.

The roots of mobile and wireless devices can be traced to three major inventions:

- the telegraph
- the telephone
- the wireless telegraph (radio)

To understand those inventions, you need to understand the scientific principle that made them possible:
- electromagnetism

2) Ask students to volunteer definitions of "electromagnetism." Then follow with a formal definition yourself. Time permitting, give a brief demonstration using a battery, a piece of copper wire, and a compass.

3) Give an overview of the workstations. Set guidelines on how long students should spend at each station.

4) As either a homework or class assignment, instruct students to write 3-5 sentences on each workstation, summarizing what they learned.

Workstation 1:
Discovery Schools' Magnetism CD-ROM v2.0

Students can build an electromagnet in the Virtual Lab, conduct experiments with it, and then catch a short "Video Adventure" on electromagnetism.

Workstation 2:
Online Morse Code Translator

www.scouting.org/fun/morse

Link to this URL and let students play around with this primitive code. This is a fun and free-of-charge feature courtesy of the Boy Scouts of America.

Workstation 3:
Morse Code Kit

Morse Code kits are available at hobby shops and educational toy stores. Ask a couple able students to build the device prior to class. Then other students can use the key tapper, sounder, bulb and wire to encode and decode words.

Workstation 4:
How Telephones Work

Log onto the Connected Earth website:
www.connected-earth.com

Click on "Journeys," then on "Telecommunications Age."

Under "Telephone" you'll find interactive pages such as:

- How the telephone works
- How an electromagnet works
- Sound
- Inside the telephone

Workstation 5:
Crystal Radio

Crystal radio kits are available at consumer electronics and toy stores. They're reasonably priced (most under $15) and simple to make. Or, you can build one from scratch. Search the Internet for instructions on how to build one using materials like toilet paper rolls, insulated wire, alligator clips and rubber bands.

What is Electromagnetism?

Electromagnetism is magnetism produced by an electric current.

In 1820, Danish physicist Hans Oersted discovered the link between electricity and magnetism. While conducting a classroom experiment, he inadvertently created a magnetic field by running an electric current through a wire. Today, electromagnetism is the basis for all electrical engineering—from electric motors to Wi-Fi notebooks.

The electromagnetic spectrum comprises the full range of radiation in all forms. It is described in terms of energy (volts), wavelength (meters) or frequency (Hertz, or cycles per second). The different types of radiation (from lowest energy to highest) are:

Radio • Microwave • Infrared • Optical • Ultraviolet X-ray • Gamma-ray

Evaluation:

(based on homework assignment):

Three points—Students will exhibit a clear and complex understanding of the basic principals behind early electric telecommunications.

Two points—Students will exhibit an adequate understanding of the basic principals behind early electric telecommunications.

One point—Students will not be able to exhibit an adequate understanding of the basic principals behind early electric telecommunications.

Standards Covered

Standard: Understands forces and motion

Benchmark 6-8

- Knows that just as electric currents can produce magnetic forces, magnets can cause electric currents

Benchmark 9-12

- Knows that magnetic forces are very closely related to electric forces and can be thought of as different aspects of a single electromagnetic force

Standard: Understands the nature and uses of different forms of technology

Benchmark 9-12

- Knows that communications systems can transfer information from person to person, person to machine, or machine to machine.

Standards Source: www.mcrel.org

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LESSON PLAN #3: *"Back to The Future"*

Length of lesson:
2 to 3 class periods

Grade Level:
6-8 (Introductory)
9-12 (Review)

Subject Area:
Physical Science; Technology

Objectives:
Students will understand the following:

1) *The distinctions between the terms "wireless," "wired" and "mobile"*

2) *The basic principles behind wireless communication; examples of advanced and emerging technologies and how they could impact society*

Suggested Materials:
Poster paper and markers

Overview:

Through class discussions and activities, students explore and explain the concepts of "wired" and "wireless" and the difference between the two. They also learn the distinction between "mobile" and "wireless," terms which are sometimes used incorrectly.

Part 1: "Wired vs. Wireless" Procedure:

1) Ask students to volunteer answers to the following questions:

- What does "wireless" mean?
- Is all "mobile" technology wireless?
- How can something be wired and mobile at the same time?

2) Write the headings "Wired" and "Wireless" on the board and draw a vertical line between them.

- Ask students to call out examples of each type of device and write them on the board. Give others in the class a chance to dispute the categorization and discuss before moving on to the next example.
- The first time someone mentions a device that can fit in either category (example: PDAs come in both wired and wireless versions), make a third column on the board for "both."
- Continue this exercise until you feel there are sufficient examples in each column, and that students understand the distinction.

3) Now ask students to brainstorm examples of things in their own homes that could conceivably be made wireless in the not-so-distant future. Start with household appliances as a discussion topic.

- A wireless toaster? Wireless fridge? What else in your kitchen could go wireless?
- Could any of these appliances or gadgets be combined together into a multipurpose wireless contraption?
- Think of devices in other rooms throughout your house. Are any already wireless? (example: garage door opener) Which are most likely to go wireless in the near future?

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4) Explain wireless technology as it relates to concepts covered in Lesson Plans 1 and 2.

- Wi-Fi uses radio technology to transmit and receive data.
- Wi-Fi converts 1s and 0s into radio waves and then back into 1s and 0s.
- Wi-Fi uses electromagnetic radiation.

Extensions:

Research and report on the distinctions between the following terms:

- Local Area Network (LAN), Wide Area Network (WAN) and Wireless Local Area Network (WLAN)
- 1G, 2G and 3G
- Bluetooth and Wi-Fi

Part 2: "We Have Visitors" Procedure:

1) Present this scenario: Friendly aliens from a distant galaxy have asked to visit your school to learn about Earthling technology. They are particularly interested in mobile and wireless devices and technology.

2) Divide the class into teams and assign each a mobile or wireless device to research. Tell them they will be giving group presentations—oral and visual—to the visiting aliens, to explain how these things work.

3) Instruct each team to create a poster describing how data, sound and pictures are transmitted from here to there. Students should use illustrations, captions, labels and arrows but minimal text, using terms and explanations that are as simple as possible.

4) The teams give oral presentations to the aliens, using their posters as reference. The challenge is to use only vocabulary words that you can explain, and references to other technology that you can explain. While one team presents, the other teams assume the role of the aliens in the audience, and are free to ask questions about terms they don't understand. (Example: "The cell phone is kind of like a regular phone but…"*Alien: "What's a phone?"*)

5) Teams then state ways in which their devices may impact society, both positive and negative.

Evaluation:

Three points—Students will exhibit a clear understanding of the basic principles behind wireless communication, as well as the distinction between the terms "wireless," "wired" and "mobile."

Two points—Students will exhibit an adequate understanding of the basic principles behind wireless communication, as well as the distinction between the terms "wireless," "wired" and "mobile."

One point—Students will not exhibit an adequate understanding of the basic principles behind wireless communication, nor of the distinction between the terms "wireless," "wired" and "mobile."

Vocabulary

Wireless

Relies on radio waves, rather than a physical connection (like cable or fiber-optics), to transmit data between sender and receiver.

Wireless LAN

Transmits data from computer to computer, within a building or group of buildings, without a physical connection. (A conventional LAN uses wires, whereas a WLAN uses a radio link.)

Standards Covered

Standard: Knows the characteristics and uses of computer hardware and operating systems

Benchmark 6-8

- Knows basic characteristics and functions of an operating system.

Standard: Understands the nature and operation of systems.

Benchmark 6-8

- Identifies the elements, structure, sequence, operation and control of systems.

Standard: Understands the relationships among science, technology, society and the individual

Benchmark 9-12

- Knows examples of advanced and emerging technologies and how they could impact society.

Standards Source: All national academic standards used in this Teacher's Guide are in the subject area of Technology. They are compiled by the Mid-Continent Educational Laboratory (McRel). www.mcrel.org

TAKE A VIRTUAL FIELD TRIP

Can't make it into the big city? Take a virtual field trip to one of the following science museum websites and learn more about the way things work.

www.sln.org
Science Learning Network—A good launchpad for planning virtual trips. Educators can stay up-to-date on the best-rated online offerings, as well as science news and resources.

www.si.edu
Smithsonian, Washington, DC—A reliable, well-respected source of information on all things scientific. You'll find an extensive collection of online exhibits in the Science & Technology gallery, including "Industry, Machines & Electricity," "Computers & Communications" and "History of Science and Technology."

www.exploratorium.edu
Exploratorium, San Francisco—This was one of the first science museums to build its own website. With more than 15,000 Web pages, the highly entertaining site explores hundreds of different topics—biodiversity, robots, you name it. With live and archived webcasts you can view a lunar eclipse or the latest "Iron Science Teacher" awards.

www.msichicago.org
Museum of Science and Industry, Chicago—Interactive online exhibits include Networld ("Experience the Internet by coming inside it!") and Toymaker 3000: An Adventure in Automation.

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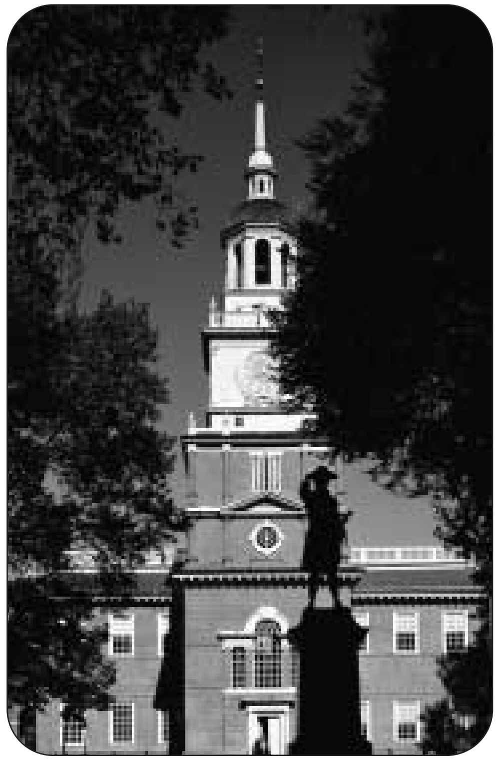
www.mos.org
Museum of Science, Boston—Click on "Explore & Learn" to reach virtual exhibits including "Build Your Own Robot" and "The Computing Revolution". The Current Science & Technology section delivers the latest news and developments from around the world.

www.sciencemuseum.org.uk
Science Museum, London—Arguably one of the biggest and best science museums in the world, now at your fingertips. Online exhibits and interactives include "Exhiblets," digital exhibitions describing important events, discoveries and personalities in science.



www.fi.edu
The Franklin Institute, Philadelphia—Obviously the best source on electricity. Educators will also want to check out Pieces of Science, an online gallery of standards-aligned resources related to a collection of historical science objects.

www.thetech.org
The Tech Museum of Innovation, San Jose, California—This Silicon Valley museum shares its resources with the rest of the world through its substantial collection of online exhibits, both current and archived.

www.museoscienza.org/english/Default.htm
The National Museum of Science and Technology in Italy offers a permanent online exhibit on the history and science of radio.

www.sciencefriday.com
Who says radio is old-fashioned? The Science Friday website celebrates its long-running kids' radio program and has searchable archives on every science topic under the sun. You can also listen to live audio broadcasts.

ULTIMATE SCIENCE FIELD TRIP KIT

***Subjects:** Earth and Physical Sciences, Biology, Chemistry and Physics*

Portable Lab

If you could design the ultimate field trip kit, with the latest mobile and wireless equipment, what would it contain? Here's a fully loaded version, to give you a glimpse of the possibilities.

The latest devices are ultra-portable, affordable and amazingly accurate. They're revolutionizing the way we teach and learn, and sparking a brand-new enthusiasm for science—both in and outside the lab.

Field trip kits can be customized to meet individual needs. This example is specific to science, but you can mix and match to create kits for other subject areas. Establish a system so that teachers know to book them in advance.

The Essentials:

GPS – to find your way there

Tablet PC – the natural way to take notes in the field

Handhelds – plug in a probe to collect data; pop it in your pocket when you're through

Digital camera – create a photo journal of your field trips or scientific field work

Real-time Data Capture and Display

Data collection and analysis has never been easier, faster, or more precise. These revolutionary new tools allow students to perform sophisticated experiments in the field or in the lab with increased efficiency. Students can do multiple tests and analyze multiple results in a fraction of the time it would ordinarily take with traditional equipment. Who says lab work has to be boring?

Data loggers – Capture and send data in real-time. Measurements are sent instantaneously to your computer (either Mac or PC) and data points are tabulated and plotted within seconds. Or, multiple data sets can be stored and uploaded later. Data loggers can also be used as meters, with readings displayed on the built-in LCD screen, thus eliminating the need for computers.

Graphing calculators – Equipped with graphing software, to plug into probes. These handy devices enable students to display and analyze real-world data on the spot, without waiting to return to the lab or classroom.

Smart probes – Designed to be plugged into handheld computers, these sensors measure scientific phenomena with amazing precision. They can also be plugged into calculators with graphing software to tabulate data. Smart probes measure the following:

- acceleration
- carbon dioxide
- conductivity
- dissolved oxygen
- distance
- force
- heart rate
- light
- magnetism
- pH
- pressure
- radioactivity
- respiration
- sonar
- sound
- temperature
- velocity
- voltage

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WRAP-UP SESSION

Thinking about mobile and wireless society

Your Local Library—Outmoded? Or more important than ever?

Say you've got a notebook, tablet PC or PDA with Internet access. Say you've got a big research paper due and need a quiet place to concentrate. You could sit in your bedroom, your backyard, a tree fort, a football field. With everything at your fingertips, who needs a library?

Discussion points:

Librarians—The role and importance of librarians in the digital age (trained in both library science and information technology; skilled at evaluating resources, both online and print).

Print vs. Web Sources—What criteria should be used to evaluate source material? Example: The University of Alaska uses "AAOCC" (Authority, Accuracy, Objectivity, Currency, and Coverage) and tells students basic questions should be asked of all information sources: books, journal articles, web pages, CD-ROMs, videos, sound recordings and e-books.

Resources:

www.library.jhu.edu

John Hopkins University's Library site is an excellent resource for pointers and guidelines. Under "Research Help" click on "Evaluating Internet Resources."

www.ala.org

American Library Association (ALA)—learn more about the importance of libraries.

www.uaf.edu/library/instruction/handouts/InfoResources.html

The University of Alaska' s library has a good section on "Evaluating Information Resources," which may be reproduced as a handout.

Ultimate Accessibility

How can wireless and mobile technology be used to facilitate learning and accessibility for people with disabilities?

Begin by talking about technology currently used. (Example: Auditory Display systems combine GPS, a mobile PC, and headphones with a built-in head-tracking sensor to help blind individuals navigate their way.) Then explore ideas for future applications.

Use the resources below for both examples and thought-provoking discussion points.

Resources:

www.wirelessrerc.gatech.edu

Wireless RERC—Rehabilitation Engineering Research Center on Mobile Wireless Technologies for Persons with Disabilities

www.w3.org/WAI

Web Accessibility Initiative (WAI)—developed by the World Wide Web Consortium (W3C)

"The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect."

— Tim Berners-Lee, W3C Director and inventor of the World Wide Web

General:

The Center for the Study of Technology & Society

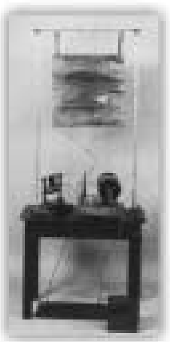
www.tecsoc.org/edu/edu.htm

This is an excellent resource for classroom discussion items.

HERE, THERE &
EVERYWHERE
Milestones in Mobile and Wireless Communications

1896 – Guglielmo Marconi files patent in England for wireless telegraphy system. (However, the U.S. Supreme Court overturns his patent in 1943 in favor of Nikola Tesla, now widely considered the inventor of wireless.)

1899 – British battleships with wireless equipment flash the first wireless signal across the English Channel



1901 – Guglielmo Marconi sends wireless signals across the Atlantic

1914 – World War 1—British Army uses mobile wireless sets carried in saddles and horse-drawn wagons

1915 – AT&T and GE send a speech from Arlington, VA to the Eiffel Tower

1921 – Police in Detroit use first two-way radio "pagers"

1934 – Before and during WWII, the British experiment with radar and develop a secret wireless communications network for military intelligence

1943 – First Walkie-Talkies, made by Motorola, weigh 35 lbs., use 18 glass tubes and have a range of 10-20 miles

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1946 – The world's first electronic digital computer, the ENIAC, covers 1,800 square feet and weighs over 30 tons.

1947 – In response to the demand of the new telephone network, Bell Labs develops the transistor.

1952 – On television, the UNIVAC computer predicts outcome of presidential election

1953 – IBM's Magentic Drum Calculator released as the first mass-produced computer

1957 – USSR launches Sputnik, the world's first satellite

1959 – The integrated circuit, developed by Jack Kilby of Texas Instruments, combines the transistor, the wires and everything needed in one small package.

1964 – Digital releases the 12-bit PDP-8, the first commercial minicomputer with monitor and keyboard

1965 – Gordon Moore, of Fairchild Semiconductor, predicts transistor density on integrated circuits to double every year for the next decade

1967 – Texas Instruments introduces the first handheld calculator

1968 – The compact, 70-pound Apollo Guidance Computer orbits the Earth aboard the Apollo 7

1969 – NASA and IBM put the first man on the moon using an onboard computing system in the Orbiting Astronomical Observatory 11

1969 – ARPANET—U.S. Dept of Defense funds first computer network connecting defense contractors and universities doing military research. (Later evolves into the Internet)

1970s – C.B. radios become a fad; no longer just for truckers!

1971 – First network e-mail message sent (from one computer to another, in Cambridge, MA)

1971 – Dubbed the "computer on a chip," the miniscule Intel 4004 microprocessor is as powerful as the ENIAC!

1973 – Ethernet, a computer networking standard developed by Robert Metcalfe of Xerox PARC, enables computers to "talk" to one another.

1975 – The first PC—the Altair 8800—graces the cover of Popular Electronics magazine as the "World's First Minicomputer Kit"

1981 – The 24-lb. Osborne 1, considered the world's first portable computer, is released by the Osborne Computer Company.

1981 – The IBM PC, the first desktop computer, makes a big splash and later lands on the cover of Time magazine as "Man of the Year 1982"

1983 – The cell phone network is launched commercially in the United States

1984 – First wrist-size television set

1986 – IBM introduces the PC Convertible, considered the first real laptop

1987 – Commercialization of the Internet

1987 – Ericsson introduces first handheld mobile phone

1989 – First "notebook" style computer—the NEC UltraLite—weighs under 5 lbs.

1991 – Developed by Tim Berners-Lee, the World Wide Web (or WWW) is officially launched

1991 – IEEE begins work on wireless Ethernet standard (which will eventually become known as Wi-Fi)

1993 – Intel's Pentium chip revolutionizes computing

1993 – World Wide Web becomes public domain

1993 – NEXTEL, first wireless network, operates in Los Angeles

1996 – Instant Messaging (IM) surges in popularity as free, downloadable ICQ software becomes available

1996 – PalmPilot launched as the first commercially successful personal digital assistant (PDA)

1996 – Smartphones hit the scene—over time the pocket-sized gadgets evolve to include e-mail, games, video and music players, even digital cameras

1998 – BlackBerry combines wireless "remote control" e-mail, along with data access, Web, phone and organizer features

1999 – Debut of 802.11b – or Wi-Fi (wireless fidelity), considered the first true wireless technology.

1999 – The Bluetooth specification is introduced, enabling short-range wireless connections.

2002 – UWB (ultra wideband) permitted by the FCC

2002 – The Tablet PC emerges, equipped with Microsoft's unique "ink-recognition" software

2003 – Public wireless "hot spots" begin to pop up everywhere from airports to Starbucks, allowing free access to the Web.

2004 – IBM incorporates Intel Centrino technology in the ThinkPad R Series, allowing for extended battery life and a thinner laptop design.

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