TEACHER'S CURRICULUM GUIDE

WHAT'S UP IN TECHNOLOGY?

Produced by Thirteen · wnet

Funded by TOYOTA USA FOUNDATION

Building Bridges to Better Education

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WHAT'S UP IN TECHNOLOGY?

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WHAT'S UP IN TECHNOLOGY?

ABOUT THE FUNDER

THE TOYOTA USA FOUNDATION

The goal of the Toyota USA Foundation is to build bridges to better education – providing today's children with a brighter tomorrow.

The Toyota USA Foundation was established in 1987 by Toyota Motor Sales, USA, Inc., to serve children in kindergarten through the 12th grade.

Since the late 1980s, the Foundation has provided funding for innovative programs that foster creativity and inquiry in the classroom, encourage problem solving and independent thinking, and increase teamwork and leadership skills. Today, the Foundation's giving emphasis is focused on programs that improve the teaching and learning of mathematics and science.

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For additional information on the Toyota USA Foundation, you may call (310) 618-6766, mail inquiries to 19001 South Western Ave., Torrance, CA 90509-2991, or visit the Foundation's Web Page at:
http://www.toyota.com/foundation

Introduction

WHAT'S UP IN TECHNOLOGY? is an innovative educational project that includes a half-hour video, this Teacher's Guide, and a Web site. WHAT'S UP IN TECHNOLOGY? shows the importance of technology in our lives and describes some of the exciting career possibilities offered by new technologies. It offers high school teachers interdisciplinary lessons, relating technology education to subject areas such as science, math, social studies, and career education.

Contents of the guide

This Teacher's Guide is to be used with the WHAT'S UP IN TECHNOLOGY? video. Teacher's pages and student activity pages accompany each segment of the program. The Guide includes background information, discussion questions, activities, and research projects. **You will need to photocopy student activity pages before each lesson. Copies are to be distributed to each student.**

We recommend that you screen the entire program at least once by yourself, so you can target the video segments you want to present in class. Each video segment has an interactive lesson plan that engages and involves students in both research and hands-on activities. The video can be used over several weeks as students become familiar with technology's role in the past, present, and future. The Teacher's Guide includes these sections: Why Study Technology?, Bikes that Fly, 100 Kilowatts of Regular, Please, Where Can We Go From Here?, Plug Into the Future, and Resources.

Why Study Technology? discusses technology's pervasiveness in daily life, and describes the importance of technological literacy.

Bikes That Fly uses the video's profile of Kestrel (an innovative bike manufacturer) as a starting point for a lesson on composite materials.

100 Kilowatts of Regular, Please examines the advantages and disadvantages of different kinds of vehicles, and refers to the video segment about ECD (a company that makes batteries for electric vehicles).

Where Can We Go from Here? looks at the history of technology since 1945, and provides student activity pages that discuss communication, transportation, and production technologies, as well as biotechnology. Curriculum connections for these activities are on page 14.

Plug into the Future uses Holly Ng's internship at Intel as a starting point for a school-to-work activity.

Resources describe organizations, publications, and Web sites that can help students and teachers learn more about different kinds of technology, school-to-work initiatives, and technology careers.

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WEB SITES

Look for more information about WHAT'S UP IN TECHNOLOGY? on the World Wide Web at wNetStation and wNetSchool at:
www.wnet.org / wnetschool / tech

ORDERING INFORMATION

To order videocassettes and curriculum guides for WHAT'S UP IN TECHNOLOGY?, please contact:

GPN
PO Box 80669
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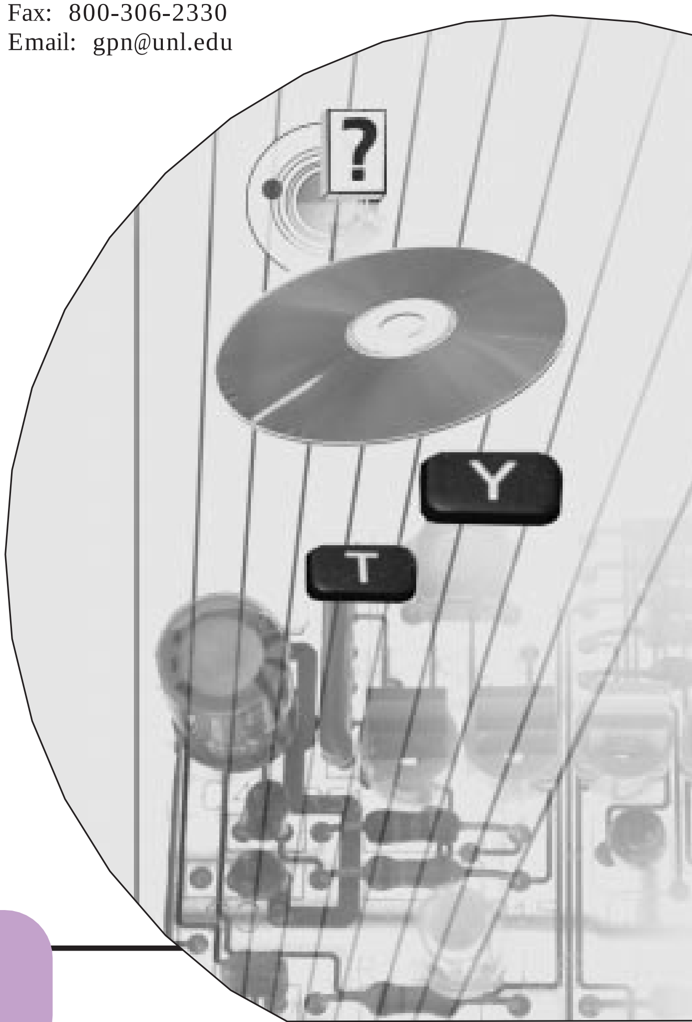


Why Study Technology?

VIDEO CLIP SUMMARY

(Time: 0:20-2:35)
We are surrounded by technology. It helps solve problems and extend our capabilities. In this segment of the video, Tamara and Travis discuss the fact that technology includes both objects as simple as paper clips and high-tech devices like compact discs.

OBJECTIVES

Students will

- explain ways that technology affects their lives
- evaluate the benefits and costs of a technological issue

ADVANCE PREPARATION

You will need

- poster board, markers
- arrangements for students to use the school library/media center

VOCABULARY

technology, technological literacy, ethics, technology assessment

RESOURCE

Technology for All Americans: A Rationale for the Study of Technology

PHOTODISC

MOTIVATION

This lesson demonstrates that technology is an important part of our daily lives. Tell students that people create technology to satisfy needs and wants. Hold up a sheaf of papers and ask them how they would use technology to keep the pages together. Use a paper clip as an example of technology. Ask them what other technologies could be used to organize loose papers (e.g., staples, paper fasteners, notebooks).

To get students thinking about how they use technology every day, have them describe their morning routines, asking: What woke you up this morning? How was your milk or juice kept cold? How did you get to school? Next, ask students to discuss other technologies that they always use. Write this definition on the board: *Technology is what people create to solve problems and extend human capabilities.*

Point out that technology is connected to other disciplines. For example, scientists often use computers. Ask how these tools extend their capabilities. Technology depends on science for an understanding of natural laws. Mathematics is an exact language used for science and technology. We use communication in various ways to record and share our knowledge of science and technology.

Explain that technological literacy is the ability to use and understand technology. Technologically literate people:

- know the history of technology
- design, use, and control technology
- make informed decisions about technology

PRESENTING THE LESSON

Show the introductory segment of the video. Ask students to describe how technology can solve problems. What were the problems with records that CDs helped solve? Why is it important that we continue to develop new materials?

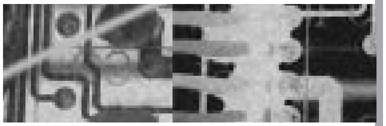
The following activity gives students an opportunity to examine the impact of technology on individuals, society, and the environment. **Distribute and review the student worksheet.** Form groups of four or five and assign a different technology issue to each. Each group will prepare a Technology Assessment poster to demonstrate its solution. Possible issues:

- A new road is needed to accommodate the cars traveling to a new shopping mall.
- Bio-engineers have nearly perfected an artificial heart that will cost more than $150,000 per patient.
- Thousands of dead fish have been found near a factory that is discharging treated water into the river.
- The Internet is a valuable information resource. Who owns it? Who, if anyone, should make sure that the material it contains is appropriate for young people?
- If possible, assign a significant local issue to one group.

LESSON WRAP-UP

Have students display their Technology Assessment posters. Give each group time to describe its issue and its answers to the questions in each category. To extend the lesson, have students identify and evaluate other technology issues that affect the community.

TECHNOLOGY ASSESSMENT



Everyone needs to be technologically literate. Technologically literate people are able to make informed decisions about technological issues before they vote.

The process used to evaluate technologies is called technology assessment. It gives us the opportunity to determine the ways that a technology may be good or bad. Below are six categories of questions that are helpful in making these judgements. Start with these questions and identify others through group discussion.

IMPACTS

ECONOMIC: What will the technology cost? How will it affect business, industry, and jobs?
ENVIRONMENTAL: Will the technology deplete natural resources or cause pollution?
SOCIAL: Who benefits from the technology? Will anyone suffer because of it?
ETHICS: What ethical issues are related to the use of the technology?
HEALTH AND SAFETY: Does the technology place workers or others at risk?
POLITICAL: What legal issues, if any, are involved in the use of this technology?

THIS IS YOUR CHALLENGE:

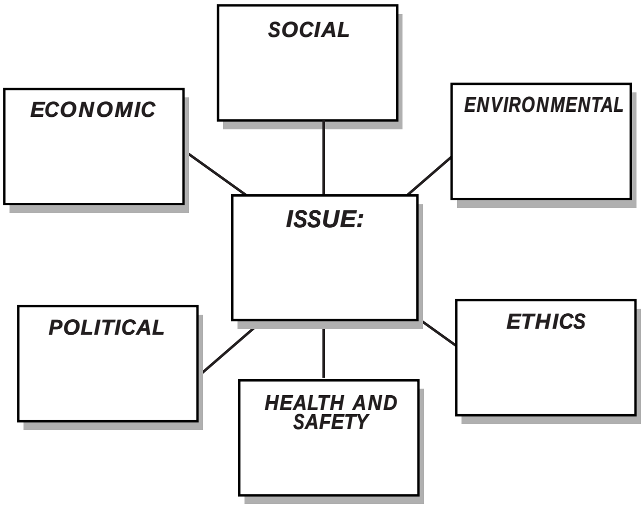
Produce a poster that describes your group's assessment of a technological issue (assigned by your teacher). The poster will be an example of using technology for communication.

Develop Alternative Solutions: Discuss the issue assigned to your group. Gather information, using resources in the classroom and library/media center. If possible, use the Internet. Record your answers for each of the six impact categories.

Select the Best Solution: As a group, agree on an answer for each question in the six categories.

Implement the Solution: Summarize your group's discussion in graphic form, using a web design. Place the issue in the center and surround it with answers to the questions for each category. (See below.) Prepare to present your information to the whole class.

Evaluate the Solution: If you had the opportunity, how could the poster be improved?



Science Connection: Many power plants are built on lakes or rivers so that water can be used for cooling. How can the hot water produced in the plant be used?

Math Connection: Imagine that a state collected $2.25 for each of the 1.6 million automobile batteries turned in last year. Recent legislation requires that 35 percent of the total be used for research into recycling automobile components. How much will be available? How should the balance of the money be used?

Social Studies Connection: Why is it important for citizens to evaluate information before making decisions about issues that impact their community? What are some of the important issues in your community?

Careers: Technical illustrators utilize artistic and computer skills. Determine if your group can present its assessment using computer graphics software.

Bikes That Fly

VIDEO CLIP SUMMARY

(Time: 2:35-7:50)
Throughout history, people have used new materials to improve the performance of technology. At Kestrel, an innovative bicycle manufacturer, a team of young engineers creates high-performance bicycles for professional athletes. Kestrel bikes are light and fast because they're made of composite materials – carbon fiber and Kevlar, interlaced with an epoxy resin.

OBJECTIVES

Students will

- create a composite material system
- simulate a common forming process used with composites
- examine the properties of a composite material

ADVANCE PREPARATION

You will need

- items made of composite materials
- clay or Styrofoam
- white glue (Elmer's)
- plastic wrap
- fabric
- sponge or abrasive paper
- latex paint
- marbles
- tank of water

VOCABULARY

ceramics, composite material, metals, polymers

RESOURCE

Kestrel Web site at www.kestrel-usa.com

MOTIVATION

Tell students that throughout history, the development of new materials was key to the advancement of civilization. Historians have named specific time periods after the prominent materials of the age, such as the Stone Age and the Bronze Age. Where are we today? This is the age of composites, which are lighter and stronger than traditional materials.

Classification of Materials

Wood, clay, and metal ores are called natural materials. Some, like wood, are renewable. Nature replaces wood within a reasonable amount of time. Other natural materials, such as oil and natural gas, are nonrenewable. To produce these materials, nature takes millions of years – just too long to wait for a refill.

Synthetic materials are created by people. Synthetics replace and improve upon natural materials.

Material Families

Traditionally, scientists have classified materials into three families: metals, ceramics, and polymers. Metals are used for their strength and their ability to be formed into a variety of shapes. Ceramics include clay, glass, gems, gypsum (plaster), and cement. Polymers are materials whose molecules form long chains. Some, like wood and rubber, are natural. Most, like plastics, are synthetic.

The newest group of materials is called composites. Composites combine materials from two or more material families, creating material systems. The new material has properties that are different and usually better than the parent materials. Fiberglass is a composite material that combines glass fibers (ceramic) and plastic resins (polymer).

Review the classifications and families of materials with your students. Identify metals, ceramics, polymers, and composite materials found in the classroom and at home. Discuss the economic, environmental, and health impacts of modern materials.

PRESENTING THE LESSON

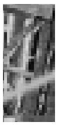
Show students the "Bikes That Fly" segment of the video. Next, show them common products that represent the composite family of materials. (Suggested items: plywood, a fiberglass food tray, and a carbon-graphite golf club or tennis racket.) Ask the students: What properties do the composite products have that traditional materials do not?

Distribute the student worksheet. Discuss the advantages of composite materials. Read through the activity with the students, asking probing questions to ensure that they understand what they must do. During the activity, act as a facilitator and encourage team effort.

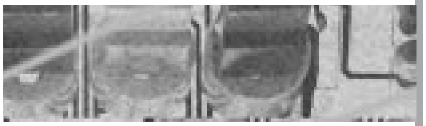
LESSON WRAP-UP

Have students respond to the following questions:

1. What advantages do Kestrel composite bicycles have over bikes made of traditional materials?
2. What products at home or in class could be improved by using composite materials, rather than traditional materials?



COMPOSITE MATERIALS



For thousands of years, people sailed the oceans and paddled across lakes in boats made from locally available, natural materials – wood, bamboo, and reed. Although these served people well, new materials have replaced them. Modern recreational boats are made from fiberglass, a composite material made of glass fibers (from the ceramic family of materials) and plastic resins (from the polymer family of materials).

The following activity will give you some experience working with simulated composite materials and processes.

THIS IS YOUR CHALLENGE:

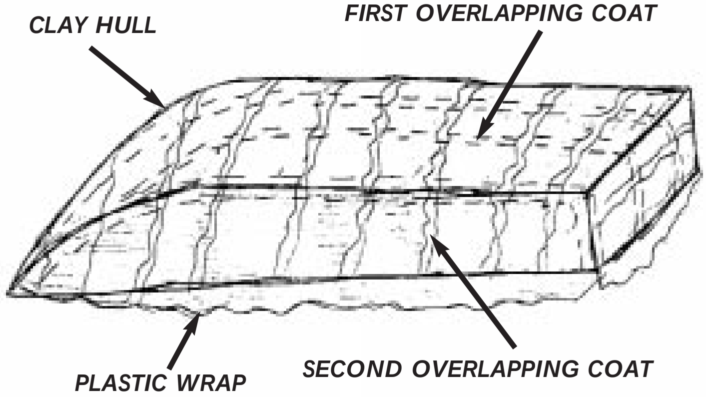
Design and build a model boat hull that will hold the greatest weight without sinking.

Equipment and Supplies:
clay, white glue, fabric, sponge, sandpaper, latex paint, plastic wrap, marbles

Develop Alternative Solutions:
1. Form a team with two other classmates.
2. Research and discuss various hull bottom shapes. Why are different shapes used?
3. Sketch possible designs. Select a design.
4. Use clay or Styrofoam to model the hull design. The outside of the clay or foam will be used as a drape mold. Use a sponge or fine abrasive paper to make the mold surface as smooth and free-flowing as possible.
5. Wrap the mold with plastic wrap, trying to keep the surface as smooth as possible. The plastic wrap will help the composite material release from the mold after it cures.

Implement the Solution:
1. Precut the fabric into 1” strips.
2. Prepare a cup of white glue by thinning it slightly with water.
3. Paint a layer of glue over the mold. Do not allow it to dry.
4. Drape an overlapping layer of glue-soaked fabric over the mold. BE NEAT.
5. Drape a second layer of glue-soaked fabric at right angles to the first layer.
6. You might want to experiment by layering the fabric at different angles to increase the hull’s strength.
7. Allow twenty-four hours for curing.
8. Remove the mold. Allow another twenty-four hours for drying.
9. Trim the excess fabric.
10. Paint the hull (two coats of paint). Let the first coat dry before painting the second coat.

Evaluate the Solution: Float the hull in a tank of water. Does the hull float evenly? Is it watertight? Use marbles to fill the hull and test for weight capacity. Compare your results with the rest of the class.



Science Connections: What forces help objects to float? Research the principle of buoyancy. How could we test the material for tensile and compression strength?

Math Connections: A company manufactures a new composite material that can hold 325 times its own weight while in tension. A 25’ section of this material weighs six pounds. How much weight can the section hold? What is the relationship between the volume of the hull and the weight it held?

Social Studies Connections: What impact did silicon, a ceramic material used to make microchips, have on world economics and politics?

Careers: Research the field of material science. What education is required? What types of activities does a material scientist do on a typical day?

100 Kilowatts of Regular, Please

VIDEO CLIP SUMMARY

(Time: 7:50 -14:00)
Science and technology can be used to solve societal problems like air pollution. In the future, pollution-free electric vehicles (EVs) may look and drive like today's gas-powered cars. Using teamwork, Energy Conversion Devices (ECD), a company that makes batteries for electric vehicles, invented something new: the nickel metal-hydride battery. These are now the batteries of choice for electric vehicles.

OBJECTIVES

Students will

- understand advantages and disadvantages of internal combustion (IC) and electric vehicles (EV)
- describe three major systems of electric vehicles
- identify energy conversions that take place in vehicles

ADVANCE PREPARATION

You will need

- assorted modeling materials for the student activities

VOCABULARY

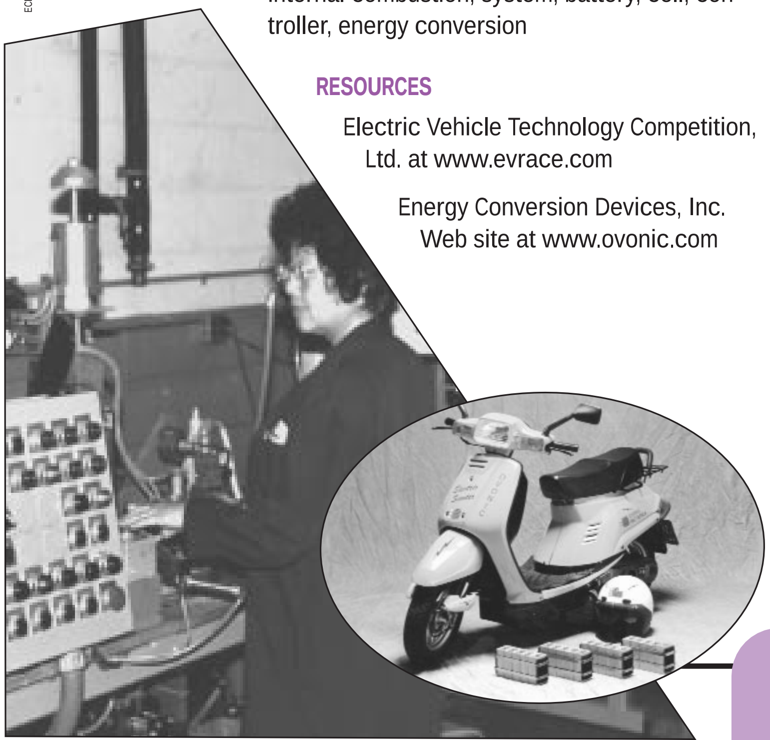
internal combustion, system, battery, cell, controller, energy conversion

RESOURCES

Electric Vehicle Technology Competition, Ltd. at www.evrace.com

Energy Conversion Devices, Inc. Web site at www.ovonic.com

ECD/OVONIC BATTERY



MOTIVATION

This lesson will give students an understanding of electric vehicle technology and its advantages and disadvantages. Students will learn about tradeoffs made, as they consider switching from internal combustion (IC) vehicles to electric vehicles (EV).

Form groups of four or five students. Ask each group to discuss the advantages and disadvantages of gasoline-powered cars. One student from each group should present a summary of the group's discussion to the rest of the class. Tell students that this discussion will continue as they learn more about electric vehicles.

Assign this activity: Keep a two-day log of all the automobile trips made with one of your family vehicles. Record the purpose of each trip, round-trip mileage, and total mileage for the day. Write a paragraph that summarizes the data. NOTE: Students who do not use cars should record the mileage and means of travel, such as bus, bicycle, or walking.

PRESENTING THE LESSON

Show the video segment. Discuss its key points about electric vehicles. In the U.S., cars use one-half of the oil consumed, and cause one-half of the urban pollution and 25 percent of the greenhouse gases. Ask why we should be concerned about these facts. The video stated that electric vehicles don't create pollution. Ask students what sources of power are needed to recharge EV batteries. What resources are used? Are electric vehicles entirely pollution-free?

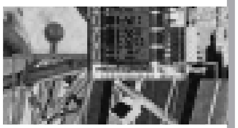
Discuss the invention process. Iris and Stan Ovshinsky started their business because they were concerned about the U.S. dependence on foreign oil and pollution from gasoline-powered vehicles. They identified a problem, experimented, and succeeded in inventing a new kind of battery. Teamwork and a diverse work force are important to their firm.

Distribute the student worksheet. Students should consider both challenges and then choose one. The model EV challenge is based on stock competitions, which convert IC vehicles into EVs. For the charging station challenge, students should imagine that electric vehicles are common, and people need attractive, convenient places to recharge them.

LESSON WRAP-UP

Have each student describe the data he or she gathered during the homework activity. Most electric vehicles can now go at least 60 miles before they need to be charged. How many of the students' trips would be suitable for electric vehicle use? Have students demonstrate their model vehicles and EV-charging stations. Summarize by using the board to create a chart covering the advantages and disadvantages of internal combustion and electric vehicles.

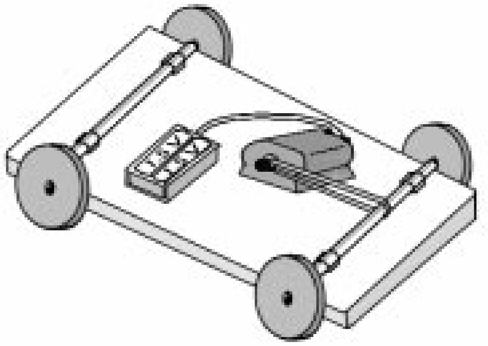
ELECTRIC VEHICLE TECHNOLOGY



Are you ready to buy an electric car? Before deciding, you should learn how they operate. Electric vehicles contain three important systems: batteries, an electronic controller, and an electric motor.

Batteries are the most important and expensive component. Each of the batteries is called a cell. In some ways they are similar to the 1.5-volt batteries used in a two-cell flashlight, which work together to produce 3 volts. In an electric vehicle, dozens of cells are connected to produce the high voltage needed for the powerful motor. The **electronic controller** connects the batteries to the motor when you step on the accelerator. Electronic circuitry ensures that the correct amount of electricity reaches the motor. At the **motor**, the electricity creates a changing magnetic field to make the motor shaft turn.

Vehicles are energy converters. They change energy from one form to another. In an internal combustion engine, the chemical energy stored in gasoline is changed into mechanical energy. In an electric vehicle, the batteries change chemical energy into electrical energy. The motor changes electrical energy into mechanical energy to propel the vehicle. What kinds of energy conversions occur at the lights, horn, and brakes?



THIS IS YOUR CHALLENGE:
(choose one of the following)

Convert a non-motorized toy car into a model electric vehicle that will travel as far as possible on one set of batteries.

OR

Imagine that you are a member of an architectural firm that is designing an electric-vehicle charging station that will be located at an office building or shopping mall.

Equipment and Supplies: toy car, small DC motor, 1.5-volt batteries of various sizes, foam board, markers, craft knife, miscellaneous modeling materials.

Develop Alternative Solutions:

1. Form a team with two other students.
2. Brainstorm possible solutions to your challenge.
3. Use sketches to record ideas. Save all your brainstorming ideas and sketches. Organize them in a portfolio and turn it in with your finished product.

Select the Best Solution: Identify your team's best idea. Gather the materials needed to construct it.

Implement the Solution: Build the model.

Evaluate the Model: Answer A or B.

A. Does your electric vehicle work? How far can it travel on one set of batteries? What might be done to increase its range?

B. Show your model charging station to students working on the model EV challenge. Ask them to comment on its design. Use their feedback to make improvements.

Science Connection: Name five electrical devices that you frequently use. What kinds of energy conversion occur during their use?

Math Connection: An electric vehicle requires 22 kilowatt-hours of electricity for an overnight charge. At a cost of $.125 per kilowatt-hour, how much does the battery charge cost? Suppose the charge enables a 60-mile trip. How does the cost of operating this EV compare to an IC that gets 24 miles per gallon when gasoline costs $1.20 per gallon?

Social Studies Connection: During the 1970s, the United States experienced a crisis because of our dependence on foreign oil. What can we do now to prevent a similar crisis?

Careers: Use your school library or career center to investigate careers related to electric vehicle technology, such as transportation engineers, chemists, model-makers, and CAD drafters.

Where Can We Go from Here?

A Look Back and A Look Forward

VIDEO CLIP SUMMARY

(Time: 14:00-19:35)
Seemingly small innovations in technology can lead to monumental change. For example, the introduction of transistors in the 1950s paved the way for today's microprocessors.

OBJECTIVES

- examine the history of the Families of Technology
- contrast early technological developments with modern technological developments

VOCABULARY

Production, communication, transportation, biotechnology

RESOURCE

Smithsonian Without Walls Project at www.si.edu/revealingthings/

UPI/CORBIS-BETTMANN

OVERVIEW: A Brief History of Technology

(use this for class presentation)

Technology began long before recorded history. When the earliest humans first flaked stones to make tools, technology was invented. That's what technology is all about: people creating ways to satisfy their needs. Technology does not have to be complex. A stone ax is technology just as much as a computer is.

All people have basic needs and wants. Technology helps people satisfy these by creating products and services. Our essential needs – for food, water, shelter, communication, transportation, protection, health care, and recreation – have not changed throughout history. How we satisfy them has changed dramatically.

The Families of Technology

To understand how different technologies satisfy needs, it is helpful to categorize them into families. The four families of technology are production systems (manufacturing and construction), communication systems, transportation systems, and biotechnology systems.

Simple technologies can lead to more complex technologies. The "Where Can We Go From Here?" segment of the video briefly mentions that today's computers are related to earlier mechanical adding devices, like the abacus. Technological families also share common processes.

Throughout much of the world, technological development has occurred in three major eras: the Agricultural Era, Industrial Era, and Information Era. Advances in the Agricultural Era include pottery, writing, plowing, and sailing. The discussion that follows looks at advances that have taken place during the Industrial and Information Eras. The end of World War II is a good place to begin an overview of technological development and change. This is because that war fueled many of the technological advancements that would later become part of everyday life.

Production Systems – Manufacturing and Construction

Production systems provide us with energy, products created through manufacturing, and the structures that comprise the human-made environment. During the twentieth century, natural gas and petroleum became the main sources of power, because they were cheap and easy to transport. The use of petroleum also sparked a growth in the chemical industry, as synthetic materials made from oil displaced traditional materials such as cotton and wood. The 1950s, '60s, and ’70s saw the growth of computer technology. Computers changed the face of manufacturing by controlling machine processes. In the 1970s, the use of computer-controlled robots became popular in some factories. The 1980s and ’90s are characterized by the use of new super-strength composite materials and Computer Integrated Manufacturing (CIM).

Communication Systems

Within ten years after World War II, television became widespread. Radio technology produced high-fidelity sounds, and microwave technology helped long-distance telephone conversations take place. Communication satellites of the ’60s increased intercontinental phone capabilities. The transistor, microchip, and circuit board miniaturized communication technology. Computers became smaller and more powerful. In the 1970s, mainframe computers and computer centers assisted in data gathering and information distribution. In the 1980s, personal computers (PCs) became a fixture on people’s desks. Most recent communication technology relies on light energy from lasers to send and store information.

Transportation Systems

After the war, powerful piston engines designed for military use (bombers, cargo carriers) were adapted to civilian air transportation. Speed was the name of the game. Prop-driven aircraft could cross the Atlantic Ocean in 20 hours. The 1950s saw the introduction of jet plane technology to commercial air traffic, reducing the crossing time to seven hours. The late 1950s and ’60s ushered in the “space race.” Today, the reusable space shuttle represents the height of air transportation technology. Changes in automobile technology included radial tires, power steering, and diesel engines. Trains and magnetic-levitation vehicles scream down tracks and guideways at speeds in excess of 300 mph. Electric cars may be found in some of our driveways by the end of the decade.

Biotechnology Systems

Post-World-War-II food production increased with the mechanization of farming, improved seeds, and new pesticides. In the 1950s, medical technology brought about techniques for controlling fatal diseases like tuberculosis and syphilis. New antibiotics such as penicillin became part of doctors’ regimen for treating illness. The 1960s saw the first heart transplant and other organ transplants. Pacemaker technology allowed for the regulation of the human heartbeat. In the 1970s, diagnostic tools like the MRI gave physicians noninvasive means of exploring the inside of the human body. Medical advances that focused on genetic engineering characterized the 1980s and ’90s.

PRESENTING THE LESSON

Show the video segment. Ask your students the following question: If they were stranded on an uninhabited tropical island with only the clothing on their backs, what basic needs would they have to satisfy? Follow up the questions with the following:

- List some products you would create to satisfy those needs.
- How will you make the products, and what materials will you use?

Compare their experience of being on the island with that of prehistoric humans. Were they creating technology on the island? Have the students categorize the products they created into the Families of Technology. If possible, read some portions from Defoe’s *Robinson Crusoe* on meeting needs and wants.

Introducing the Activities

Distribute one of the following four student worksheets.

1. Present the activities on the following pages as opportunities to see how technologies were developed to satisfy people’s wants and needs, just as the students used technology to satisfy their needs on the island. Stress the fact that simpler technologies were combined to create new and more complex technologies, as people’s wants and needs became more complex.
2. Read through the activity with the students.
3. Review the Design Process (define the problem, develop solutions, etc.).
4. Ask probing questions to be sure the students understand what they must do.
5. During each activity, act as a facilitator, and encourage team effort.

LESSON WRAP-UP

Have each team respond to the following questions:

1. How did the technologies they investigated impact upon people in the past and today?
2. Simple technologies develop into more complex technologies. What were some of the simpler technologies that led to the development of the technology they investigated? What more complex technologies might the technology they investigated lead to?
3. Describe another activity they could do that would build upon the information they learned through doing each activity.

Please note: Curriculum Connections for the four student worksheets in “Where Can We Go From Here?” appear on page 14.

COMMUNICATION SYSTEMS

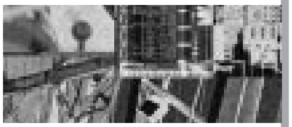
Have modern communication technologies had an impact on the way you do things? They sure have! Satellite transmissions can beam phone calls, and even beeper messages, to any location in the country.

Communication systems have political, social, and cultural impacts. Political campaigns are hard to imagine without mass communication technologies. When someone uses an ATM card, the data is processed and recorded by bank computers that maintain financial profiles on almost every American. Television has become a major part of American culture. Modern communication systems have also changed the environment. Do you have a microwave antenna tower in your area?

Gutenberg's invention of movable metal type in 1450 forever changed the flow of information around the world. For the first time, books became affordable to the average person. The thoughts and discoveries of inventors, scientists, and writers could be shared with wider audiences. Information, through books, gave more and more people the power of knowledge. Communication technology gives people an opportunity to have an impact on the way others live, work, and play.

THIS IS YOUR CHALLENGE:
Select one of the past and current communication technologies listed on the right. Research and describe that technology's impact upon politics, society, culture, and environment. Make some educated guesses about future communication technologies and their effects. Describe a futuristic communication device (perhaps by combining some present technologies) and predict its impact on people's lives in the future. Use the chart below as a model to help organize your data.

FUTURE COMMUNICATION TECHNOLOGY



Select and research one past and one present communication technology listed below.

I. Past Communication Technology – telegraph, phonograph, early telephone, camera, printing press
II. Present Communication Technology – fiber-optic cable , bar code scanner, fax machine, video recorder
III. Create your own futuristic communication device.

Equipment and Supplies: Look in your school and public library for books, magazine articles, videos, and Web sites (if available).

Develop Alternative Solutions:
1. Form a research team with two classmates.
2. Prepare a timeline of developments in communication technology.
3. Brainstorm the obvious impacts of two of the devices.
4. Assign each team member a device to further research.
5. Gather information about each device and its impact on politics, society, culture, and environment.
6. Brainstorm some futuristic communication devices and their possible impacts.

Select the Best Solution: After a discussion, select the most significant effects.

Implement the Solution: Fill in the chart based on your research and discussions.

Evaluate the Solution: Get reactions from teachers and other teams about your findings. Compare the information you have all gathered.

PAST COMMUNICATION TECHNOLOGY

Device Name	Political Impact	Social Impact	Cultural Impact	Environmental Impact

PRESENT COMMUNICATION TECHNOLOGY

Device Name	Political Impact	Social Impact	Cultural Impact	Environmental Impact

FUTURE COMMUNICATION TECHNOLOGY

Device Name & Description	Political Impact	Social Impact	Cultural Impact	Environmental Impact

TRANSPORTATION

Transportation systems are used to move people, animals, products, and materials from one place to another. People have always needed to move things, but speed, comfort, and efficiency have changed dramatically over the years. All transportation systems have one thing in common. Each requires energy to create movement.

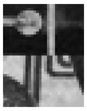
Motor vehicles such as cars, trucks, and buses are the most widely used method of transportation today. Most use an internal combustion engine to provide power. These engines burn fuel to create motion within the engine's cylinders. Pistons located inside the cylinders transfer the energy to the wheels through a series of shafts and gears.

Environmental and ethical concerns about the use of internal combustion engines have created a demand for new transportation technologies. Improving batteries is a key to their success.

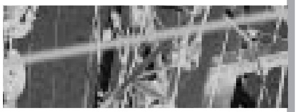
THIS IS YOUR CHALLENGE:

You work for a company that manufactures "natural batteries" from everyday materials. Its research has shown that fruit and vegetable wet cells can be used to power micro-vehicles that require low-voltage power. The micro-vehicle might be "vegi-powered" by a tiny sliver of potato. Using the model shown in the diagram, conduct a series of tests to determine the best materials for electrodes and electrolytes in a "natural battery."

Equipment and Supplies: volt meter, two alligator leads; **electrodes:** zinc strip, nails, copper strip, brass keys, rolled aluminum foil; **electrolyte:** lemon, potato, tomato, orange, grapefruit

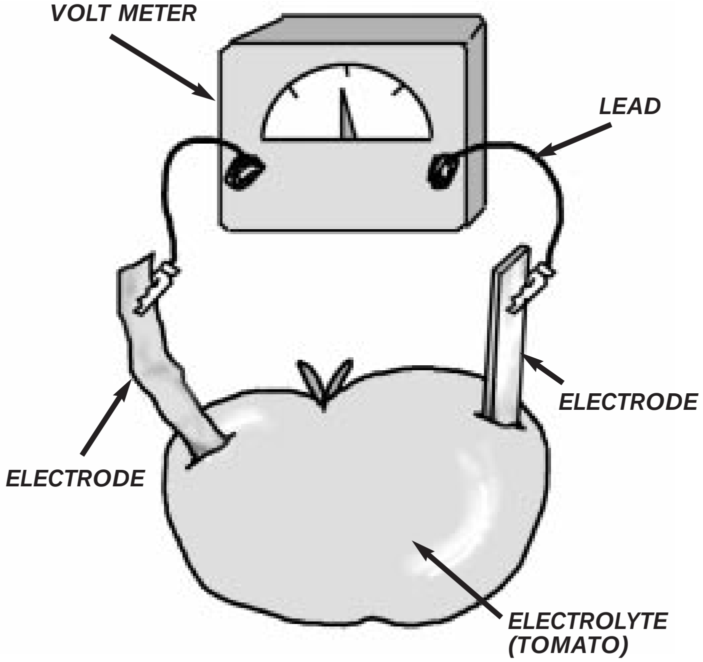


DEVELOPING A WET CELL



Develop Alternative Solutions:

1. Form a team with two other classmates.
2. Research and discuss how wet cells work. Conduct a search of the World Wide Web.
3. Brainstorm possible design solutions.
4. Select three different electrolytes for testing.
5. Select three pairs of electrode materials for testing. Remember, electrodes must be two different materials.
6. Construct the wet cells as shown in the diagram.



Implement the Solution:
Conduct the experiments and record the data collected using the format of the chart provided.

Evaluate the Solution: Which combination of materials creates the best natural wet cell? Compare your findings with your classmates'. What wet-cell system would you recommend to power the micro-vehicle?

Example ***ELECTRODE PAIRS***

ELECTROLYTE		Volt.		Volt.		Volt.
lemon	zinc/nails		zinc/copper		zinc/brass	
potato	zinc/nails		zinc/copper		zinc/brass	
etc.						

PRODUCTION

TESTING COLUMN STRENGTH

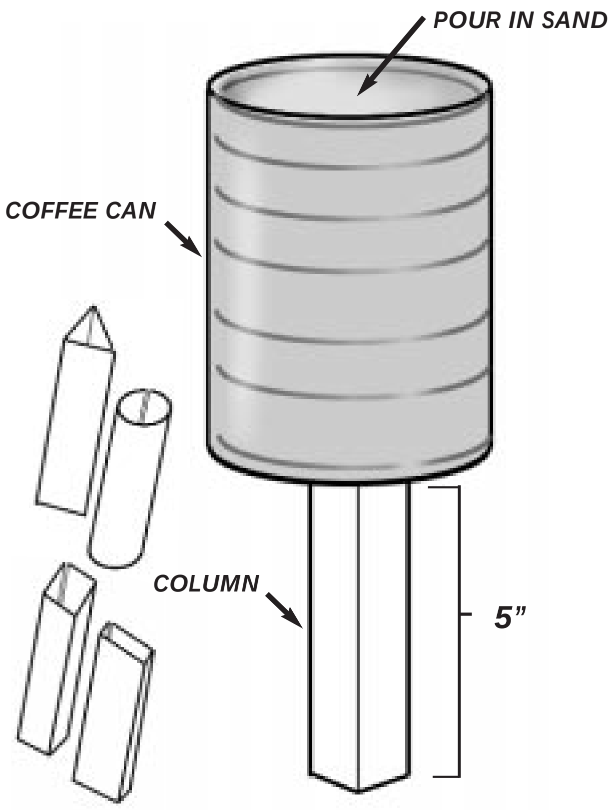
Do you know what a system is? Think of it as an organized way of doing things. Just about all the goods we use – such as clothing, vehicles, and computers – and all the structures we need – homes, schools, and roads – are the result of production systems. There are two major categories of production systems: manufacturing and construction. Manufacturing systems convert materials into products. Construction systems use manufactured items to produce something on site, such as a home.

During the late 1700s, the Industrial Revolution started in England, and production began to shift from the home to the factory. Production systems in the United States grew because of the discovery and development of new materials, the use of interchangeable parts, and the development of the assembly line.

WHAT'S UP IN TECHNOLOGY? illustrates that the introduction of new materials can improve technology. For example, computers became more powerful and efficient when transistors replaced vacuum tubes.

THIS IS YOUR CHALLENGE:

Some materials are stronger than others, but the strength of a material can usually be increased by changing its shape. In this activity, you will test the strength of differently shaped index card columns. In buildings, columns are vertical supports that are usually made of wood, concrete, or steel.



Equipment and Supplies: 3” x 5” index cards, ruler, masking tape, coffee can, sand, scale

Develop Alternative Solutions:

1. Form a team with two other students.
2. As a team, brainstorm how to make 5”-tall columns from a single index card which, when viewed from the end, looks like these geometric shapes – square, triangle, rectangle, and circle.
3. Assemble several different columns of each shape, using no more than 5” of tape.
4. Test each column by placing the coffee can on top and gradually adding sand until the column fails. Weigh the can of sand, and record results.

Select the Best Solution: Discuss the results of your preliminary testing, and determine the best way to make each column.

Implement the Solution: Build and test the final columns. Record the size of each column and test results.

Evaluate the Solution: Which column(s) were the strongest? Why? Compare your results to the data gathered by other teams.

BIOTECHNOLOGY

The products of technology are all around us: furniture, buildings, and even the paper these words are printed on. There is also a whole family of technologies – biotechnology and biorelated technologies – that is not as easy to spot.

Bioprocessing uses microorganisms to change materials. Sound strange? Not really. An example can be found in baking bread, which people have done for thousands of years. When live yeast cells are added to bread dough, they give off carbon dioxide. This creates tiny pockets of air, making the bread light and soft. Modern bioprocessing techniques are used to clean polluted soil and water. Live organisms are mixed into polluted areas to remove pollutants.

Biorelated technologies also include health technology. From artificial joints to vaccines, in recent years this group of technologies has improved our quality of life. The oldest biorelated technologies are used in agriculture. Mechanization has dramatically increased farm production and made farm work easier. Pesticides and fertilizers have made plants bigger, stronger, and insect-resistant. Today, biorelated technologies genetically change the characteristics of plants and animals. These technologies have also changed how we grow plants. The use of environmentally controlled greenhouses and hydroponics (growing without soil) brings agriculture indoors, yielding higher production and faster-growing plants.

GROWING PLANTS HYDROPONICALLY

Equipment and Supplies: one-liter plastic soda bottle, small square of window screening, strip of cloth (50% cotton, 50% synthetic works best), black construction paper, supply of seeds (lettuce, radish, beans, spinach, etc.), vermiculite

Develop Alternative Solutions:

1. Form a team with two other classmates.
2. Research traditional farming techniques. What do plants need to grow?
3. Research the principles behind hydroponic farming.
4. Research the growing requirements for a variety of common plants.
5. Build three growing units as shown in the diagram.

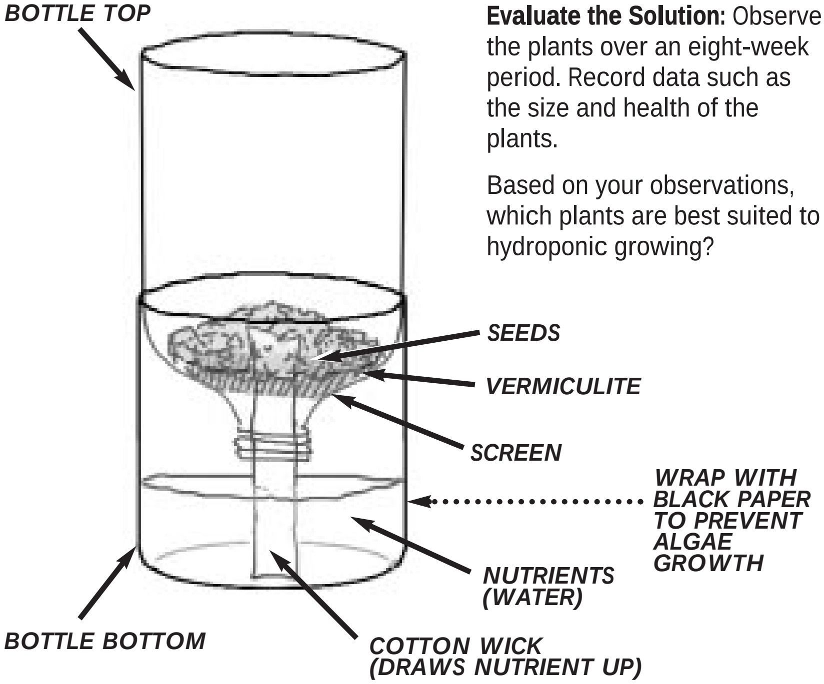
Implement Your Solution:

1. Based on your research, select three different plants to grow. Label your growing units, and place your seeds below the surface of the vermiculite. Be sure not to mix seeds. Only one species of plant may grow in a unit.
2. Pour water through the top of the growing unit and allow it to drain into the reservoir at the bottom of the unit.
3. Check the nutrient level (water) each day.

This is Your Challenge:

Challenge 1. *You and your teammates work for NASA, which is interested in hydroponic technology as a means of growing food in space. You have been asked to conduct an experiment to see which plants grow best hydroponically. Use the plans provided for your growing unit.*

Challenge 2. *There are many different techniques used to provide nutrient solution to the hydroponics plant. In Challenge 1 we used a wick system. Investigate other growing techniques such as drain down and aeroponic systems. Have your team develop an experiment to see which system grows the same plant most efficiently.*



Evaluate the Solution: Observe the plants over an eight-week period. Record data such as the size and health of the plants.

Based on your observations, which plants are best suited to hydroponic growing?

CURRICULUM CONNECTIONS

Communication Systems

Science Connection: What discoveries in science led to the development of modern communication devices?

Math Connection: In communications we often use prefixes to quantify or measure something. Define the prefixes in the following words: megabyte, gigabyte, decibels.

Social Studies Connection: What impact did television have on the Nixon / Kennedy debates of the 1960s?

Careers: Communication technology offers many career opportunities. Can you picture yourself as a graphic artist or video editor? Investigate these and other careers at the library. Access a Web page. What kind of skills would a Web page designer have to have?

Transportation

Science Connection: How does the wet cell generate a flow of electrons? Where are the positive and negative sides of the cell?

Math Connection: The volt meter you used for this activity reads volts and millivolts. What part of one volt is in a millivolt? Create an accurate graph that shows the results of your testing.

Social Studies Connection: What impact did the railroad have on the settlement of undeveloped territory in the United States?

Careers: Transportation technology offers a variety of career opportunities. Could you see yourself as an automotive engineer, mechanic, research scientist, or lab technician? Research these and other opportunities in transportation.

Production

Science Connection: Force is a push or pull applied to an object. Compression is a pushing force. Tension is a pulling force. Torsion is a twisting force. What kind of force was applied to the columns in this activity? How could the columns be tested to determine their strength when subjected to other kinds of forces?

Math Connection: Calculate the volume of each of the final columns. How do they compare?

Social Studies Connection: Why is it important for people to able to work as part of a team? What should a team do when one of its members is not doing his / her share of the work?

Careers: Many industries employ technicians to test the quality of raw materials and finished products. Technicians often have two-year degrees from technical colleges. Contact a local technical or two-year college to learn more about the programs they offer. Find out how successful their graduates are.

Biotechnology

Science Connection: Plants create energy through photosynthesis. Can you explain the process of photosynthesis? Not all plants can be grown hydroponically. What characteristics might a plant have that would prevent it from being grown hydroponically?

Math Connection: Five lettuce plants can grow hydroponically in a square-foot area. How many plants can grow in a 400-square-foot greenhouse?

Social Studies Connection: What impact did biorelated technologies have on the American farmer?

Careers: Biorelated technologies are growing in leaps and bounds. You may want to research careers in the fields of medicine, genetic engineering, botany, agriculture, human factors engineering, and environmental engineering.

UPI/CORBIS-BETTMANN

Plug into the Future

VIDEO CLIP SUMMARY

(Time: 19:35-24:50)

Holly Ng works two hours per day, five days per week in an internship at Intel. The experience connects classroom and workplace learning and enables her to develop technical and work-readiness skills.

OBJECTIVES

Students will

- understand how school-to-work activities connect school and workplace learning
- identify attitudes and skills required by most employers
- prepare to "shadow" an employee in a career of interest

ADVANCE PREPARATION

You will need

- local business/industry contacts

VOCABULARY

shadowing, internship, mentoring, service learning, youth apprenticeship (see below)

RESOURCES

National School-to-Work Learning & Information Center. *Occupational Outlook Handbook*

What Work Requires of Schools: A SCANS Report for America 2000

Intel Web site at www.intel.com

MOTIVATION

Most students are interested in working. This is an opportunity to explain school/career connections. School-to-work activities connect school-based learning and work-based learning, and help students learn what they want to do with their lives and prepare them for the workforce.

Reasons why school-to-work activities are needed:

- The labor market is changing rapidly.
- Most newly created jobs require skilled workers.
- Most high school graduates are not prepared for jobs.
- Skilled workers get higher-paying jobs.
- A skilled workforce attracts good employers.

Common school-to-work activities include:

CAREER AWARENESS activities such as guest speakers and field trips.

SHADOWING introduces students to particular jobs by pairing students with workers one-on-one.

MENTORING allows for a long-term relationship during which the student and mentor work on interpersonal and job skills.

SERVICE LEARNING has students work on community-related projects at an agency or other work site.

INTERNSHIPS are based on one-on-one relationships providing hands-on learning in areas of student interest.

YOUTH APPRENTICESHIPS follow a course of study for high school juniors and seniors that integrates learning at school, learning at the job, and work experience.

PRESENTING THE LESSON

Show the "Plug into the Future" segment of the video. Explain the purpose of school-to-work activities. Describe common school-to-work activities, focusing on internships and shadowing. During internships, students work for an employer for a specified period of time. Job shadowing can help students explore their career objectives as they follow an employee to learn more about an occupation or industry.

In the video, we learned that Holly Ng obtained her internship through the Business Education Compact, a nonprofit organization that links education and industry. Determine if such an organization exists in your school's community.

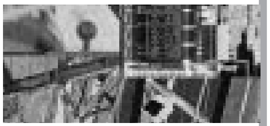
Review skills that are important to employers that can be learned through school-to-work experiences. Holly learned technical skills related to computers and communication skills such as using the telephone, sending email, and dealing with people in an office environment. Ask students to explain why the internship was valuable for both Holly and Intel.

Distribute and explain the "Shadowing" student worksheet. Assign a written and/or oral report. Assist students in locating someone to shadow during a typical workday. Younger students may want to shadow a parent or other relative. Encourage more mature students to make their own arrangements for shadowing. Follow established school procedures.

LESSON WRAP-UP

Use role playing to model an initial telephone contact between a student and someone he/she is asking to shadow. Use information from the student's reports to discuss what was learned. Discuss similarities and differences, and relate the discussion to Holly Ng's experience. As an extension activity, have students create a directory listing local companies that offer shadowing and internship opportunities. Include company name, contact person, telephone number, address, and a brief description of the business.

SHADOWING



In WHAT'S UP IN TECHNOLOGY? you met Holly Ng and learned about her internship experience at Intel. Internships are an important school-to-work activity. During internships, students learn technical skills and other things that employers consider important, such as arriving on time, communicating effectively, and being able to work as part of a team. What specific things did Holly learn during her internship? Employers such as Intel benefit from school-to-work activities because they help develop a supply of capable workers.

Another good way to learn about careers and the workplace is by shadowing an employee who works in an interesting career. During shadowing, you will observe the employee, on the job, for a full day of work. Your parents, a teacher, or a counselor can help you find someone to shadow.

Use the telephone to contact the person you are interested in shadowing. Explain your career interests and desire to gain first-hand knowledge of the workplace. Find out when it is convenient for you to visit, directions to the company, when you should arrive, and where you should park. Call one to two work days ahead to confirm your appointment. Be sure to dress appropriately and arrive on time. Afterward, write the person you shadowed a formal thank-you letter.

SHADOWING REPORT

Following your shadowing experience, you will need to prepare an oral and/or written report. It should cover the points listed below.

- Describe the employee's occupation and duties.
- Describe the working conditions.
- What is the employee's educational background? What school subjects would be most helpful to prepare for this position?
- What does the employee enjoy most about this position?
- What does the employee find most difficult or stressful?
- What recommendations would the employee offer to someone who is interested in entering a similar position?
- In the employee's opinion, what type of attitude or personal traits are important in order to be successful in this career?
- What opportunities are there for advancement in this career?
- Describe this employee's role in supervising others.
- What are the starting salaries and educational requirements for this career?
- What does this company do to encourage its employees to continue their education?

In a final paragraph, describe how the shadowing experience will help you in planning your career.

ALTERNATE ACTIVITY

Research a career of interest in the *Occupational Outlook Handbook* or by using the Internet. Prepare an oral and/or written report based on the points listed for the Shadowing Report above.

*WHAT EMPLOYERS ARE LOOKING FOR**

Basic Skills:
Reads, writes, performs arithmetic and mathematical operations, listens and speaks
Thinking Skills:
Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reason
Personal Qualities:
Displays responsibility, self-esteem, sociability, self-management, integrity, and honesty

COMPETENCIES

Resources:
Identifies, organizes, plans, and allocates resources
Interpersonal:
Works with others
Information:
Acquires and uses information
Systems:
Understands complex interrelationships
Technology:
Works with a variety of technologies

*adapted from *What Work Requires of Schools* (see Resources listing)

Resources

School-to-Work

Organizations

American Vocational Association
1410 King Street
Alexandria, VA 22314
1-800-826-9972
www.avaonline.org

The largest national education association dedicated to the advancement of vocational education. Its mission is to provide educational leadership in developing a competitive workforce. The AVA also publishes a school-to-work (STW) newsletter monthly online at www.avaonline.org/reporter.html

American Youth Policy Forum
1836 Jefferson Place, NW
Washington, DC 20036
(202) 775-9731
www.aypf.org

Provides learning opportunities for policy makers – legislative staff, government officials, researchers, and advocates – working on youth issues at the local, state, and national levels. The forum focuses on "youth development," and the scope of issues includes youth community service and the transition to careers.

Jobs for the Future
88 Broad Street
Boston, MA 02110
(617) 728-4446
www.jff.org

Works to enhance economic security and access to opportunity for all individuals by strengthening the transitions and linkages between learning and work. Conducts research, proposes policy innovation, designs systems, and provides technical assistance to help people and regions adapt to change. A publications list and order forms are available from Jobs for the Future's Web site at www.jff.org/publications/index.shtml

National School to Work Learning and Information Center
400 Virginia Avenue, Room 150
Washington, DC 20024
800-251-7236
www.stw.ed.gov

This Information Center is a service of the U.S. Department of Education. It offers general information about school-to-work, grant listings, outreach tools, research and evaluation information, and more. The Web site also includes a template for building school-to-work systems and a bulletin board for STW practitioners.

Publications

Olson, Lynn. *The School-to-Work Revolution: How Employers and Educators Are Joining Forces to Prepare Tomorrow's Skilled Workforce.* New York: Addison Wesley, 1997.

Steinberg, Adria. *Real Learning, Real Work: School-to-Work as High School Reform.* New York: Routledge, 1997.

Stern, David, M. Raby, and C. Dayton. *Career Academies: Partnerships for Reconstructing American High Schools.* San Francisco: Jossey-Bass, 1992.

U.S. Department of Labor, Bureau of Labor Statistics Staff. *Occupational Outlook Handbook,* 1998-1999 edition. Lincolnwood, Ill.: Vgm Career Horizons, 1998. Web site at stats.bls.gov/ocohome.htm

U.S. Department of Labor. *What Work Requires of Schools: A SCANS Report for America 2000.* The Secretary's Commission on Achieving Necessary Skills, June 1991. Available from the National Technical Information Service (NTIS), Operations Division, Springfield, VA 22151, (703) 487-4650. NTIS number: PB92-146711. Excerpts can be found at www.academicinnovations.com/report.html

Technology Education

Organizations

International Technology Education Association
1914 Association Drive
Reston, VA 22091
(703) 860-2100
www.tmn.com/Organizations/Iris/ITEA.html

Association of technology-education teachers and supervisors in elementary, secondary, and higher education.

Junior Engineering Technical Society
1420 King Street, #405
Alexandria, VA 22314-2715
(703) 548-JETS
www.asee.org/jets/index.html

Society for high school students interested in math, science, technology, and engineering; chapters in 50 states.

Technology Student Association
1914 Association Drive
Reston, VA 22091
(703) 860-9000
www.tsa.www.org

Association of elementary, junior high, and senior high school technology-education students. Goals are to help students make informed decisions about jobs through experiences in technology programs and to help prepare them for entry into technology-related careers.

Publications

Technology for All Americans

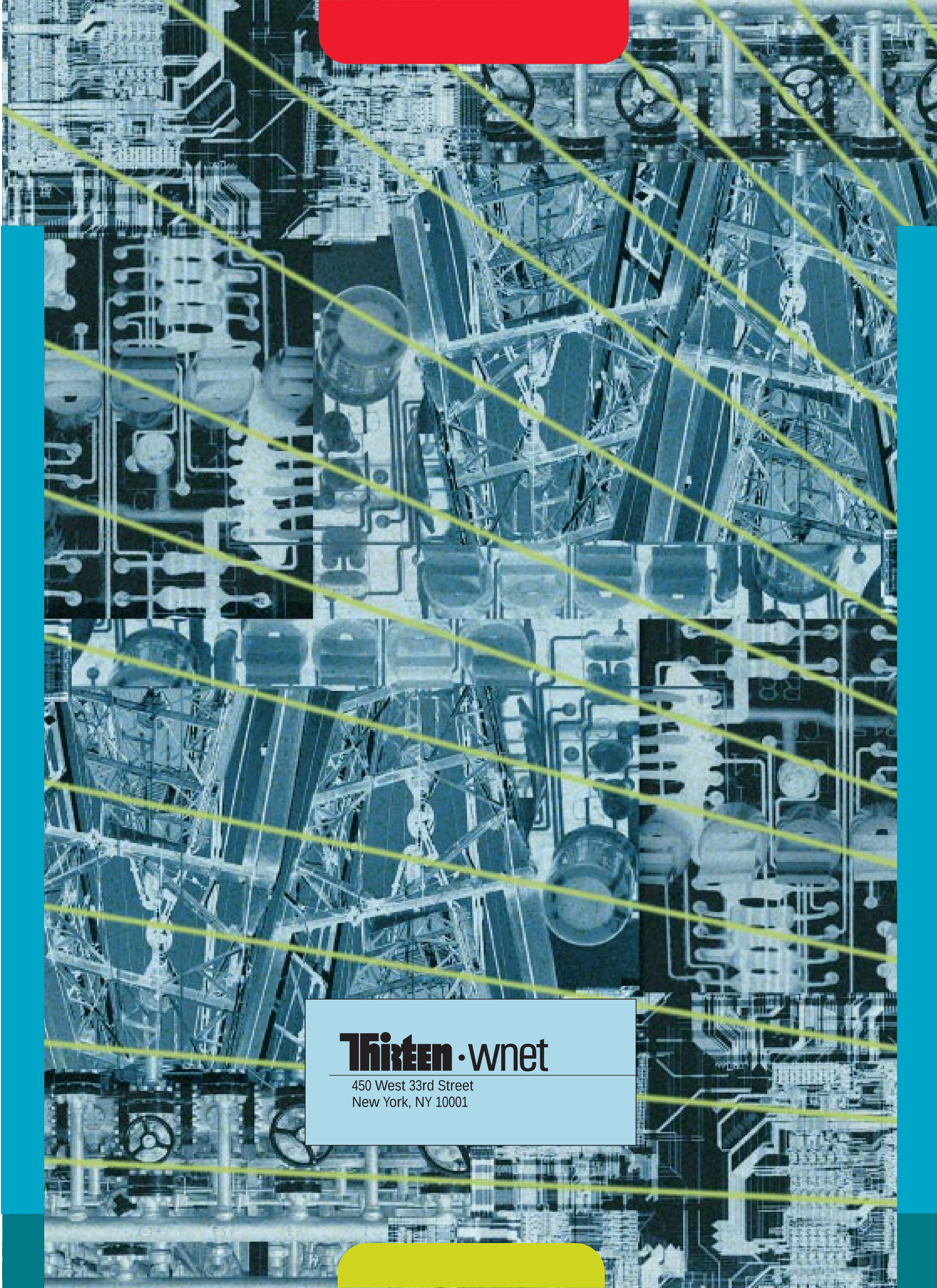
Technology for All Americans (TAA) is a project to develop national standards for K-12 education. All aspects of technology will be included in the standards, as well as relationships with such allied disciplines as science, mathematics, and engineering.

Copies of *Technology for All Americans: A Rationale and Structure for the Study of Technology* are available for purchase for $10 (International Technology Education Association members) and $15 (non-members), plus postage and handling, from the International Technology Education Association, phone (703) 860-2100, fax (703) 860-0353, email itea@iris.org.

For more information about TAA, contact: Technology for All Americans, 1997 South Main Street, Suite 701, Blacksburg, VA 24061-0353, (540) 953-0203, scholar.lib.vt.edu/TAA/TAA.html

Ties: The Magazine of Design and Technology Education
103 Armstrong Hall
The College of New Jersey
P.O. Box 7718
Ewing, NJ 08628-0718
(609) 771-3333
www.tcnj.edu/~ties/

Ties is a non-profit magazine that supports technology education and the integration of math, science, and technology curriculum primarily in middle and junior and senior high schools. It emphasizes design and problem-solving as an instructional technique. Published six times a year, Ties is available free of charge to teachers and school administrators in the United States.



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