STEM

science | technology | engineering | math

Introduction

The STEM Essentials modules were designed to be used in a variety of classroom settings. They can be used as whole class discussions, with small groups of interested students, or even with individual students who need a new challenge. The goal of these activities is to give students exposure to a spectrum of STEM fields and careers. By giving students an opportunity to hear about and learn about STEM careers the hope is that it will spark one student's interest to learn more about a specific topic, one student will discover hidden or unknown skills and talents, or one student will set higher goals and realize the opportunity that is in front of him/her.

We each look at the world in a different way or from a different perspective. Think about the sky. Some students will look at the sky and want to paint a picture depicting the beautiful colors of a morning sunrise or the deep vivid colors of a sunset. Others will want to write a poem or a song to express how it makes them feel. Still others will look at the sky and want to meditate on the meaning of life. Some students would want to study the clouds to see if they could predict the weather. And then there are students who don't want to just look at the sky, they want to explore it. . .to be a part of the final frontier. Think about these many responses—and we all looked at the same sky. That is what STEM Essentials does---it is providing the opportunity to challenge students to respond to topics, each in their own individual way.

Besides the teaching support found below, there are also additional readers that have been referenced at the end of each module. These materials are available for purchase from McGraw-Hill and continue the study for students who are interested. At the end of each grade span you will find a listing of the top 20 Engineering disciplines. This can be a resource to guide students interested in specific topics.

Technology A Closer Look

Title	Using the STEM Lessons	Making a STEM Connection
Technology A Closer Look	**Lesson 1** *What is Technology?* **pp.** *4–6*	Use resources from ***Engineering Marvels*** to expand upon this lesson. ***Engineering Marvels*** *Foods that Feed the World* *Farming for the Future—How Do We Feed Ourselves* *Microwaves and Cooking* *From Dragonflies to Helicopters—Learning from Nature* *Sonar, Radar, and Laser* *The Smithsonian: America's Attic*
	Lesson 2 *The Design of Things* **pp.** *7–9*	Use resources from ***Architecture, The Space Frontier,*** and ***Engineering Marvels*** to expand upon this lesson. ***Architecture*** *A New Pyramid for Paris* *Build a Biome* *Build a Cathedral* *The Taj Mahal* ***The Space Frontier*** *Life on a Space Station* *Mission to Mars* *Looking to the Sky* *Space Station* *What Is GPS?* *Finding Our Way* ***Engineering Marvels*** *Foods that Feed the World* *Farming for the Future—How Do We Feed Ourselves* *Microwaves and Cooking* *From Dragonflies to Helicopters—Learning from Nature* *Sonar, Radar, and Laser* *The Smithsonian: America's Attic*
	Lesson 3 *Technology in Communications* **pp.** *10–12*	Use resources from ***Engineering Marvels*** to expand upon this lesson. ***Engineering Marvels*** *Foods that Feed the World* *Farming for the Future—How Do We Feed Ourselves* *Microwaves and Cooking* *From Dragonflies to Helicopters—Learning from Nature* *Sonar, Radar, and Laser* *The Smithsonian: America's Attic*

Technology A Closer Look

Title	Using the STEM Lessons	Making a STEM Connection
Technology A Closer Look	**Lesson 4** *Technology in Medicine* **pp.** *13–15*	Use resources from ***Engineering Marvels*** and ***Genetics and Medicine*** to expand upon this lesson. ***Engineering Marvels*** *Foods that Feed the World* *Farming for the Future—How Do We Feed Ourselves* *Microwaves and Cooking* *From Dragonflies to Helicopters—Learning from Nature* *Sonar, Radar, and Laser* *The Smithsonian: America's Attic* ***Genetics and Medicine*** *Genetics* *The Story of DNA* *DNA Fingerprinting* *Science in the Snow* *Search for Cures* *Nuclear Medicine*
	Lesson 5 *Technology in Industry* **pp.** *16–18*	Use resources from ***Engineering Marvels*** to expand upon this lesson. ***Engineering Marvels*** *Foods that Feed the World* *Farming for the Future—How Do We Feed Ourselves* *Microwaves and Cooking* *From Dragonflies to Helicopters—Learning from Nature* *Sonar, Radar, and Laser* *The Smithsonian: America's Attic*
	Lesson 6 *Technology of the Future* **pp.** *19–21*	Use resources from ***Architecture, The Space Frontier,*** and ***Genetics and Medicine*** to expand upon this lesson. ***Architecture*** *A New Pyramid for Paris* *Build a Biome* *Build a Cathedral* *The Taj Mahal* ***The Space Frontier*** *Life on a Space Station* *Mission to Mars* *Looking to the Sky* *Space Station* *What Is GPS?* *Finding Our Way* *Continued...*

Technology A Closer Look

Title	Using the STEM Lessons	Making a STEM Connection
Technology A Closer Look	**Lesson 6** *Technology of the Future* **pp.** *19–21*	***Genetics and Medicine*** *Genetics* *The Story of DNA* *DNA Fingerprinting* *Science in the Snow* *Search for Cures* *Nuclear Medicine*
	Lesson 7 *Exploring the Impact of Technology on Society* **pp.** *22–24*	Use resources from ***Architecture, The Space Frontier, Uses of Natural Resources*** and ***Energy Power*** to expand upon this lesson. ***Architecture*** *A New Pyramid for Paris* *Build a Biome* *Build a Cathedral* *The Taj Mahal* ***The Space Frontier*** *Life on a Space Station* *Mission to Mars* *Looking to the Sky* *Space Station* *What Is GPS?* *Finding Our Way* ***Uses of Natural Resources*** *Mission: Green Earth* *Plants: An Amazing Resource* *Technology and Nature: Water* *Garbage: Where Does It Go?* *Greenhouse Effect* ***Energy Power*** *Energy Problems and Solutions* *Powered by the Sun* *Energy Hunter* *Do Fossil Fuels Have a Future?* *Power for Our Future* *Searching for Tomorrow's Energy*
Science Fair Handbook	Can be used with any lesson to further explore STEM fields and careers. This book is available for purchase from McGraw-Hill. ISBN 0-02-285258-1	

Lesson 1 What is Technology?

Objectives

- Understand that technology offers solutions to human problems, needs, and goals
- Recognize the reciprocal relationship between science and technology

1 Introduce

▶ Assess Prior Knowledge

Explore what students know about technology by asking:

- **What technology have you used today? How did it help you?**
- **What technology did your great-grandparents have?**

Have students give examples of modern technology, including clothing, food, TV, cell phones, cars, medicine, lightbulbs, eyeglasses, and many other everyday products.

2 Teach (Student pages 2–5)

▶ Discuss the Main Idea

Help students understand that technology is as old as the human race.

- **How do humans use technology to adapt or alter nature to meet their needs and wants?** *(Technology means humans design, develop, manufacture, and sell new or improved machinery and equipment. These products, such as furniture and paper, often solve practical everyday problems.)*

▶ Use the Visuals

What Is Technology? Using the text, photos, and diagram on pages 2 and 3, point out that advances in technology can lead to the growth of other industries. Guide students to conclude that new technology often means new jobs for workers, who then help the economy by spending money they earn on food, housing, and other necessities.

Quick Check

People might improve technology, which might require other inventions and industries to support it (e.g., oil refineries, manufacturing plants).

Tech Activity

small groups or whole class

20 minutes over 2 days

Objective To use science to achieve a technological solution

Plan Ahead Find a sunny place where students' set-ups will not be disturbed.

Tips Have students observe the water collected in the glass.

- **Without tasting the water, how could you test it for salt?** *(Allow the water to evaporate. Does any salt remain?)*

Explore More Have students repeat the experiment on different days to see how weather affects the rate of evaporation.

Science and Technology Read the text and scan the transportation time line on pages 4 and 5. Stress the interdependence between science and technology. Explain that many technological advances improve on technology that came before. Have students keep this idea in mind as they discuss the transportation time line.

Quick Check

Greater knowledge of science can lead to new technologies. New tools and instruments can help scientists learn more about the world.

Technology in Action

Right on Track!

Write About It Student research should reveal that mass transit systems address transportation problems, such as traffic jams and pollution. The following is an outline of a student journal.

- **Problem** Crowded roadways leading from Place A to Place B.
- **Solution** Create bus route from Place A to Place B.
- **Plan** Design bus route; estimate costs (equipment, bus drivers, etc.); propose plan to appropriate legislative body; develop ad campaign to encourage motorists to use mass transportation.

3 Close (Student page 7)

Think, Talk, Write

Students may answer questions independently or in a group. **Answers:**

1. *Students should include idea of adapting nature to meet human needs.*
2. ***(A)** Cars could not operate without gasoline or roadways.*

   ***(B)** People would not have the knowledge needed to maintain or improve the technology.*
3. ***(A)** people; **(B)** principles; **(C)** electrical properties of silicon; **(D)** hand-in-hand*
4. *Speed has increased.*
5. *horse and steam train*

Writing Link Student writing should include information from the main headings of Lessons 2 through 7 of this book.

Extend

Extra Activity Copy and distribute **Lesson 1** worksheet on page 48 of this booklet.

Art Link

Technology Posters Challenge students to use technology to make a poster about technology. Materials can include such forms of technology as paper, markers, pictures, scissors, glue, and a computer. Invite students to discuss their posters with the class.

Differentiated Instruction

Leveled Activities

EXTRA SUPPORT Invite students to find examples of *technology* in magazines and newspapers. Challenge them to name and describe the items.

ENRICHMENT Have students organize a section of the lesson into the main idea and supporting details.

STEM Encourage interested students to choose a topic or product such as the light bulb, telephone, computers, playing music, TV, communication, and so on, that they are interested in learning more about. Have them research the key inventions and milestones that have occurred and the influence that has had in creating the products we have today. Students can predict where they think this product line will be in five years.

Name _____ Date _____

What Is Technology?

You have entered the Savannah Grand Challenge. You must design a vehicle to transport a pair of adult elephants 400 miles across the African Savannah to a wildlife sanctuary.

Materials

- paper
- pencil

Instructions

1. List the problems you will encounter in transporting the animals.

Answers will vary.

2. Draw a diagram showing the top, side, and rear of the vehicle. Label the parts, including wheels, body, axles, and cargo area.

3. List the materials you will use to build the vehicle. Tell how it solves the problems you noted.

Answers will vary.

4. Explain why you think the vehicle will work.

Answers will vary.

5. Optional. Build a model of your vehicle and test it. Test it against the vehicles designed by your classmates.

Lesson 2 The Design of Things

Objectives

- Understand that developing a technology involves a step-by-step process
- Identify a design problem and propose possible solutions

1 Introduce

▶ Assess Prior Knowledge

Discover what students know about the design process.

- **How might an idea be turned into a product?**
- **What is a design?**

As students share ideas, help them to understand that new product designs often improve on existing designs.

2 Teach (Student page 8–13)

▶ Discuss the Main Idea

Stress the link between design and technology.

- **What part does a designer play in producing new technology?** *(A designer takes an idea for a product and comes up with a detailed plan for making the product a reality.)*

▶ Use the Visuals

The Design of Things Read the text and scan the visuals on pages 8 and 9. Stress that the design process involves problem solving and may improve existing technology or create new products.

Quick Check

A design develops from an idea that is meant to solve a problem or fill a need. The designer makes a detailed plan, which then can be turned into a product.

Tech Activity

small groups or individuals

20 minutes

Objective To use the design process to improve a technology

Plan Ahead Have students bring in old newspapers to use for their airplane designs.

Tips Have students write notes evaluating their airplane's design. What worked? Did not work?

Explore More Have students repeat the experiment, this time modifying their designs to fly higher and farther. How do the new designs compare with the originals? What conclusions can students draw about their design improvements?

The Design Process Read the text, charts, and diagram on pages 10 and 11. Discuss the design process, from identifying a problem to proposing solutions to designing a solution.

Quick Check

Constraints are obstacles to a solution that designers must identify and overcome, if possible. (Examples: Would the design require expensive, hard-to-obtain materials?) Criteria are ways to evaluate the pros and cons of a design solution. (Examples: Can we design this solution using affordable, easily obtained, safe materials?)

Engineers and Their Work As you read the text and study the photos on pages 12 and 13, have students discuss the different fields of engineering. Discuss the history of computer technology (page 13) as an example of how the design process evolves through innovations to the existing design.

Quick Check

Types of engineers include civil (community projects), aerospace (build and test jets, rockets, spaceships), mechanical (design machines using scientific principles), biomedical (develop pacemakers and artificial limbs).

Technology in Action

Designing Safer Cars

Write About It Student journals should include the survey they have designed; a chart or graph showing responses to the survey; an analysis of the survey to identify a need; research into various solutions; a schematic showing the best solution to the problem.

3 Close (Student page 15)

Think, Talk, and Write

Students may answer questions independently or in a group. **Answers:**

1. *identify problem, think up solution(s), develop a schematic, list materials and costs, build model, build prototype, test prototype, modify design, retest*
2. *The design process requires taking a specific series of steps to get the job done. The steps in the process might change, depending on the project. Building a new product from scratch, for example, would require more steps than improving on an already existing product.*
3. *The computer evolved based on the human need to count things. The first computer weighed about 30 tons, but as technology gradually improved (with the invention of the transistor and then the microchip), computers became smaller and capable of performing a large number of tasks.*
4. ***(A)** transistor; **(B)** airbag; **(C)** survey; **(D)** design; **(E)** prototype; **(F)** schematic; **(G)** sensors; **(H)** models*
5. ***(A)** solution; **(B)** schematic; **(C)** transistors conducted electricity faster and weighed much less than vacuum tubes; **(D)** using microprocessors to determine when and how to deploy the airbags*
6. *Correct order: 8, 5, 1, 4, 2, 7, 11, 9, 6, 10, 3*

Writing Link Students might wish to share their letters with the class.

Extend

Extra Activity Copy and distribute **Lesson 2** worksheet on page 51 of this booklet.

STEM Encourage students to find examples of new designs in magazines or take pictures of products in stores that feature cutting-edge products. Students can compare the former version or model with the new—identifying features that make the new product better. Good examples of innovative products are sweepers, hand dryers, and fans from the Dyson Company or new models of cars.

Name _____ Date _____

The Design of Things

Reveal the hidden sentence. First fill in the term that fits each definition. Then find each term in the puzzle and circle it. The letters that remain will form a sentence. Write the sentence on the lines provided.

Fill in the blanks.

1. detector S E N S O R
2. full-size working model of a design P R O T O T Y P E
3. small-scale objects built to design specifications M O D E L S
4. this item replaced the vacuum tube T R A N S I S T O R
5. questions designed to investigate the experience of a group of people S U R V E Y
6. a plan for making a new product or improving an old one D E S I G N
7. inflates to protect a person in a car crash A I R B A G
8. detailed diagram of a design idea S C H E M A T I C

Word Search

B	E	F	O	M	R	E	P	Y	O
S	E	N	S	O	R	U	R	M	A
K	E	A	N	D	E	W	O	P	R
O	S	C	H	E	M	A	T	I	C
D	U	U	C	L	T	Y	O	O	U
T	R	A	N	S	I	S	T	O	R
N	V	E	E	D	T	O	Y	C	O
M	E	E	U	P	A	W	P	I	T
H	Y	A	N	G	I	S	E	D	D
E	S	I	G	N	R	M	A	K	E
A	M	O	D	E	B	L	A	N	D
T	E	S	T	A	A	P	R	O	T
O	T	Y	P	E	G	O	F	I	T

Hidden Sentence

Before you make a new product you need to come up with a design, make a model, and test a prototype of it.

Lesson 3 Technology in Communications

Objectives

- Describe how technology has changed communication
- Explain how systems are used in technology
- Describe the future of communication systems

1 Introduce

▶ Assess Prior Knowledge

Discover what students know about technology in communication.

- **What is communication?**
- **What part does technology play in how people communicate?**

2 Teach (Student pages 16–21)

▶ Discuss the Main Idea

Highlight the connection between communication and technology.

- **From 1844 to the present, how has technology changed the way people communicate?** *(communication technology has evolved from telegraph to telephone to radio to computer to cell phone)*

▶ Use the Visuals

Technology in Communication Read the text and scan the time line on pages 16 and 17. Discuss the evolution of the communications systems.

Quick Check

Before electricity, people communicated by talking and writing. The discovery of electricity led to inventions that allowed quick communication over long distances.

Communication Systems Read the text on pages 18 and 19. Discuss the idea that various systems must be in place for communications technology to work.

Quick Check

Both systems depend on a group of separate parts that work together. However, body systems are natural and depend on inputs such as air and food. Communication systems are artificial and often use electricity to function.

Picture That! Read the text and scan the visuals on pages 20 and 21. Discuss how producing and communicating images has changed as technology has advanced.

Quick Check

Movies and photographs are both technologies that record images. Both can be digital or film based. Movies also record sound and show movement.

Tech Activity

individual 20 minutes

Objective Understand film technology by creating a primitive movie.

Plan Ahead Bring in a manufactured flipbook ahead of time for students to see. Have paper and coloring tools ready and organized for student use.

Tips Using transparent paper will allow students to trace portions of the previous image and speed up the drawing process.

Explore More Have students flip their books from front to back and back to front, first quickly and then slowly. Have them describe what they see. What can they tell about how movies work?

Technology in Action

That Colorful TV

Write About It Student research should reveal that television has impacted society profoundly. Student writing should include the following:

- The first TVs were in grayscale (black and white), then were colorized. New advancements include digital TVs, High-Definition TVs, plasma TVs, and LCD TVs.
- Television has allowed people to see world events as they happen or very soon afterward. They may give examples of these events and how news commentary impacted the way the public perceived these events.
- Television has changed entertainment and culture.

3 Close (Student page 23)

Think, Talk, and Write

Students may answer the questions independently or in a group. **Answers:**

1. *Technology has increased the speed, distance, and number of people we can communicate with.*
2. *The Internet links a system of computers and files. The World Wide Web contains information and files that a computer can tap into.*
3. *Sequence*
   - *Light bounces off objects, enters the camera lens, separates into the three basic colors, and hits image sensors in the camera to create video signals.*
   - *Radio waves transmit the video signals from the TV station to your TV, which decodes and sends them to electron guns behind the TV screen.*
   - *Each gun shoots a beam of electrons through a cathode ray tube. The beam is projected onto the back of the TV screen.*
   - *Pixels glow when hit by electrons and produce the image you see.*
4. *Order (1) language; (2) writing; (3) camera; (4) telephone; (5) television; (6) Internet; (7) cell phones*
5. ***(A)** ideas and information; **(B)** pony express or stagecoach; **(C)** radio waves; **(D)** fiber optics; **(E)** process; **(F)** wireless*

Art Link Students' work should demonstrate an ability to use computers to create digital art.

Extend

Extra Activity Copy and distribute **Lesson 3** worksheet on page 54 of this booklet.

Differentiated Instruction

Leveled Activities

EXTRA SUPPORT Have students draw a picture showing a form of technology in use. Discuss the images as a class. Which technology is depicted? How is it being used?

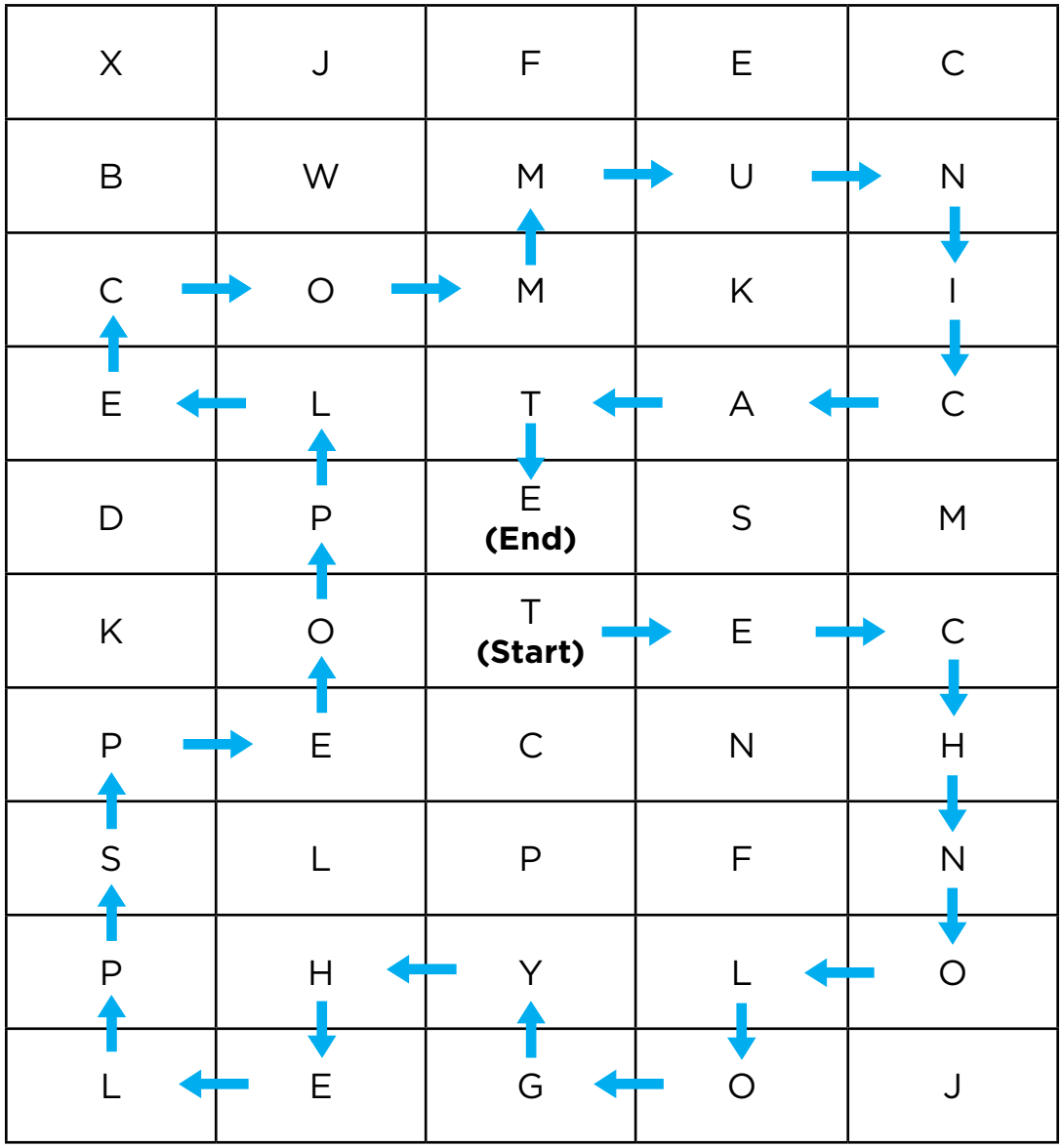
ENRICHMENT Have students use Morse code to send a message to a partner.

STEM Have students compare the latest technology to those just read about---including cameras and video cameras in your phone, iPod, iPhones, iPads, HD TVs, and so on—giving the new capabilities and how each has impacted society or the way we live our daily lives.

Name _____ Date _____

Technology in Communications

Work through the *Message Maze*. Starting with the letter T find the hidden message by moving to neighboring letter boxes, connecting the boxes to form words. Each letter box is used only once, and the path does not go diagonally.



Message

Technology helps people communicate.

Lesson 4 Technology in Medicine

Objectives

- Explain that people have used medical technology since prehistoric times
- Identify modern medical technologies and techniques
- Describe the positive and negative benefits of biotechnology

1 Introduce

▶ Assess Prior Knowledge

Discover what students know about how technology impacts the medical field.

- **What is medical technology?**
- **What are some of the latest developments in medical technology?**

As students share ideas, help them understand that in the past two decades we have seen significant advances in medical technology.

2 Teach (Student pages 24–29)

▶ Discuss the Main Idea

Stress the history of medical technology.

- **How has medical technology evolved throughout history to prevent and combat diseases?** (*Our ancestors used medical technology to treat disease. Over time, scientists learned more about what caused diseases. This knowledge led to better medicines to treat diseases as well as ways to prevent them.)*

▶ Use the Visuals

Technology in Medicine Look at the photographs on pages 24 and 25. Discuss the relationship between the white willow tree and aspirin. Help students to conclude that chemicals obtained from plants can be used to make medications to prevent disease or combat the symptoms of disease. Point out that medical technology began with the use of natural things, such as plants, to treat diseases.

Quick Check

The injections serve to help your body develop a defense against the stronger microbes.

Modern Medical Technology Read the time line of medical advances, and explore the photos and captions on pages 26 and 27. Help students to conclude that the field of medical technology has advanced quickly since the discovery of penicillin in 1928.

Quick Check

EKG machines, CAT scans, MRI devices, X rays, lasers, endoscopes, and pacemakers

Tech Activity

small group or individual — 30 minutes

Objective To make a robotic hand to help students understand modern medical technologies and techniques

Plan Ahead Have a variety of craft supplies available for students to use.

Tips If students are having difficulty building the robotic hand, have them research artificial limbs or robotics on the Internet to jog the imagination.

Explore More Have students attempt to pick up a variety of objects with their robotic hand. Have students consider revising the design to increase the hand's capabilities.

Into the 21st Century! As you read pages 28 and 29, discuss the use of robotics in medical technology and genetic engineering in farming. Point out that each science has negative side effects. Have students discuss examples of the benefits and risks of each.

Quick Check

Biotechnology can save trees from gypsy moths, but butterflies may be killed in the process.

Technology in Action

Spare Body Parts

Write About It Student research should reveal that today's prosthetic limbs feel more like the real thing, allowing recipients to feel temperature and pressure (touch), for example. Student journals should include the following discussions:

- Today, scientists make prosthetic limbs from modern materials, such as fiberglass, instead of metal and wood.
- Nerve connections between the artificial limb and the body are made at the amputation site or using other body sites.
- Do these technological changes improve the lives of people who use prosthetics?

3 Close (Student page 31)

Think, Talk, and Write

Students may answer questions independently or in a group. **Answers:**

1. *Medical technology helps prevent illness; it also helps doctors diagnose and treat illness.*
2. *In prosthetics, for example, feedback from a microcomputer analysis of a person's movements allows technicians to adjust the prosthetic to give the right amount of support.*
3. ***(A)** genetics; **(B)** biotechnology; **(C)** prosthesis; **(D)** laser*
4. *X rays provide a flat, two-dimensional picture of hard body parts like bones.*
5. *folk medicine, genetics, penicillin, vaccinations, DNA, MRI, organ transplant*

Writing Link Have students share their product ideas.

- **What medical problems do you know of that need a solution?**

Social Studies Link Invite students to share the Native American medicines that they have researched with the class. Have them discuss any relationships between the plants that the Native Americans used and modern medicines.

Extend

Extra Activity Copy and distribute **Lesson 4** worksheet on page 57 of this booklet.

Art Link

Medicine Pamphlet Challenge students to design a pamphlet explaining to a prospective patient one type of medical technology. Have students include pictures or drawings of the technology.

STEM Have students research to find what new medicines or treatments are currently being tested by the FDA. Ask, How do you think scientist decide what to work on—what medicine, vaccine, or treatment? How would funding or personal interest play a part or would they? Why would people want to be a part of the testing group? Ask students if they would want to be a part of the test group---why or why not?

Name _____ Date _____

Technology in Medicine

Today more than four million people use artificial limbs, called prostheses, which look, feel, and move more like the real thing. Try this exercise to better understand the challenges faced by scientists who develop artificial limbs.

Objective

Work with a partner and take turns mirroring each other as you move one of your body limbs.

Instructions

1. Stand face to face with a partner.
2. One partner begins by moving a limb. The other mirrors the movement.
3. Switch roles. Repeat about five times, each time moving a different limb. Notice how fast your reflexes work to move your limbs.
4. Now choose one of your partner's limbs to observe throughout the day, as you do different tasks. Notice such details as range of motion, direction, and speed.

Draw Conclusions

Use the library or Internet to research ways that scientists develop more responsive and realistic artificial limbs?

Answers will vary, but should reflect student's research.

Lesson 5 Technology in Industry

Objectives

- Define and describe the term *industry*
- Understand the effects of computers, robots, and mass production on industry
- Identify the byproducts and wastes produced by industry

1 Introduce

▶ Assess Prior Knowledge

Discover what students know about producing goods and providing services.

- **What are goods? What goods have you used today?**
- **What are services? What services have you used today?**
- **Where and how are goods produced?**
- **What is a business?**

As students share ideas, help them understand that businesses produce goods and provide services—that the term *industry* is another word for business. Industries have particular branches, such as the car or tourist industry.

2 Teach (Student pages 32–37)

▶ Discuss the Main Idea

Stress the definition of an *industry*: the processing of raw materials and manufacture of goods in factories.

- **How does technology benefit industry?** *(Industry uses technological advances to produce more in less time.)*

▶ Use the Visuals

Technology in Industry Review the diagram on page 32 and discuss the different industries shown.

- **What do these different industries work together to do?** *(make textbooks)*

Help students conclude that industries work together to make goods. As you read the text on pages 32 and 33, make sure students understand that the manufacturing process has evolved throughout history.

Quick Check

With mass production, more goods could be made in less time, which allowed manufacturers to sell the goods at lower prices.

The Age of Machines and Computers Read the text and visuals on pages 34 through 36. Discuss the evolution of industry. Point out the key role computers and robotics will play in the future of industry.

Quick Check

Robots lift heavy objects, assemble things, perform dangerous tasks, and work with hazardous materials.

Tech Activity

small group or individual — 30 minutes

Objective To test materials to make a bridge

Plan Ahead Have supplies available for students.

Tips Students should observe that pleating and folding the paper improves the strength of the bridge.

Explore More Have students test how many cars their bridge holds before it collapses.

The Bad News As you read page 37, discuss the by-products of technology, noting that improvements in technology can help reduce ill effects. Discuss the cause-and-effect relationship between the need to protect the environment against the hazardous by-products of industry and the practices of reusing, reducing, and recycling.

Quick Check

perform tasks more quickly; lift heavy objects; explore distant planets; explore ocean depths

Technology in Action

Power Up with Biomass Conversion!

Student research should focus on one type of biomass fuel and include costs and benefits. Letters should contain convincing arguments on how benefits outweigh costs. Student journals should include the following information:

- Biomass converts plant/animal waste to fuel.
- How the biomass fuel is produced.
- Advantages and disadvantages of the biomass fuel.

3 Close (Student page 39)

Think, Talk, and Write

Students may answer questions independently or in a group. **Answers:**

1. *Technology has allowed industries to make products more quickly through the use of assembly lines, computer technology, and robotics.*
2. *Input can be raw materials or ideas. Process involves the steps in creating a product. Output is the product. Feedback can include safety tests or letters from consumers like you!*
3. *Technologies increase productivity but often create great amounts of waste and pollution.*
4. *coal*
5. ***(A)** less, more; **(B)** business, trade*
6. ***(A)** business; **(B)** assembly; **(C)** robots; **(D)** textiles; **(E)** biomass; **(F)** machines*
7. *Student webs should link at least three different industries into the product or service. Students should accurately describe each industry.*
8. *Student brochures should give detailed information about the industry. Students should also reference their sources of information.*

Extend

Extra Activity Copy and distribute **Lesson 5** worksheet on page 60 of this booklet.

Art Link

Robot Ads Have students design an ad for a robot that cleans. Have students draw the robot performing several different tasks.

Differentiated Instruction

Leveled Activities

EXTRA SUPPORT Invite students to define *mass production* in their own words.

ENRICHMENT Challenge students to explain how mass production helps provide us with less expensive products.

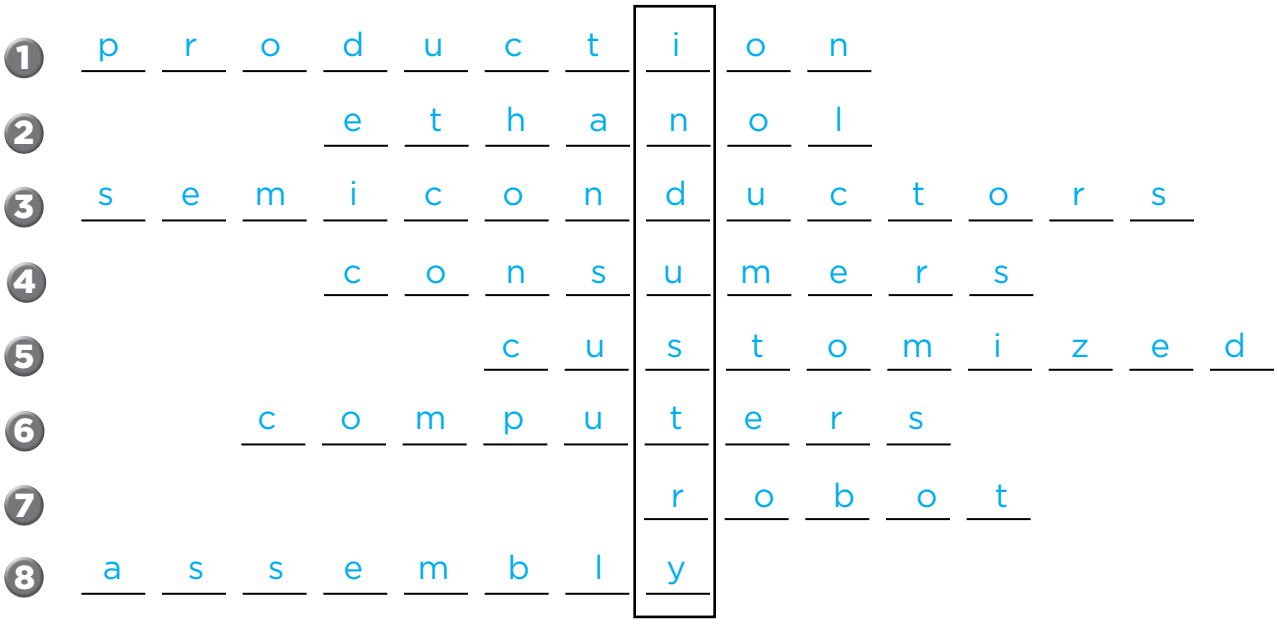
STEM Find out how your school disposes of old computers and other hazardous waste. As a class, work with your school district or local EPA to organize a hazardous waste day—an opportunity for people to bring in old batteries, telephones, computers, and other such items that need to be disposed of properly. Students can help organize and write the communication out to the community about the planned events and the importance of such events.

Name _____ Date _____

Technology in Industry

Industry refers to all the businesses that produce and sell goods or provide services. Different industries make many of the products you use every day.

Fill in the puzzle below with a word that describes each statement. Another word is spelled vertically in the box.



1. the manufacture of more units in less time is called mass _____
2. comes from corn and sugar cane
3. chips that store and move information in comptuers, phones, cars, and other products
4. people who buy things
5. specially made
6. can be used to manufacture machines, solve problems, process data and store information
7. a machine that automatically performs a task over and over again
8. _____ lines are used in mass production

Complete the sentence below with the word in the box.

_____ Industry _____ is another word for a business or trade.

Lesson 6 Technology of the Future

Objectives

- Explain the early stages of nanotechnology
- Describe how materials made using nanotechnology differ from other materials
- Identify ways nanotechnology may impact us in the future

1 Introduce

▶ Assess Prior Knowledge

Discover what students know about the future of technology. Advise students to let their imaginations run free in answering the following question:

- **What changes might you see in the technology of the future?**

As students share their thoughts, focus the discussion on the definition of nanotechnology. You may want to share that *nano* is the Greek term for *dwarf*. Help students understand that the ability to manipulate the tiniest building blocks of matter has implications for the future of technology.

2 Teach

▶ Discuss the Main Idea

Stress that nanotechnology uses very small particles to accomplish tasks.

- **What are some of the advantages of the types of molecules and atoms scientists use in nanotechnology?** *(Nanotubes are many times stronger than steel and great conductors of heat and electricity.)*

▶ Use the Visuals

Technology of the Future Look at the text and diagram on pages 42 and 43. Discuss the advantages of the products made using nanotechnology. Have students explain how nanotechnologists have been able to make new fibers for clothing *(by combining properties from different atoms or molecules)*. Point out the ways nanotechnology has benefited the environment and the medical community. Discuss the future of nanotechnology in the area of space exploration.

Quick Check

Fullerenes and carbon nanotubes both come from carbon atoms, but their shapes differ. A fullerene is ball-shaped; a nanotube is shaped like chicken wire.

Tech Activity

individual 20 minutes

Objective To test the strength of different structures made of paper

Plan Ahead Make a sample box and paper tube to show to students beforehand. Have paper and tape ready for use. Assemble a pile of the smallest paperback books available to ensure success in balancing them on the paper tube.

Tips Students should test the tube's strength lying down and standing on end.

Explore More Prove that the dome is one of the strongest shapes in the world. Crack four eggs, trying to leave more of the shell intact at the wider end. Dispose of the material inside the egg. Carefully chip the edge of each shell until they are relatively even and of equal height. Arrange the eggshells in a small square on a towel, chipped edge down. Stack books one at a time on the eggshells. Stop when the eggshells crack. Students will be amazed at the number of books stacked before the eggshells crack.

Quick Check

Cell phones designed to use spinach chloroplasts would not have to be plugged in to recharge.

Nanotechnology Scores!

Student research should focus on nanotechnological innovations in sports equipment, taking a pro or con stance on the use of nano-equipment. Student journals should include the following information:

- A detailed example of one state-of-the-art piece of sports equipment.
- How the equipment benefits athletes.
- Why using this equipment would have mainly a positive or negative impact on the sport.

3 Close (Student page 45)

Think, Talk, and Write

Students should answer questions independently or with a group. **Answers:**

1. *Nanotechnology is the use of the tiniest building blocks of matter to create or improve things in various industries.*
2. *Some of the industries affected include construction, textile (clothing), medical, aerospace, communications, and sports*
3. *true; false (one-billionth of a meter); false (named after R. Buckminster Fuller); true; false (chip would carry patient information for analysis anywhere in the world); true*

Art Link Students' fullerene should resemble a regulation soccer ball. You may wish to have a soccer ball available to show how the hexagons and pentagons go together. Ask students what they think the balls of clay and toothpicks represent *(carbon atoms and molecular bonds)*.

Writing Link Students should write in the first person from the point of view of a future student. They may describe how nanotechnology changed the school environment physically or how nanotechnology helps them learn.

Extend

Extra Activity Copy and distribute **Lesson 6** worksheet on page 63 of this booklet.

Differentiated Instruction

Leveled Activities

EXTRA SUPPORT Have students draw a futuristic picture showing their interpretation of the kinds of structures described on student page 43.

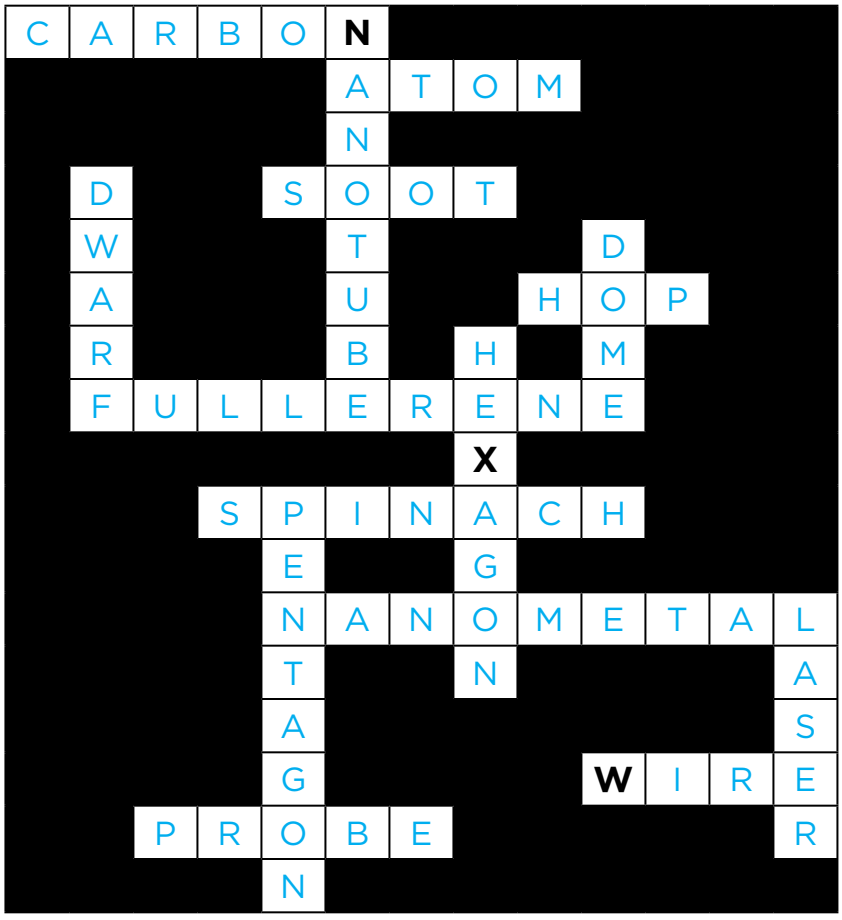
ENRICHMENT Have students research various forms of nanotechnology in use today. Have students predict which other industries may use nanotechnology in the future, and why.

STEM Have students write about what life might be like in the city of the future shown on page 43 or what kind of experience the trip up the elevator to the space station might be. How might daily life be the same and how might it be different in these flashes to the future.

Name _____ Date _____

Technology of the Future

Fit all of the words listed below into the grid. Three letters have been entered to get you started.



3-letter word
HOP

4-letter words
DOME
WIRE
ATOM
SOOT

5-letter words
DWARF
LASER
PROBE

6-letter word
CARBON

7-letter words
SPINACH
HEXAGON

8-letter words
NANOTUBE
PENTAGON

9-letter words
FULLERENE
NANOMETAL

Lesson 7 Exploring the Impact of Technology on Society

Objectives

- Describe the positive and negative effects of technology on society
- Define the term *ethics* and understand that ethical considerations guide the responsible use of technology

1 Introduce

▶ Assess Prior Knowledge

Discover what students know about the positive and negative effects of technology on society.

- **What kinds of problems does technology solve?**
- **What kinds of problems does technology create?**

2 Teach (Student pages 46–49)

▶ Discuss the Main Idea

Stress the ethical and practical issues that the use of technology raises.

- **Why is it important to ensure that society uses technology responsibly?** *(Because technology can have a negative impact on society.)*

▶ Use the Visuals

The Impact of Technology on Society Read the text and explore the visuals on pages 46 and 47. Discuss the practice of clearing land by setting forest fires. Help students conclude that this practice has negative effects on the environment.

Quick Check

Using a technology may involve benefits and risks (impacts). The decision to use or not use a specific technology would involve a trade-off.

Similar Systems, Different Technologies Read the text and scan the photographs on pages 48 and 49. Compare the technology used to carry water into Ancient Rome with the technology used today in New York City.

Quick Check

Rome: aqueducts; NYC: tunnels and reservoirs

Tech Activity

small group or individual · 30 minutes

Objective To use your senses to test water for pollution

Plan Ahead Fill a container with 1 gallon of water. Add 1 cup lemon juice and organic materials such as sticks and leaves. Pour each group a large glass of the water you have prepared.

Tips Students should observe the water.

- **Does the water look safe to drink?**

Have students filter the water into a bowl. The water should look clean.

- **Does the water look safe to drink?**

Explain that even if water looks clear, it still may not be safe to drink due to high acidity. Have students use pH paper to test the water's acidity.

Explore More Help students understand how difficult it is to restore polluted water by repeating the experiment, adding to the water organic debris with smaller particles. Discuss implications of this experiment for our lakes and rivers.

Technology in Action

Tracking with Technology

Write About It As you read page 50, discuss the history of tracking technology, including observational recording, numbered tagging, tagging with radio transmitters, and satellites. In writing about satellites, students' journals should include the following information:

- A description of a satellite.
- An overview of how people use satellites.
- The benefits and risks involved in using satellites.

3 Close (Student page 51)

Think, Talk, and Write

Students may answer questions independently or in a group. **Answers:**

1. *impacts on society and trade-offs*
2. *Answers will vary.*
3. *Answers may vary.* ***(A)*** *mean we should;* ***(B)*** *improved ability to do work;* ***(C)*** *a person can steal another person's personal information;* ***(D)*** *give up;* ***(E)*** *predicting earthquakes and tracking hurricanes and forest fires*
4. *Students' presentation should include facts to support their argument.*
6. *Students should report survey responses using a bar graph.*

Writing Link Students should share their reports with the class. Reports should include references.

Extend

Extra Activity Copy and distribute **Lesson 7** worksheet on page 66 of this booklet.

Art Link

Technology Poster Challenge students to make a poster that demonstrates an historical or a futuristic change in technology and the effect that change had or will have on society.

Differentiated Instruction

Leveled Activities

EXTRA SUPPORT Invite students to define the term *trade-off* in their own words.

ENRICHMENT Encourage students to find an example of technology in the classroom or in the newspaper or a magazine. Challenge them to write about or draw how the technology impacts society.

STEM Organic farming is very popular today. Organic farming excludes the use of fertilizers, pesticides, hormones (for plant/animal growth), antibiotics (for livestock), or additives of any kind. This process is more time consuming and produces less product per acre. Have interested students research organic farming and present the pros and cons.

Name _____ Date _____

Exploring the Impact of Technology on Society

As a class or individually, create a *Technology Survey* of 5 to 10 questions, based on what you've learned about the impact of technology on society. Have students in other classes fill out the survey. Tally and report your results.

The Impact of Technology on Society		
Questions	**Agree**	**Disagree**
1. Do advances in technology make life better for all living things?		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Architecture

Title	Using the Leveled Reader	Making a STEM Connection
A New Pyramid for Paris This books shares the architecture that influenced the new design for the Louvre. ☐ This book supports Lesson 2, 6, and 7 in ***Technology A Closer Look.*** **Reading Levels** GR Z Benchmark 80 Lexile 880	**Before Reading** Using a world map or globe, identify where the pyramids are in Egypt are where Paris, France is located. Identify the closest art museum to your school. Talk about the Louvre in Paris as one of the most famous art museums in the world. **During Reading** Have students watch for details between the two famous structures and make notes to be able to compare and contrast the two. **After Reading** Students may want to research I.M. Pei more and expand their study to compare and contrast other famous structures he has designed. What are some features that the structures have in common?	**NOTE: You may want to use *A New Pyramid for Paris* and *Building a Biome* in conjunction with each other to compare and contrast structures.** **Engineering Connection** After students have read through the books in this package, you may want to discuss the following questions as a class. • **Why was an architect needed for each structure?** • **Why was the structure built or needed?** (student responses should reflect the purpose of each structure) • **How did the concept of light play into the planning of each structure and the materials used?** • Assign groups of interested students to research the architect and report back to the class. Encourage them to compare the structures he/she built. **Is there a common theme?** **Pyramid Project** • **How do you think the builder knew how to build the pyramids? How did they know it would stand up or that the structure would last? How would they make the corners so square and precise?** • **How do you think learning from trial and error or making models may have contributed to the pyramids?** • Ask students to build a model of the pyramids to scale (sugar cubes, toothpicks, shoeboxes, or other such building material) • Create the pyramid structure with straws and cover with paper to create sides. This structure can also be made into a kite. **STEM Careers** Students who enjoy this kind of study may be interested in more information on Architectural Engineering, Civil Engineering, Structural Engineering, or Architecture.

Building a Biome
This book describes the unique Deserts Biome at the Indianapolis Zoo.

This book supports Lesson 2, 6, and 7 in ***Technology A Closer Look.***

Reading Levels
GR X
Benchmark 62
Lexile 1050

Before Reading Make a word web around the word **desert.** Have students tell what they know about deserts in the American Southwest or anywhere in the world. **What are common traits of deserts?**

During Reading Point to the compound words *rain forest* (page 2), *sometimes* (page 4) and *energy-rich* (page 2), emphasizing that a compound can be open, closed, or hyphenated. Model word-learning strategies by helping students identify the words that make up each compound and by noting that the meaning of these smaller words can often help students define the compound word.

After Reading Discuss the book by asking inference questions, such as **What inferences can you make about people who are putting rain forests at risk?** Or, **How are people harming ecosystems?**

Engineering Connection After students have read through the books in this package, you may want to discuss the following questions as a class.

- **Why was an architect needed for each structure?**
- **Why was the structure built or needed?** (student responses should reflect the purpose of each structure)
- **How did the concept of light play into the planning of the structure and the materials used?**
- Assign groups of interested students to research the architect and report back to the class. Encourage them to compare the structures he/she built. **Is there a common theme?**

Dome Project The Deserts Biome at the Indianapolis Zoo is enclosed in a large geodesic dome.

- **Why would the architect need to study the biome to understand the needs of this particular habitat?**
- Have small groups of interested students research other biospheres. **What would be the specific needs of each? Which would be the most difficult to build? Why?**
- Create a structure of the geodesic dome with straws; Compare this structure with the pyramid. **How are they alike? Different?**

STEM Careers Students who enjoy this kind of study may be interested in more information on Architectural Engineering, Civil Engineering, Structural Engineering, or Architecture.

Building a Cathedral This book shares the structure and architecture of these great cathedrals.

This book supports Lesson 2, 6, and 7 in ***Technology A Closer Look.***

Reading Levels
GR Y
Benchmark 70
Lexile 880

Before Reading Write the word cathedral on the board. Have students share what comes to mind when they hear this word. Remind them of movies and books, such as *The Hunchback of Notre Dame,* that are set in cathedrals.

During Reading Direct students to the diagram on page 9 that shows the typical floor plan for a cathedral. The plan labels the different spaces and describes their purposes. Have students explain the terms *balance, symmetry,* and *east-west axis* using examples from the diagram.

After Reading Ask students to summarize the selection and to share one new fact that they learned.

NOTE: You may want to use the books *Building a Cathedral* and The *Taj Mahal* in conjunction with each other to compare and contrast their structure.

Engineering Connection After students have read through the books in this package, you may want to discuss the following questions as a class.

- **Why was an architect needed for each structure?**
- **Why was the structure built or needed?** (student responses should reflect the purpose of each structure)
- **How did the concept of light play into the planning of the structure and materials used?**
- Assign groups of interested students to research the architect and report back to the class. Encourage them to compare the structures he/she built. **Is there a common theme?**

The large Gothic Cathedrals were huge and took many, many years to build. Notre Dame in Paris took crews about 100 years to complete. **How long do you think it would take today? Why?**

- Many churches or cathedrals were built in the Gothic style. **What are some characteristics of Gothic style?**
- **Have small groups of interested students research and report on Romanesque and Gothic architecture—compare and contrast.**
- Work with your art teacher to have students design a stained glass window for your school. Have students describe the story the window would tell.
- Compare one of these old structures with one built a couple hundred years ago and one built today. **How are they alike? Different?**

STEM Careers Students who enjoy this kind of study may be interested in more information on Architectural Engineering, Civil Engineering, Structural Engineering, or Architecture.

The Taj Mahal This book shares the architecture of this monument.  This book supports Lesson 2, 6, and 7 in ***Technology A Closer Look.*** **Reading Levels** GR U Benchmark 50 Lexile 820	**Before Reading** Ask students to name famous buildings both old and new, such as the Great Pyramids, the Coliseum in Rome, the Empire State Building, The White House, Buckingham Palace, or medieval castles. Ask: **Why do you think these building are famous? What is special about them?** Talk about large buildings and structures in your city or state that students may be familiar with and compare to these famous places. **During Reading** Point to the word *mausoleum* on page 5 and talk about what this word means. Encourage students to learn who built the Taj Mahal, why he built it, and where it was built. **After Reading** Ask students to summarize what they learned about this famous structure and what questions they have after reading the story that they would like to ask Shah Jahan.	**NOTE: You may want to use the books *Building a Cathedral* and The *Taj Mahal* in conjunction with each other to compare and contrast their structure.** **Engineering Connection** After students have read through the books in this package, you may want to discuss the following questions as a class. • **Why was an architect needed for each structure?** • **Why was the structure built or needed?** (student responses should reflect the purpose of each structure) • **How did the concept of light play into the planning of the structure and the materials used?** • Assign groups of interested students to research the architect and report back to the class. Encourage them to compare the structures he/she built. **Is there a common theme?** The Taj Mahal took more than 20,000 workers more than 20 years to build. **How long do you think it would take today? Why?** • Compare and contrast the Taj Mahal with another famous building. **What common structures do you see in the Taj Mahal that you see in the other structure? Why do you think that is? How are the two structures different?** • Design a monument for yourself or a family member. **What would it include and why?** Draw a detailed picture or create a model of the structure. **STEM Careers** Students who enjoy this kind of study may be interested in more information on Architectural Engineering, Civil Engineering, Structural Engineering, or Architecture.

The following books are also recommended to extend the concepts presented in this module. These books are available for purchase from McGraw-Hill.

- ***City Planning*** This book shares a behind-the-scene look at city planning and all of the elements that must be taken into consideration. (ISBN 978-0-02-101116-2)
- ***Machines That Build*** This book takes a look at machines that help us work. (ISBN 978-0-02-285945-9)
- ***Solving the Pyramid Puzzle*** This book describes the precision and geometric knowledge ancient Egyptians used to build the pyramids. (ISBN 978-0-02-101104-9)

The Space Frontier

Title	Using the Leveled Reader	Making a STEM Connection
Life on a Space Station This book discusses life aboard the International Space Station, from scientific research to everyday tasks. ☐ This book supports Lesson 6 and 7 in ***Technology A Closer Look.*** **Reading Levels** GR V Benchmark 46 Lexile 920	**Before Reading** Display the book and read the title. Ask student to keep a problem-solution chart of some problems astronauts (*astro-* which means "a star or stars" and *–naut* which means "sailor") living in space faced and how the problems were solved. **During Reading** Point to the word weightlessness on page 7. Model strategies students can use to determine the meaning of multi-affixed words. Have students identify the base word *weight* and the suffixes and their meanings: *-less* (without) and *–ness* (the state of being). Help student rebuild the word: *weight* + *-less* = *weightless* (without weight) + *-ness* = *weightlessness* (the state of being without weight) **After Reading** Have groups of students use their problem-solution chart to write and present a brief oral summary of life aboard the *International Space Station.*	**NOTE: You may want to use these four books in conjunction with each other to expand on the concept of space exploration.** **Engineering Connection** Ask students to think about this question. **How you ever wanted to go somewhere or do something that no one else has ever done?** We all look up at the same sky—some admire it for the beautiful colors and cloud formations, some want to understand the weather patterns, while other look at the sky and are driven to explore it. • Exploration of the solar system required better devices to look at the sky. **Do you think the telescopes that were created were handheld? How were they created?** Interested students may want to research the science behind the large telescopes used in astronomical observatories across the country or even the Hubble Space Telescope. • The more we explored space the more we wanted to learn about it and this led to more and more inventions. One of the first areas involved rocketry and thinking of way to travel into space. Fueled rockets ignited the desire to travel into our atmosphere. Starting with a small handheld rocket, our models grew larger with each successful test until we have the modern space shuttles of today. • Traveling into space—at that speed and distance required different navigational tools than what existed at the time. We needed tools that were more accurate and precise than ever before. Interested students may want to research the creation of GPS systems or how the space shuttle (that takes off like a rocket) can land like an airplane. ***Continued on next page.***

Mission to Mars This book reviews NASA's mission to land two robotic Rovers on the planet Mars and to take pictures and collect samples. This book supports Lesson 6, and 7 in ***Technology A Closer Look.*** **Reading Levels** GR S Benchmark 50 Lexile 1060	**Before Reading** Draw a large sphere and label it *MARS*. Have students write questions they have about Mars or the missions to Mars on self-stick notes. Place these notes around the sphere. **During Reading** Point to the word *propulsion* on page 4 and model strategies students can use to figure out what it means. The prefix *pro-* (forward) and the suffix *–ion* (the action or process of). Propulsion also looks somewhat like *propel* (cause to move forward). From this you can conclude that *propulsion* (process of moving forward). **After Reading** Have students summarize the story and as a class create a list of questions you would like to ask someone who worked on the Rover project.	• Pretend you are the flight commander for the first space mission. **How do you simulate the conditions of some place you have never been? How do you know how to train the astronauts? How do you know if you can keep the human beings safe and the equipment working under such extreme conditions?** • Students who enjoy studying space travel may want to choose a space mission to research. They can share their findings with his/her class or another class. They may also want to design and label blueprints for their own space craft or space station. • Pose the question: **How do the Mars Rovers continue to work with no one there to fill the fuel tank?** Students engaged by this topic may want to research the rover series—*Curiosity, Opportunity, and Spirit*—to learn more about the missions and what the goals and outcomes have been. • This question can be asked: **How can we call or Skype someone on the other side of the world or receive pictures back from a land rover on Mars??** Interested students will enjoy researching this topic and sharing the information with the class. **STEM Careers** Students who enjoy this kind of study may be interested in more information on the Aeronautical/Aerospace, Computer, Electrical, or Mechanical Engineering fields.
Looking to the Sky This book examines how people have studied space, from the earliest days to the present. This book supports Lesson 6, and 7 in ***Technology A Closer Look.*** **Reading Levels** GR S Benchmark 43 Lexile 830	**Before Reading** Ask student to help you begin a K-W-L chart to tell what they know and what they would like to know about space. **During Reading** Prompt students to set a purpose for reading. Ask: **How do we study space from Earth? What can we learn about Earth from space?** Point to the vocabulary word astronomy on page. 2. Note the combining form *astro-*, meaning "of a star or stars." Also point out that *–nomy* comes from the Greek, meaning "a system of knowledge," and that when taken together, *astronomy* means "knowledge of the stars" or "study of the stars" **After Reading** Ask student to add what they have learned about the study of space to the K-W-L- chart on the board. Invite them to use the chart to summarize the facts they have learned.	

Space Station This book goes behind the scenes to show how astronauts live and work on the International Space Station and how the station functions as a floating laboratory. ☐ This book supports Lesson 6, and 7 in ***Technology A Closer Look.*** **Reading Levels** GR V Benchmark 60 Lexile 880	**Before Reading** Ask student to visualize living on the space station and discuss what everyday life might be like. Make a list of questions that students would want to ask the astronaut (*astro-* which means "a star or stars" and *–naut* which means "sailor") on the book cover. **During Reading** Point out the timeline on pages 20-21. Explain that timelines show events in the order they happened. It is a quick and easy way to present a larger amount of information. Ask students to locate specific events. **After Reading** Ask students to go back through the book and find examples of captioned photographs and sidebars that either reinforce or expand upon the text.	
What Is GPS? This book defines GPS (Global Positioning System) and describes its many uses. ☐ This book supports Lesson 2, 6, and 7 in ***Technology A Closer Look.*** **Reading Levels** GR Q Benchmark 40 Lexile 760	**Before Reading** Display the book and read the title. Ask if any students know what GPS is, what the letters stand for, and how it is used. Have students preview the photographs, drawing, and captions, as well as the maps, to predict the science facts they might learn as they read this book. **During Reading** Point to the initials *GPS* on page 3. Explain that sometimes people use initials to abbreviate or shorten commonly used words and phrases. Point out that usually in a text message, for example, initials are placed instead of the words for which they represent. Ask what *GPS* means. (Global Positioning System) Have students share other initials, phrases, or acronyms with which they may be familiar, such as *NASA* (National Aeronautics and Space Administration). **After Reading** Have students to summarize what they have learned about GPS.	**NOTE: You may want to use these two books in conjunction with each other to expand on the concept of exploration.** **Engineering Connection** • As a class discuss: **How has GPS changed our world? Our communication?** • **How do you think GPS relates to space exploration? How are the two related?** • GPS is based on triangulation. In older times, the same idea can be found with two lighthouses and a ship. Have students compare and contrast the two systems. **STEM Careers** Students who enjoy this kind of study may be interested in more information on one of the fields of Engineering: Aeronautical/ Aerospace, Computer, Electrical, Materials, Mechanical, or Software Engineering

Finding Our Way This book explores the history of navigation, from landmarks, the Sun and stars, to modern navigational methods such as GPS***.*** ☐ This book supports Lesson 2, 6, and 7 in ***Technology A Closer Look.*** **Reading Levels** GR T Benchmark 52 Lexile 880	**Before Reading** Ask students if they have ever been lost or have ever been with a parent who has gotten lost while driving. Ask: **How did you find your way to your destination?** **During Reading** Point to the word *astrolabe* on page 12. Model how students can use etymology, or word origin, to figure out the meaning of unfamiliar science words. *Astro-* (star) and *–labe* comes from a word that means "take." An *astrolabe*, then, must be a tool that used the stars to take measurements. **After Reading** Encourage students to use their notes to summarize the book. Then, use these questions to start discussions. **How have navigation tools changed? What do you think will be the next new tool? What will it be able to do that GPS can't?**	

The following books are also recommended to extend the concepts presented in this module. These books are available for purchase from McGraw-Hill.

- ***The Galileo*** This book outlines the Galileo mission to Jupiter. (ISBN 978-0-02-285942-8)
- ***Exploring Mars*** This book outlines how scientists have explored Mars and what they have learned about it. (978-0-02-284667-1)
- ***All About the Moon*** This book discusses the Moon, focusing on what scientists have learned about it. (ISBN 978-0-285933-6)
- ***The International Space Station*** This book describes the things people do while living and working on the space stations for up to six months. (ISBN 978-0-02-192856-9)
- ***Journey into Space*** This book gives a quick overview of man's journey into space—from the Wright Brothers to the International Space Station. (ISBN 978-0-02-285871-1)
- ***Moon Gazing*** This book discusses the phases of Earth's moon. (ISBN 978-0-02-100896-4)
- ***On the Moon*** This book describes the historic journey when the first humans walked on the surface of the moon and the challenges that scientists and astronauts faced. (ISBN 978-0-02-193198-9)

Engineering Marvels

Title	Using the Leveled Reader	Making a STEM Connection
Foods That Feed the World This book compares and contrasts various staple crops around the world. ☐ This book supports Lesson 2 and 4 in ***Technology A Closer Look.*** **Reading Levels** GR X Benchmark 64 Lexile 1050	**Before Reading** Begin a Venn diagram to record what students know about the crops *wheat* and *rice*. **During Reading** Point to the word *staple* on page 3. This may be confusing for students who only know that a "staple" holds their papers together. Model strategies students can use to figure out the meaning of multiple-meaning words. As students read the text encourage them to add to the Venn diagram. **After Reading** Ask students to summarize what they have learned. Invite them to choose other staple crops to compare and contrast.	**NOTE: You may want to use these two books in conjunction with each other to expand on the concept of food production.** **Engineering Connection** We live in a world with many different climates---some with too much water, some too little water. Other regions may experience extremes in temperatures—extremes that make growing crops challenging. We need crops that can withstand floods, drought, extreme swings in temperature, and are insect/disease resistance. These are some of the problems we face that need new inventions and/or engineering solutions. • Today we are farming less and less land but we have more and more people to feed. **How can we do this?** We need crops that are more productive per acre and are faster growing—faster to harvest. Interested students may want to research more about selective breeding. • Today's farmers are really part botanist, part zoologist or biologist, part agricultural engineer, and part economist or business manager. Running large farms today are big business. Have students research farmers and add to this list of attributes or knowledge base that a farmer needs today. Compare this with early settlers and the farming they did. • Have students research the use of crops such as corn and soy beans as clean alternative fuels. Ask them to present the pros and cons. **STEM Careers** Students who enjoy this kind of study may be interested in more information on Agricultural and Biological Engineering, Chemical Engineering, Genetic Science, or even Agriculture Economics
Farming for the Future: How do We Feed Ourselves? This book shares the improvements in growing crops and raising livestock that have helped farmers produce more food on less land including practices like genetic engineering and organic farming. ☐ This book supports Lesson 2, and 4 in ***Technology A Closer Look.*** **Reading Levels** GR W Benchmark 60 Lexile 810	**Before Reading** Write this statement on the board: *The most important goal in farming is to use less land to grow more crops.* Have pairs of students discuss this statement to consider whether this is a proper goal, or whether it could have negative results. **During Reading** Remind students that words like *some, probably, most, many people believe*, and *so on* are words that often indicate the statement is an opinion. When reading a piece like this it is important for the reader to distinguish facts from opinions. **After Reading** Ask students to evaluate what they read and share their opinion supporting with facts from the texts.	

Microwaves and Cooking This book discusses how Percy Spencer's accidental discovery led to the invention of the microwave oven. ☐ This book supports Lesson 1, 2, 3, and 4 in ***Technology A Closer Look.*** **Reading Levels** GR V Benchmark 58 Lexile 960	**Before Reading** Begin a main-idea chart with the following sentence in the main-idea column: *Microwave ovens are useful kitchen appliances.* Have students write detail sentences that support this main idea. **During Reading** Point to the vocabulary word *electricity* on page 5 and have a volunteer define it. Invite students to confirm the definition in the glossary. Then point to the words *electrical* and *electrician* on page 5, and *electronics* on page 6. Help students to see the relationship among the words **After Reading** Have students work in pairs or small groups to write and present a brief summary of the book to the class.	**NOTE: You may want to use these three books in conjunction with each other to expand on nature's influence on inventions and technology.** **Engineering Connection** In many cases science fiction has become science fact. For example, lasers are a reality today. *"Initially, the laser was called an invention looking for a job."* This quote from Harry Stine can spark some class discussion. • Ask interested students can make a list of the uses of lasers today. The list should include medical lasers (as a scalpel, for eye surgery, or to fuse skin together after surgery), entertainment (laser light shows), computer and music (reading CDs and fiber optics), and metal working (intricate cutting and precise, consistent welding). • Have students think about science fiction they are reading today. **What do you think has a chance to become a reality? How have old cartoons like *The Jetsons* or movies such as *Harry Potter* or *Star Wars* influenced inventions and technology of today?** • Some of our best inventions were accidents, or at least were not the results the person working on the project thought would happen. Have students research to find a common item we use today that was discovered "by accident". • Discuss other things humans can learn from animals. For example, you might ask students where we got the idea for camouflage or what we could learn from ants. • Have students think about sonar, radar, and lasers. **Which form of technology do you find the most interesting? Why?** **STEM Careers** Students who enjoy this kind of study may be interested in more information on fields of Engineering such as Chemical, Computer, Electrical, HVR&AC, Industrial, Manufacturing, and Metallurgical Engineering.
From Dragonflies to Helicopters: Learning from Nature This book presents some of the ways that humans have imitated nature to produce technological innovations. ☐ This book supports Lesson 2, 3, and 4 in ***Technology A Closer Look.*** **Reading Levels** GR V Benchmark 60 Lexile 880	**Before Reading** Have students look at the cover of the book and read the title. Ask students to turn to page 10 if they are not familiar with a dragonfly. Explain that the book they will be reading describes human inventions that were inspired by animals. **During Reading** Explain that the author uses compare/contrast structure to present information. Have students describe how the sidebar on page 7 compares and contrasts how birds fly and human flight. **After Reading** Have students work in pairs or small groups to summarize the book.	

Sonar, Radar, and Lasers This book explains sonar, radar, and lasers and cites examples of their many uses. ☐ This book supports Lesson 2, 3, 4, and 7 in ***Technology A Closer Look.*** **Reading Levels** GR W Benchmark 46 Lexile 1000	**Before Reading** Have students make a K-W-L chart to record what they know about sonar, radar, and lasers. Then ask students what they would like to know. **During Reading** Have students find the glossary word *sonar* on page 2. Call on a volunteer to read what sonar stands for. Tell students that some science terms and acronyms–their names are formed from the first (or first few) letters of a series of words. Write *sound navigation and ranging* on the board and underline the letters that for the acronym *sonar.* Repeat with the word *radar* (page 11). **After Reading** Work with students to complete the first column of the K-W-L chart. Then have partners review their notes to prepare a brief written summary of the book.	
The Smithsonian: America's Attic This book profiles some of the Smithsonian's more famous collections: the popular culture, air and space, American folk art, and gem collections ☐ This book supports Lesson 1, 2, 3, and 4 in ***Technology A Closer Look.*** **Reading Levels** GR Z Benchmark 80 Lexile 780	**Before Reading** Have students independently list some of the items their families have stored in attics, basements, and/or garages. Ask students to think about the following questions: **Why does your family keep these items? What do these items tell about your family or your family's history?** **During Reading** Remind students as they read through the chapters that they are reading about only a couple of the many museums that make up The Smithsonian. **After Reading** Ask students to share the one thing they would like to see at The Smithsonian. Ask students, **Do you agree with the author's assessment that the *Spirit of Saint Louis* is a must-see object at the museum? Why or why not?**	**Engineering Connection** The Smithsonian is the world's largest museum and research complex with 19 museums and galleries as well as the National Zoological Park. **Ask students why they think the Smithsonian is important?** In the discussion help students understand that we have a collection of precious firsts of inventions and engineering marvels which allows us to remember where we've been, to understand where we are today, and to appreciate where we're going. The book title say "attic" but it is like an engineering scrapbook. • **What items from today do you think will be in The Smithsonian when you are older? Why do you think this item will be there or why should this item be there?** **STEM Careers** Students who enjoy this kind of study may be interested in more information on Engineering and Inventions.

The following books are also recommended to extend the concepts presented in this module. These books are available for purchase from McGraw-Hill.

- ***The Camera's Eye*** This book examines the way in which the human eye and cameras take in light to receive and record images. (ISBN—978-0-02-284675-1)
- ***Amusement Park Rides*** This book explores Newton's three laws of motion through the use of amusement park rides. (ISBN 978-0-02-285915-2)
- ***Thrills and Chills*** This book describes the invention and early history of roller coasters. (ISBN 978-0-02-192672-9)
- ***Plastics*** This book explores the history and development of one of the most versatile materials—plastics. (ISBN 978-0-02-284727-2)
- ***Skates, Bikes, and Rockets*** This book explores Newton's three laws of motion. (ISBN 978-0-02-285947-3)
- ***How Do Toys Work?*** This book explores Sir Isaac Newton's three laws of motion to explain how toys work. (ISBN 978-0-02-285928-2)
- ***Thomas Alva Edison*** This book shares interesting anecdotes and details about Thomas Edison and some of his most famous inventions (from more than 1000 inventions). (ISBN—978-0-02-193064-7)
- ***Thomas Edison*** This book gives and inside look at one of the most famous of all inventors. (ISBN—978-0-02-284695-4)
- ***Alexander Graham Bell*** This book looks at the evolution of the telephone. (ISBN 978-0-02-199754-1)
- ***Oops! Food Surprises*** This book share the story of some of our tastiest foods and how they created by accident. (ISBN 978-0-02-192864-4)
- ***Inside a Science Museum*** This book takes students on a tour of science museums. (ISBN 978-0-02-101109-4)
- ***Growing Goods in a Growing Country*** This book focuses on crop production in the 10 US Department of Agriculture farm production regions. (ISBN 978-0-02-106239-3)
- ***Braille and Beyond: Inventions that Helped the Blind*** This book explains how Braille developed by Louis Braille and other advancements in education and technology since then have worked to help blind people read and write. (ISBN 978-0-02-193222-1)
- ***The Sky's the Limit*** This book gives a brief history of flight—from early days and experiments to today and technology. (ISBN 978-0-02-193227-6)

Genetics and Medicine

Title	Using the Leveled Reader	Making a STEM Connection
Genetics This book focuses on genetics, explaining how certain traits are passed on, and how scientists study genes to better understand life on Earth. ☐ This book supports Lesson 4 and 6 in ***Technology A Closer Look.*** **Reading Levels** GR W Benchmark 46 Lexile 1050	**Before Reading** Display the cover of the book. Create a chart with two columns—"Text Clues" and "Conclusions" Begin a conclusions chart, writing in the "clues" column, *You get traits from your parents.* **During Reading** Point to the letters DNA on page 9. Remind students that letters or initials often are used to replace longer terms and phrases. Mention that the first time such letters are used; they usually appear with the longer term or phrase. Ask students what DNA stands for. (deoxyribonucleic acid) Repeat with the letters GMO on page 18. (Genetically Modified Organism) **After Reading** After students to work in small groups to fill in and present a conclusions chart to help summarize the research and advances scientists have made in the field of genetics.	**NOTE: You may want to use these three books in conjunction with each other to expand on the study of DNA.** **Engineering Connection** Genetics and DNA. Many TV shows, such as *CSI* (Crime Scene Investigation) and *Cold Case* or movies, such as *Jurassic Park,* use the scientific knowledge of DNA to solve criminal cases or mysteries. • Have students write an idea for a script or storyline for one of these shows that involves genetics and/or DNA. • Students may want to research careers that involve DNA fingerprinting. The list of jobs could include how DNA fingerprinting is used. • **In the criminal justice world, how is DNA fingerprinting used to solve crimes? How can DNA find someone guilty of a crime or find that someone is innocent who has been convicted?** Explain. • Bodies that have been recovered after a long period of time are often identified through DNA. Being able to use DNA to identify mummified bodies enables the scientist to trace back thousands of years to their ancestors. **How do you think this is possible?** • Just because we have the knowledge and ability to do something, doesn't always mean we should do it. Cloning is one example of this. Students interested in this area of study may want to research Dolly, the first cloned animal (a sheep). Research in cloning can be found in the cloning of animals, plants, organs, and even humans. Have students present the pros and cons and the ethics of cloning. Ask, **Is cloning the right thing to do? Why or why not? Is there ever a time when just because you have the knowledge and the ability to do something, it still isn't the right thing to do?** **STEM Careers** Students who enjoy this kind of study may be interested in more information on Biomedical Engineering, Chemical Engineering, or Nuclear Engineering.

The Story of DNA This book outlines the advances made in genetics since the time of Gregor Mendel to the cracking of the DNA code and its future implications. ☐ This book supports Lesson 4 and 6 in ***Technology A Closer Look.*** **Reading Levels** GR S Benchmark 50 Lexile 850	**Before Reading** Ask students what color eyes a child might have if both parents have brown eyes. Repeat with blue-eyed parents and then with one parent who has blue eyes and the other who has brown eyes. Record students' ideas on a conclusions chart. **During Reading** Point to the word biologist on page 10. Model strategies students can use to figure out the meaning of words, pointing out the combining forms *bio-* (life or living), *-ology* (study), and *–ist* (one who). Ask students to think about scientists who study genetics and DNA and to define what a biologist is. (someone who studies living things) **After Reading** Ask students to use their charts and their books to summarize what they have learned about DNA. Encourage them to share and support why breaking the code of DNA was one of the most important discoveries In science.	
DNA Fingerprinting This book explores DNA fingerprinting and how it is used as a tool to solve crimes and to further scientific, medical, and historical research. ☐ This book supports Lesson 4 and 6 in ***Technology A Closer Look.*** **Reading Levels** GR Y Benchmark 70 Lexile 1050	**Before Reading** Display the cover of the book and read the title. Invite students to share what they know about DNA fingerprinting. **During Reading** Point to the word fingerprints on page 4. Model strategies students can use to figure out the meaning of compound words. Have them circle the two words in the compound *(finger + prints),* defining each word to help them construct meaning. **After Reading** Have students prepare a brief oral summary of the book. Have a class discussion.	

Science in the Snow
This book reveals how scientists study fossils, animals, and people in these regions.

This book supports Lesson 4 and 6 in ***Technology A Closer Look.***

Reading Levels
GR X
Benchmark 60
Lexile 840

Before Reading Ask students to share what they know about the North and South Poles. Ask students to write down what questions they have about science at the Poles.

During Reading Point out that in a science book, some of the information presented will be facts that scientists have proven and other will be theories or hypotheses. Have students note words such as *probably, could, some...say, others disagree, perhaps,* and so on that signify theories or hypotheses.

After Reading Ask each student to relate one interesting fact or something new they learned from reading this book.

Engineering Connection Have students identify one location that they would like to travel to and study, or something specific they would enjoy learning more about. Two extreme locations that draw scientists are the Arctic and Antarctica. These scientists endure bitter cold and 24 hours of darkness or 24 hours of daylight at different times of the year. **Why do you think scientist go to such extremes to study the science in the snow? What mysteries are in the ice?**

- Interested students may want to research "Otzi the Ice Man". Have students share with the rest of the class or another class in your school the information about this ancient mummy found frozen in a glacier.
- Forty of the 50 states have an official state fossil. Have students research the one for your state. If you live in one of the ten that do not have one, have students research and recommend one—being sure to support their reasoning. You may want to encourage them to send an official request to your state governor to be considered.
- One topic that is often in the news is global warming. Scientists who monitor our polar icecaps say that the ice is disappearing. **How would this effect animals and the environment? What is causing it? What can we do to stop it?**

STEM Careers Students who enjoy this kind of study may be interested in more information on Anthropology or one of the many specialized branches within this area of study such as Paleontology or Archeology.

Searching for Cures
This book examines the development of the microscope, the creation of antibiotics, and vaccines used to treat deadly diseases of the past and the present.

This book supports Lesson 4 and 6 in ***Technology A Closer Look.***

Reading Levels
GR S
Benchmark 50
Lexile 630

Before Reading Write the words sickness and health and the board. Have students brainstorm associations for each word. Record the list of words for each word prompt. (words such as *scientists, diseases, cures, doctors,* and so on should come up in this discussion)

During Reading Point out the word *spread* on page 2. Explain that this is an example of an English word that has more than one meaning. Here the word *spread* means "go from person to person, and from place to place."

After Reading Ask students to share why Alexander Fleming is an important figure in the history of medicine. Talk about the difference that one person can make—one person who won't give up until they find an answer.

NOTE: You may want to use these two books in conjunction with each other to expand upon advances in medicine.

Engineering Connection

- One common thread that students may gain from reading these books is that you need to be observant. Many discoveries have been made by people who were really looking—they didn't just see something, they looked at it. They either used their eyes or a microscope but they choose their tool and thought about what they saw. What do you do everyday? Do you really look at things and question how they work or so you tend to look over them?
- Many inventions were discovered while the inventor was trying something else. A couple of good examples would be x-rays and penicillin. Both of these important inventions or discoveries were found by accident. Both times the inventor observed something and thought about what he saw and pursued it. Have students research and find other Inventions discovered when someone went wrong with the original plan. What are the common factors you find? Were the inventors playing around or did something else happen? How do the words "questioning, inquiry, curiosity, and wondering" fit into these discoveries?
- Many of the tools students read about in these books are used to prevent or detect a problem or to fight a disease. Have students make a list of each type of technology mentioned and compare and contrast. Encourage students to add to this list with any newer treatments they research that were not included in the books.

Continued on next page.

Nuclear Medicine This book discusses the use of nuclear medicine in detecting and treating medical conditions, and explores the use of MRI scanners.  This book supports Lesson 4 and 6 in ***Technology A Closer Look.*** **Reading Levels** GR Y Benchmark 70 Lexile 1050	**Before Reading** Ask student to describe the experience of having had an X ray taken of their bones or teeth. Help students begin a K-W-L chart to record what they know and would like to know about X rays. **During Reading** Point to the boldfaced word *radioactive* and the related words *radiation* and *radiologists* on page 5. Have students use what they know about radioactive materials and word usage, along with context clues, to determine the meaning of *radiation* and *radiologists.* **After Reading** After reading the book, guide a discussion by asking compare-and-contrast questions, such as: **How are X rays and CT scans alike? How are they different?** Have students use their charts to tell what they have learned about nuclear medicine.	• The focus of these books has been mainly on the research and treatment of diseases in human beings. Interested students may encourage research about the use of these and other tools on animals to detect and treat ailments such as rabies, lyme disease, and other such diseases. **What common diseases do animals get? What are common diseases for pets? How can you prevent?** • Thinking about what students just read about, ask them to think about these questions and prepare a short presentation or skit to share with younger students in your school to convey this important information. **How can we prevent the spread of germs from colds and the flu? Why is it hard to cure colds and the flu--why don't we have a vaccine that works on them all? How can you protect yourself? What does our school cafeteria, janitorial staff or school nurse do to help prevent the spread of germs?** **STEM Careers** Students who enjoy this kind of study may be interested in more information on Biomedical Engineering.

The following books are also recommended to extend the concepts presented in this module. These books are available for purchase from McGraw-Hill.

- **What Makes You Special?** This book explores heredity, by defining DNA and examining traits inherited from parents. (ISBN 978-0-02-285884-1)
- **Gregor Mendel** This book explains the life and work of Gregor Mendel and how his pea experiments led to the science of genetics. (ISBN 978-0-02-285924-4)

Use of Natural Resources

Title	Using the Leveled Reader	Making a STEM Connection
Mission: Green Earth This book explores problems associated with the use of nonrenewable energy sources and makes a case for the use of renewable energy sources. ☐ This book supports Lesson 7 in ***Technology A Closer Look.*** **Reading Levels** GR U Benchmark 44 Lexile 900	**Before Reading** Make a K-W-L chart to record what students know and would like to know about he use of natural resources for energy. Distribute copies of the book and ask what students think the title means. **During Reading** Point to the word *hydropower* on page 14. Note the combining form *hydro-* (water). Elicit other words that contain this combining form. **After Reading** Have groups of students complete the K-W-L chart and use it and their notes to summarize the book.	**Engineering Connection** • Encourage interested students to find one item mentioned in this book that they would like to learn more about. Ask them to research the topic and share back with the class. • As a class, discuss using up our natural resources—**Is it a good thing or bad thing and why?** • **What does it mean to "think green"?** Encourage students to create a skit or cartoon to convey this information to younger students. **STEM Careers** Students who enjoy this kind of study may be interested in more information on Environmental Engineering or Environmental Science.
Plants: An Amazing Resource This book shares many of the common uses for plants from inspiration for inventions to medicines and vitamins. ☐ This book supports Lesson 7 in ***Technology A Closer Look.*** **Reading Levels** GR Y Benchmark 70 Lexile 900	**Before Reading** You may want to talk about the difference in herbs, medicines, and vitamins before students begin reading this book. You could take a survey to find out how many students in your school take a daily vitamin. **During Reading** You may want to stop and discuss specific scientific terms such as *photosynthesis* that are found throughout the book. **After Reading** Ask students to share the main idea of this book.	**NOTE: You may want to use these two books in conjunction with each other to expand upon the concept of natural resources and how they influence inventions or improvements today.** **Engineering Connection** • Encourage interested students to research different diseases caused by vitamin deficiencies. • Explore foods that have vitamins added such as milk, butter, cereals, juice, and so on. • Create a list of all the vitamins found in a multi-vitamin and then have students each chose one to research. Make a class list of each vitamin and the top five foods that are good sources that that vitamin. **STEM Careers** Students who enjoy this kind of study may be interested in more information on Industrial Engineering, Marine Engineering, or Ocean Engineering, Materials Engineering, or even information on becoming a Botanist.

Technology and Nature: Water This book shares several inventions that were inspired by animals that live in the water.  This book supports Lesson 7 in ***Technology A Closer Look.*** **Reading Levels** GR S Benchmark 50 Lexile 840	**Before Reading** Have students look at the word echolocation on page 4. Encourage students to look at the two words that make up this word and how they reveal the word's meaning–echo and location. Also, discuss the word melon on page 5. This will be a different meaning from the fruit that most students will recognize. **During Reading** Remind students to read the call-out boxes on pages 5, 6, 11, 14, and 19 as they provide additional information. **After Reading** Have students summarize the main points of this book and share a favorite thing they learned.	

Garbage: Where Does It Go? The book explains why the accumulation of garbage is a growing problem in the United States. ☐ This book supports Lesson 7 in ***Technology A Closer Look.*** **Reading Levels** GR S Benchmark 40 Lexile 640	**Before Reading** Have students share ideas on how the school contributes to the garbage problem. Ask students to brainstorm and discuss ways in which the school could reduce the amount of garbage. **During Reading** Point to the words unheeded on page 3. Remind them that the verb *heed* (pay attention to) and when paired with *un-* (do the opposite of), *unheeded* (opposite of paying attention to) would mean to ignore. **After Reading** Have students summarize the main ideas from the book. Ask: **Why is it important whether or not a writer has backed up his/her opinions with facts?**	**NOTE: You may want to use these two books in conjunction with each other to expand upon the growing problem of garbage and its effects on our environment.** **Engineering Connection** • Encourage interested students to work with a Neighborhood or school recycling day or program. If one doesn't currently exist in your area, consider having students petition school officials to begin one at the school. With the proceeds, the school could sponsor an animal at the local zoo or other such charity. Students could set up the plan and promote the new recycling center or drop-off location. • Have small groups research local concerns. For example, **Where does your community's garbage go? Where is the landfill? How large it is? If it isn't already to capacity, when will it be? What else could be done with the garbage?** If possible, take students on a field trip to the landfill so that they can see the magnitude of the problem. • Encourage your class to monitor the waste that your classroom creates on an average day. Brainstorm ways to reduce the amount of waste. Share these ideas with each classroom in your school building or district. Discuss other areas where large amounts of waste are created each day, such as the lunch room. Create a list of ways to lower the amount of waste produced and share with students and their families. **STEM Careers** Students who enjoy this kind of study may be interested in more information on Environmental Engineering or Environmental Science.
Greenhouse Effect This book discusses the greenhouse effect and tells how natural events and human actions on Earth can affect it ☐ This book supports Lesson 7 in ***Technology A Closer Look.*** **Reading Levels** GR V Benchmark 56 Lexile 950	**Before Reading** Talk about what a *greenhouse* is (a building used for growing plants). Then have students record what they know about the greenhouse effect and what they would like to know in a K-W-L chart. **During Reading** Point to the highlighted word deforestation on page 14. Have students identify the prefix *de-* (remove), the base word *forest,* and the suffix *–ation* (the act of). Help them rebuild the word to determine meaning: *de-* + *forest* = *deforest* (remove the forest) + *-ation* = *deforestation* (the act of removing the forest). Ask students to compare this meaning with the contextual meaning of the word and with the glossary definition. **After Reading** Ask students. **What is the greenhouse effect?** Encourage them to summarize the science facts they have learned.	

The following books are also recommended to extend the concepts presented in this module. These books are available for purchase from McGraw-Hill.

- ***Air Pollution*** This book explores air pollution, its causes, and its effects on Earth and on all living things. (ISBN 978-0-02-284717-3)
- ***Earth's Water*** This book examines the uses of water, as well as the water cycle, recycling, pollution, and conservation. (ISBN 978-0-02-284714-2)
- ***Up, Up and Away*** This book shares ways that scientists are finding to track weather patterns and to learn more about Earth and the space around it. (ISBN 978-0-02-193262-7)

Energy Power

Title	Using the Leveled Reader	Making a STEM Connection
Energy Problems and Solutions This book explores how our use of energy harms Earth's environment and what individual and industries can do to conserve. ☐ This book supports Lesson 7 in ***Technology A Closer Look.*** **Reading Levels** GR W Benchmark 60 Lexile 890	**Before Reading** Write the words *How We use Energy* at the center of a concept web on the board. Have students tell different ways they use energy throughout the day. Then have pairs of students list and discuss problems that come with our use of energy, such as limited resources and pollution. **During Reading** Students may know the word *fossil* (remains of plants and animals from a long time ago) and they may know *fuel* (substances that power machines), but *fossil fuels* (energy sources made from fossils) may be new. **After Reading** As a class create a "Causes and Effects of Using Fossil Fuels" chart. One example would be: (cause) gasoline is burned by car engines; (effect) exhaust from cars causes smog.	**Engineering Connection** • Have students write a letter to the editor of your local paper or to your congressional representative in support of developing cleaner forms of energy. • Have interested students create a picture or diagram to illustrate a typical day in their school, identifying all of the energy types and sources. Students may also want to journal a typical day and indicate all of the different forms of energy they encounter. • As a class discuss the pros and cons of solar energy. Have students research the cost for installing solar panels at your school. **How long would it take to pay them off with the savings? How much power would they generate?** **STEM Careers** Students who enjoy this kind of study may be interested in more information on Chemical Engineering (or one of the many branches such as Petrochemical Engineering) or Environmental Engineering.

Powered by the Sun This book explores ways in which the Sun's energy is used and how it might be harnessed.  This book supports Lesson 7 in ***Technology A Closer Look.*** **Reading Levels** GR Y Benchmark 68 Lexile 1050	**Before Reading** Help students begin a K-W-L chart to share what they know and would like or know about solar energy. **During Reading** Prompt students to set purposes for reading. Ask: **In what ways does Earth depend on solar energy? How can people use solar power?** Point to the word **nuclei** on page 3. Model strategies students can use to read unfamiliar words, leading them to see that this word is an irregular plural. Write the word *nucleus* on the board and have students compare the plural and singular forms of the word. Elicit other words students may know that have an irregular plural form, such as *alumni, fungi,* and *algae.* **After Reading** Discuss the book by asking sequence questions: **How does the water cycle begin with the Sun? What events would you include in a timeline of solar energy?** Ask students to revise and add to the K-W-L chart and to summarize what they have learned about solar energy.	**NOTE: You may want to use these three books in conjunction with each other to expand upon the concept of energy–its sources and our resources.** **Engineering Connection** • Have students divide into teams and role play a legal debate. Students should prepare to play the role of the lawyer defending each "side' of the fuel issue. • Identify all of the different fossil fuels. Ask a series of **"What if.....?"** questions for each kind of fuel and discuss as a class. **STEM Careers** Students who enjoy this kind of study may be interested in more information on Chemical Engineering (or one of the many branches such as Petrochemical Engineering), Environmental Engineering, or even Geology.
Energy Hunter This book examines a variety of energy sources available in different parts of Earth.  This book supports Lesson 7 in ***Technology A Closer Look.*** **Reading Levels** GR X Benchmark 62 Lexile 810	**Before Reading** Write *energy* in the center of a word web. Have students brainstorm different kinds of energy sources. Distribute the book and identify the windmills as an energy source. **During Reading** Point to the word *geothermal* on page 10. Model how combining forms can help determine word meaning. Note the meaning of *geo-* (Earth) and *thermo-* (heat) as clues to figuring out the definition of *geothermal* (head from inside Earth). **After Reading** Ask questions to engage students in discussion. **How does the rain forest supply energy?** Encourage students to add new energy sources to the word web and to use the web to summarize the book.	

Do Fossil Fuels Have a Future This book explores the use of fossil fuels and the need to develop alternate, renewable energy sources ☐ This book supports Lesson 7 in ***Technology A Closer Look.*** **Reading Levels** GR X Benchmark 64 Lexile 1050	**Before Reading** Have students share what they know and would like to know about the use of fossil fuels. **During Reading** Point to the word *nonrenewable* on page 7. Model strategies students can use to read unfamiliar words, helping them identify the base word and affixes: new + *re-* (again) = *renew* (make new again) + *-able* (capable of being) = *renewable* (capable of being made new again) + *non-* (not) = *nonrenewable* (not capable of being made new again). **After Reading** Have students read the chapters and draw conclusions bout the effects of burning fossil fuels on people and the environment.	

Power for Our Future This book explains the need for alternative energy sources.

This book supports Lesson 7 in ***Technology A Closer Look.***

Reading Levels
GR Y
Benchmark 70
Lexile 1050

Before Reading Have students preview the photographs, captions, headings, and other visual resources to predict the science facts they might learn

During Reading Ask: **Why do we need alternative energy sources?** to set a purpose for reading.

Point to the word *renewable* on page 3. Model strategies students can use to read unfamiliar words, helping them identify the base word and affixes: *new* + *re-* (again) = *renew* (make new again) + *-able* (capable of being) = *renewable* (capable of being made new again) Have students use this strategy to define *nonrenewable* (not capable of being made new again).

After Reading Discuss what was read in the book by asking, **Why do we need alternatives to fossil fuels? What kinds of energy can be gotten from the ocean?**

NOTE: You may want to use these two books in conjunction with each other to expand upon advances in finding energy for tomorrow.

Engineering Connection

- Create an ad for a hybrid car. **What would entice buyers to look at a hybrid car?** Be sure to explain what its advantages are for this kind of vehicle.
- Explore what renewable energy sources are available in your communities and what energy sources are currently being used.
- Pick one issue to recommend and offer some solutions for the energy problems. **How can we harness one of the energy sources?** Discuss as a class how we talk about these different energy sources and what should do about it. Take the oil supply for example. The supply is declining but demand is increasing—what can we do. Remind students that sometimes you think you have solved a problem, but it may create another issue or have another cause/effect so be sure to try to think of all of the angles.

Continued on next page.

Searching for Tomorrow's Energy This book gives an insight into what scientists are looking at in alternatives energy sources to help us not rely on fossil fuels as our only energy sources This book supports Lesson 7 in ***Technology A Closer Look.*** **Reading Levels** GR Y Benchmark 70 Lexile 780	**Before Reading** Write on the board: *Ways I use energy every day include…* Provide examples such as using the computer or taking a shower. Then ask students where the energy for these tasks comes from—coal, oil, natural gas, nuclear power, sun, or wind. **During Reading** Have students look through the book and describe the photographs and their captions. Ask students what many of the pictures show. Point out that pictures and captions can be helpful in understanding and visualizing unfamiliar concepts in a nonfiction text. Also, have students turn to the timeline on pages 20-21. Explain that this feature summarizes—in chronological order—some of the inventions and attempts to use alternative energy sources. **After Reading** Have students reread the Conclusion to this book. Ask **Do you think the Conclusion does a good job of summarizing the main ideas of this book? Give reasons for your answer.**	Energy is certainly a topic that is In the news. Debates on energy sources rage on—and include discussions over the kind of fuel to be used and the risk taken in obtaining it. • Have students work in teams to support one side or the other, or have each team take a different kind of fuel to research and present their case for why this would be the best fuel for us going forward. • Have students determine ways that your school can save energy. Encourage them to research what could be done, how much savings could be seen. Students could write and present to school administration and create an ad campaign to get the school body on board. • Have students research ways to save energy at home. This information could be presented at a Parent's Night or could be put into an Energy packet and sent home. **STEM Careers** Students who enjoy this kind of study may be interested in more information on Chemical Engineering (Petrochemical), Agricultural and Biological Engineering, or Metallurgical Engineering.

The following books are also recommended to extend the concepts presented in this module. These books are available for purchase from McGraw-Hill.

- ***Spoiled by a Spill*** This book explains why oil spills happen, how they spread, how they hurt the land and endanger animals, and how people try to clean up after them. (ISBN 978-0-02-19267-4)
- ***When Energy Changes*** This book explores the idea that energy comes from the Sun and is changed from one kind of energy to another. (ISBN 978-0-02-285912-1)
- ***Earth's Resources*** This book shares information about water, minerals, and fuels—precious natural resources. (ISBN 978-0-02-284751-7)

Top 20 Engineering Disciplines

Below is a list of the top 20 Engineering Disciplines. Engineering is a diverse and challenging field of study. With more than 25 major branches of engineering and 100 specialties, there is something for everyone who pursues the field.

Aeronautical / Aerospace Engineering - Aeronautical/aerospace engineers design and develop technology for commercial aviation, national defense and space exploration. They may help design and manufacture military aircraft, missiles, helicopters, and spacecraft. Within this field, they may specialize in the structure of the aircraft, aerodynamics, guidance and control, propulsion and design, manufacturing, or a certain type of aircraft. Commercial airliners, military aircraft, space shuttles, satellites, rockets, and helicopters are all within reach for talented aeronautical engineers, who may also be referred to as astronautical, aviation or rocket engineers.

Agricultural and Biological Engineering - Biological and agricultural engineering, two closely integrated disciplines often called biological systems (biosystems), bioresources, or natural resources engineering, are concerned with finding solutions for life on a small planet. Our swelling world population places great demands on our limited natural resources, and biological and agricultural engineers work to ensure that we have the necessities of life: safe and plentiful food to eat, pure water to drink, clean fuel and energy sources, and a safe, healthy environment.

Architectural Engineering - Architectural engineers apply engineering principles to the design and technical systems of buildings - mainly their structural, mechanical, plumbing and lighting/ electrical design. Engineers need to be aesthetic as well as technical, creative as well as practical. They need to know if what looks good on paper is also technically possible.

Biomedical Engineering - The objective of biomedical engineering is to enhance health care by solving complex medical problems using engineering principles. Those who specialize in this field want to serve the public, work with health care professionals, and interact with living systems. This broad field allows a large choice of sub-specialties. Many students say they choose biomedical engineering because it is people-oriented. The field includes many branches: biomechanical, bioelectrical, biochemical, rehabilitation, clinical, and genetic engineering. There are also many sub-specialties within biomedical engineering such as surgical lasers, telemedicine, nuclear medicine, and clinical computer systems.

Chemical Engineering - Everything that our senses enjoy consists of chemicals in one way or another. Chemical engineers have worked on creating the purple rose that has no thorns, the caramel on a caramel apple, and even your tennis shoes. The chemical engineering profession has improved water and waste systems, created new drugs and drug delivery systems, and improved the crop yields for farmers. Most chemical engineers work in manufacturing, pharmaceuticals, healthcare, design and construction, pulp and paper, petrochemicals, food processing, specialty chemicals, microelectronics, electronic and advanced materials, polymers, business services, biotechnology, and the environmental health and safety industries.

Civil Engineering - Traditionally, civil engineers planned and designed such things as roads, bridges, high-rises, dams, and airports. Because of population growth and a booming economy, however, the civil engineer now also designs new things such as underwater tunnels, new and better wastewater treatment plants, solutions for highway congestion, and special tracks for the magnetic levitation trains of the future.

Computer Engineering - Computer engineering deals with the many aspects of computer systems. These engineers may design computer systems, networks, operating systems, or software. They may design the future automobile dashboard computers that will monitor engine functions. Engineers in this field design computer chips, circuits, equipment, and systems; plan computer layouts; and formulate mathematical models to solve technical problems on computer. They design, develop, and test computer hardware and peripheral equipment. They also design, develop, and maintain software programs and software systems.

Electrical Engineering - The developments of electrical and electronic engineers are everywhere. There are thousands of electrical devices and systems available today that electrical engineers have somehow touched. Anything you plug into the wall – stereos, computers, microwaves, televisions, power tools, air-conditioners, and major appliances – has been touched by an electrical engineer. Even things you can't plug into the wall – satellites, cellular phones, and beepers – have been designed, manufactured, or modified by electrical engineers. Electrical engineers also work in areas that generate, transmit, and distribute electrical power to consumers.

Environmental Engineering - Environmental engineering focuses on the development of a sustainable future, preventing pollution, assessing the environmental impact of everything, water distribution systems, recycling methods, sewage treatment plants, and pesticide prevention. This fast-growing field offers a challenging and satisfying chance to protect the health and safety of people and our environment. These earth-friendly professionals concern themselves with preventing and fixing problems caused by industrialization. They concentrate on delivering better environmental conditions for the public through knowledge, research, a caring attitude, and common sense.

Heating, Ventilating, Refrigerating, and Air-Conditioning Engineering - Heating, ventilating, refrigeration, and air-conditioning (HVR&AC) engineers have dramatically improved our lives. HVR&AC engineers develop systems to create and maintain safe and comfortable environments. Airplanes, trains, schools, cars, and computer rooms are only a handful of the environments that depend on HVR&AC engineers.

Industrial Engineering - Industrial engineers figure out how to improve everything. They work with people to help them do things better. Industrial engineers save employers money by streamlining systems, often making the workplace better for employees too. They improve productivity and quality while saving time and money. Industrial engineers work on all type of businesses. They see the big picture and focus on what makes a system perform efficiently, safely, and effectively to produce the highest quality.

Manufacturing Engineering - Just as the mechanical engineer designs parts, the manufacturing engineer designs the processes that make them. Wherever there's a production process to be designed and managed, you'll find manufacturing engineers at work. They work with plant managers, production supervisors, CNC programmers, quality managers, product designers, and R&D staff on issues ranging from evaluating new technology and choosing equipment and suppliers to leading industry-wide standards development to reorganizing a plant into a more efficient production system.

Materials Engineering - Materials engineers design, fabricate, and test materials. They may work to make automobiles lighter and more fuel efficient by creating stronger and lighter metals. They may help to create artificial knees and elbows using special polymers, or they may design new materials for the space ship. A materials engineer can work with any type of material – plastic, wood, ceramic, petroleum or metals –and create completely new synthetic products by rearranging molecular structure.

Mechanical Engineering - Mechanical engineers is one of the broadest and most diverse disciplines. Mechanical engineers design, develop, and manufacture every kind of vehicle, power system, machine, and tool: jet engines, steam engines, power plants, underwater structures, tractors for food production, hydraulic systems, transportation systems, medical devices, sports equipment, smart materials, materials and structures for space travel, measurement devices, and more. Any type of machine that produces, transmits, or uses power is most likely the product of a mechanical engineer.

Metallurgical Engineering - Metallurgical engineers turn raw materials into useful products. Metallurgical engineering includes processing mineral and chemical resources into metallic, ceramic or polymeric materials; creating new high strength or high performance materials; or developing new ways to refine and process materials for new consumer applications.

Nuclear Engineering - Nuclear engineering falls into three major areas of benefit to mankind: nuclear medicine, agricultural uses and pest control, and nuclear energy. Nuclear engineers search for efficient and beneficial ways to use the power generated from splitting an atom, and they research peaceful ways to use nuclear energy and radiation.

Naval Architecture, Marine Engineering, and Ocean Engineering - Naval architecture, marine engineering, and ocean engineering are professions that integrate disciplines such as materials science and mechanical, civil, and electrical engineering. These engineers and architects design, build, operate, and maintain ships such as aircraft carriers, submarines, tankers, tugboats, sailboats, and yachts. They also develop underwater structures, underwater robots, and oil rigs. They develop transportation systems, plan new uses for waterways, design deep-water ports, and integrate the land and water transportation systems and methods. They are concerned with discovering, producing, and transporting offshore petroleum as sources of energy and developing new ways to protect marine wildlife and beaches against the unwanted consequences of offshore oil production.

Software Engineering - Software engineering is on the cutting edge of technology. Software enables us to use computers. It is the translator between humans and computers. Without software, a computer would be nothing but ones and zeros. The current demand for software engineers far exceeds the supply. The largest employers of software engineers include familiar names such as Microsoft, Motorola, Autodesk, Netscape, Adobe, Symantec, Nintendo, and Corel. However, there are thousands of software manufacturers that hire software engineers.

Structural Engineering - Structural engineering focuses not only on the design and development of structures, such as houses, coliseums, bridges, and shopping malls, but on the design and development of materials that will create these structures. The structural engineering profession offers exciting challenges and potential for growth. Each day brings new and more sophisticated materials that will change the shape and the future of structures. Structural engineers must be creative and resourceful. They must visualize the framework of a structure and determine what forces will produce what loads upon it. Many structural engineers in California design buildings that are able to sustain ground-shaking (earthquake) loads.

Transportation Engineering - Transportation engineering is a branch of civil engineering that aims to allow people and goods to move safely, rapidly, conveniently, and efficiently. Transportation engineers design streets, highways, and public transportation systems. They design parking lots and traffic flow patterns that will prevent major congestion at busy intersections, shopping malls, and sporting events. They are involved in planning and designing airports, railroads, and busy pedestrian thoroughfares.

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