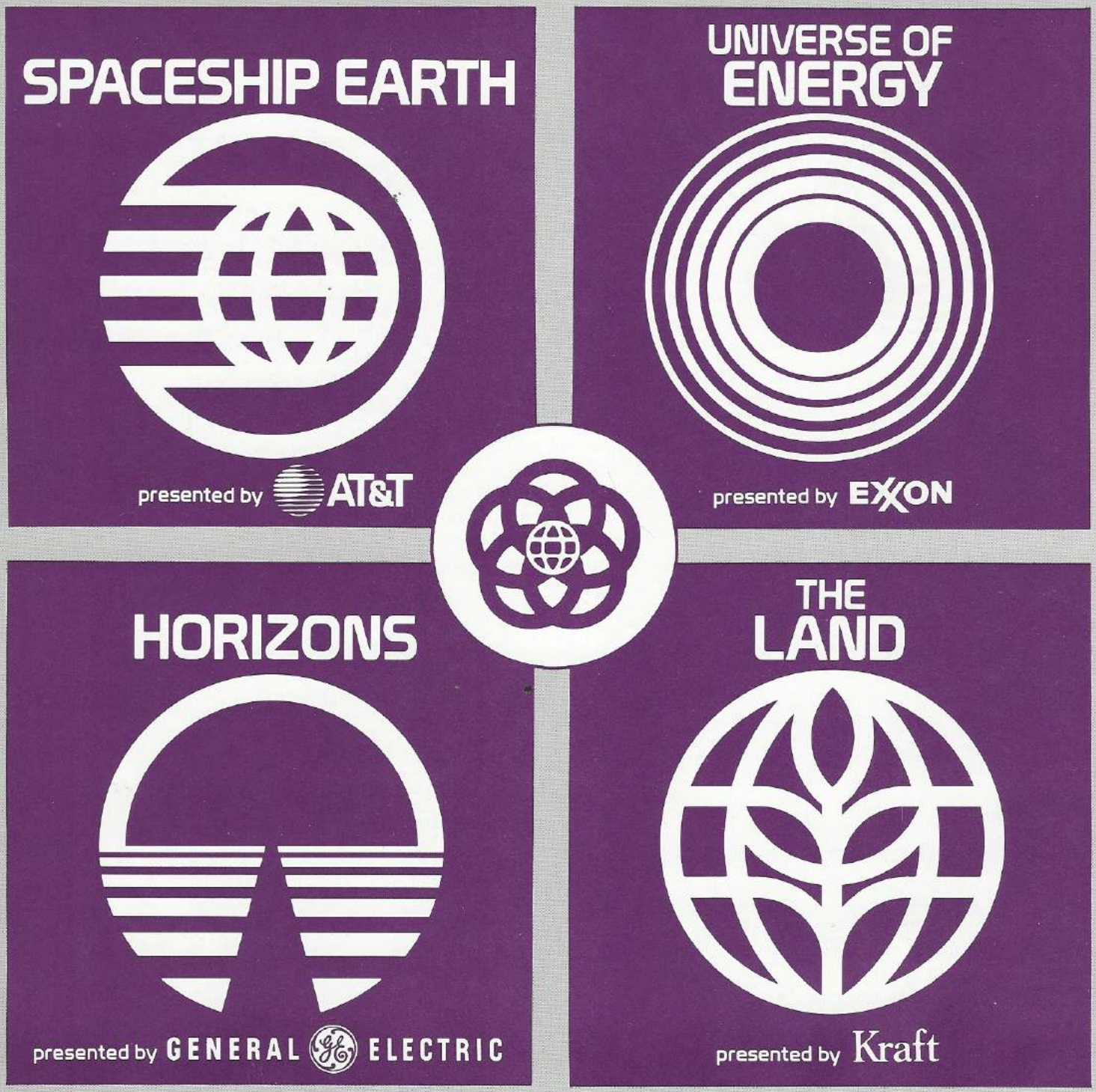
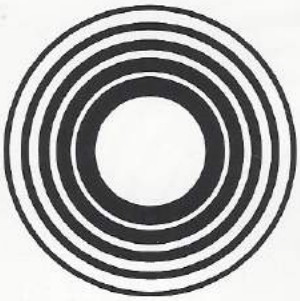


Classroom Guide
The EPCOT Center Experience



EPCOT Center: A Definition

Welcome to EPCOT Center, the Experimental Prototype Community of Tomorrow. Walt Disney chose this name to describe what has become the realization of his greatest dream. He visualized EPCOT Center as a project that "will never be completed but will always be introducing, testing, and demonstrating new materials and new systems . . . a showcase to the world for the ingenuity and imagination of American free enterprise." But unlike most Utopian visions, EPCOT Center is real: here the future is something to see, hear, smell, touch and taste and wonder about.

There are two parts to EPCOT Center: Future World and World Showcase. In the Disney tradition of master storytelling, Future World demonstrates the dazzling technology of the years to come. World Showcase highlights the present and its most vital resource: people. The World Showcase illustrates life around the world with such realism that visitors may well feel transported to the countries represented. Both parts of EPCOT Center work together to create a "permanent (showcase) of imagination and discovery, education and exploration . . ."

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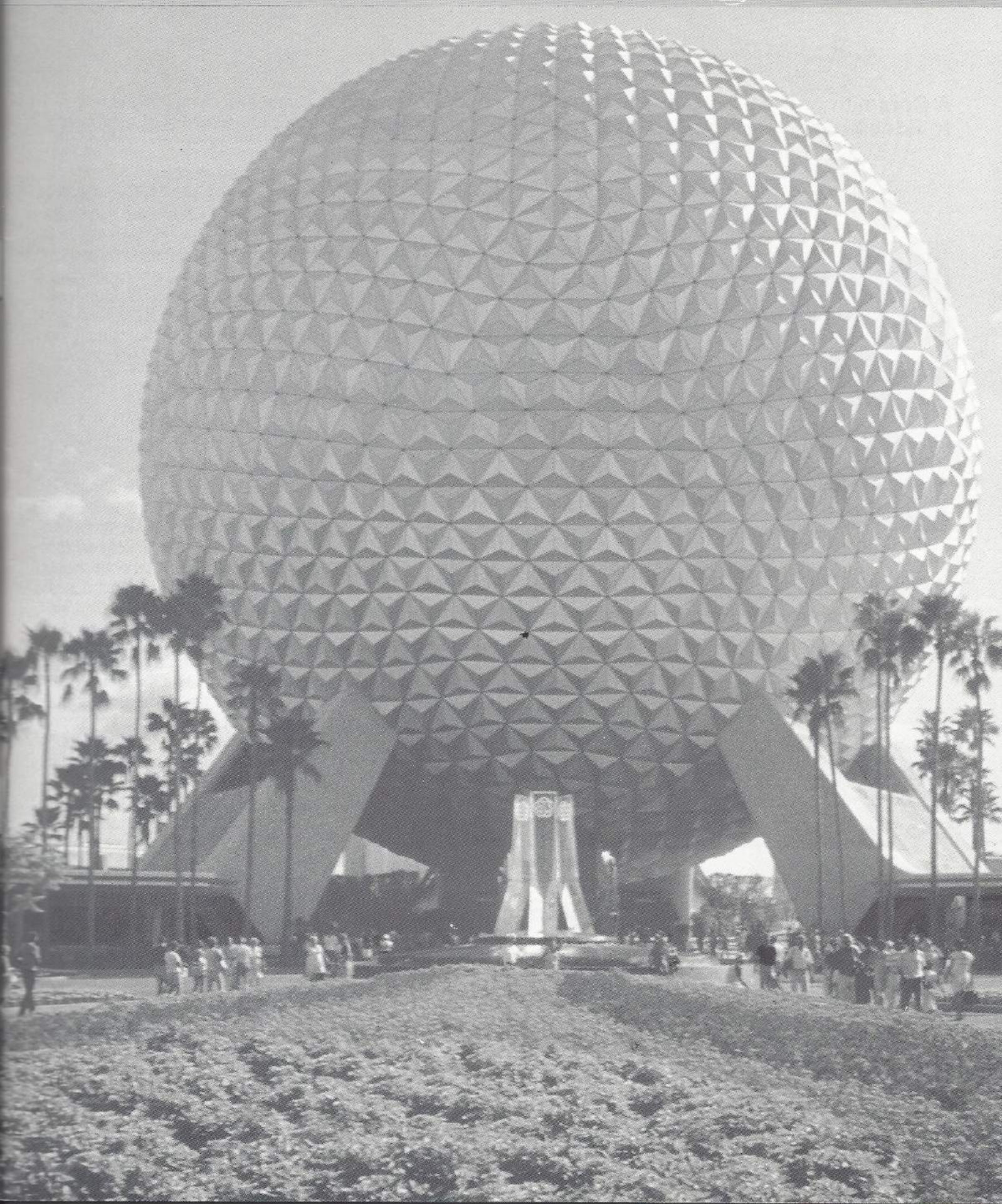
A Classroom Guide
to the EPCOT Center Experience

SPACESHIP EARTH
Presented by AT&T



A Commitment to Education

EPCOT Center combines the Disney expertise in entertainment and communication with a compendium of information from the academic world, industry, and government. The primary goal of this combination is to provide visitors with an exceptional educational experience that *inspires them to actively participate in the shaping of the future*. In classrooms each day teachers try to achieve this same goal. For this reason, teachers, our most important guides to the future, are considered very special guests at EPCOT Center.

An aerial view of EPCOT Center.

A Field Trip with a Long Memory

Teachers often enrich the curriculum by bringing to it the immediacy of their own experiences. Sharing snapshots and souvenirs is one way of transferring the excitement of travel to a classroom. But EPCOT Center is much more than a sightseeing destination. The discerning educator can stretch an EPCOT Center visit into a functional and lasting part of a curriculum. This Teacher's Guide is designed to help educators tap the vast informational resources of EPCOT Center and put them into a meaningful academic context. Filled with practical, easy-to-use materials and ideas for immediate classroom use, this guide serves as a "take-home" field trip to EPCOT Center!

How to Use this Guide

To assist teachers in a variety of learning situations, the materials in this guide have been divided into three instructional levels.

Almost everything needed for a complete lesson is included. Each level is composed of three parts:

1) Instant Lesson Plan

It is "instant" because very little prior preparation is necessary. Each lesson plan provides specific learning objectives, brief teacher directions, and answers to the corresponding reproducible worksheets. Suggested follow-up activities are also included. These ideas will help teachers who choose to cover these educational ideas in greater detail. Designed to be flexible, these suggestions can be applied to math, language arts, computer literacy, or other subject areas.

2) Reading Experience

This is a reproducible sheet that gives students a brief summary of the educational content of Spaceship Earth. The vocabulary and concepts are appropriate to each instructional level.

3) Follow-Up Worksheet

This reproducible page features questions and activities that review the reading material and provide practice in basic reading comprehension skills, such as recalling facts, sequencing, inference, and prediction.

BEFORE YOU START . . .

Before the lesson begins, you may want to describe your own experience at EPCOT Center. This not only personalizes Spaceship Earth; it also gives you a chance to share photos and souvenirs! The subject area specialists and classroom teachers who have contributed to this and other EPCOT Center educational materials hope that this Teacher's Guide will be among the most useful of your mementoes of EPCOT Center.

OBJECTIVES

To define communication
To introduce basic facts about the history of communication
To provide practice in reading comprehension skills

PROCEDURE

1) Write the word *communication* on the board. Help students to understand it and ask them to tell what they think it means.

2) Explain to students that they will be reading some interesting things about communication and that when they are finished, they should have a good idea of what *communication* means. Students can also be expected to remember at least two facts about the ways people communicated in the past. Inform students that they will be responsible for writing answers to a follow-up sheet. Teachers may wish to review directions on this activity sheet. Distribute reading materials.

EVALUATION

Review answers to activity sheet:
1-a, 2-c, 3-c, 4-b, 5-b, 6: a-2, b-1, c-3

Visitors to Spaceship Earth experience new technologies first hand.

SUGGESTIONS FOR FOLLOW-UP ACTIVITIES

1) Develop a list of communication devices students use daily (television, radio, home computer, magazines, books, telephone, newspaper, video recorder, stereo, movies). Have students graph and/or record the amount of time they use each in one week. Collect the data and create a cumulative bar graph for the class.

2) Divide the class into groups to research the communications advances made by the following groups and individuals: Egyptians, Phoenicians, Greeks, Muslims, Medieval monks, Gutenberg, Marconi, Bell. Assign other groups to find out about the inventions of the telegraph, motion pictures, television, and the computer. Organize a communications "history parade" or a "living time line" in which students create costumes and props to demonstrate the significance of the group, person, or invention they have researched.

3) For a specific amount of time eliminate an important form of communication, such as talking or reading, from the classroom. Plan this time in advance with your students and have them discuss what they think could happen as a result. Later have students write about their actual experiences and compare it to their expectations.

4) Interview a friend using only written communication.

5) Tell about something you did using only pictures you've drawn.

6) Tell about something you did using only body language.

The Story of Communication

Communication is the way in which people share information between one and another. There are many different ways to communicate. Speaking face to face is the simplest way of sharing an experience. The story of communication is the story of how people invented faster and better ways to share information with each other.

Long ago people communicated in very simple ways. At first they used sounds and gestures. But they had no way of recording their ideas. The first form of written communication was when people painted on cave walls. These pictures were about things that were important in their life, like the animals they hunted.

Thousands of years later, Egyptians wrote on the walls of their temples. They used hundreds of pictures for certain ideas or objects.

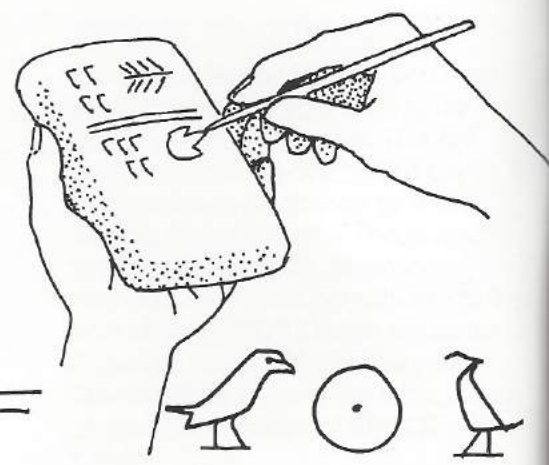
In other parts of the world people began writing on clay tablets. This made writing easier and now it could be moved. The Egyptians, however, discovered how to use papyrus plants to make a kind of paper. Papyrus scrolls could be easily carried from place to place. This was very important because it meant that ideas and learning were also carried to many more people.

The Phoenicians developed a simpler way of writing using only twenty-two symbols. This was the first real alphabet, and it is something like the one we use today.

Although communication was improving, everything still had to be copied by hand. This method was very slow. Then something great happened: a man named Johan Gutenberg invented the printing press with movable type. A page could be copied many times at once and put into books. These printed books brought new ideas to many more people than ever before.

As time went by, people developed more machines to help them communicate. They invented things like the telegraph, telephone, radio, motion picture, and television. Today, new communication tools, such as computers and satellites, can send information around the world in less than a second.

This is not the end of the story of communication. In the future people will keep finding better and faster ways to send and receive information. As long as there are people and ideas, the story of communication will go on and on.



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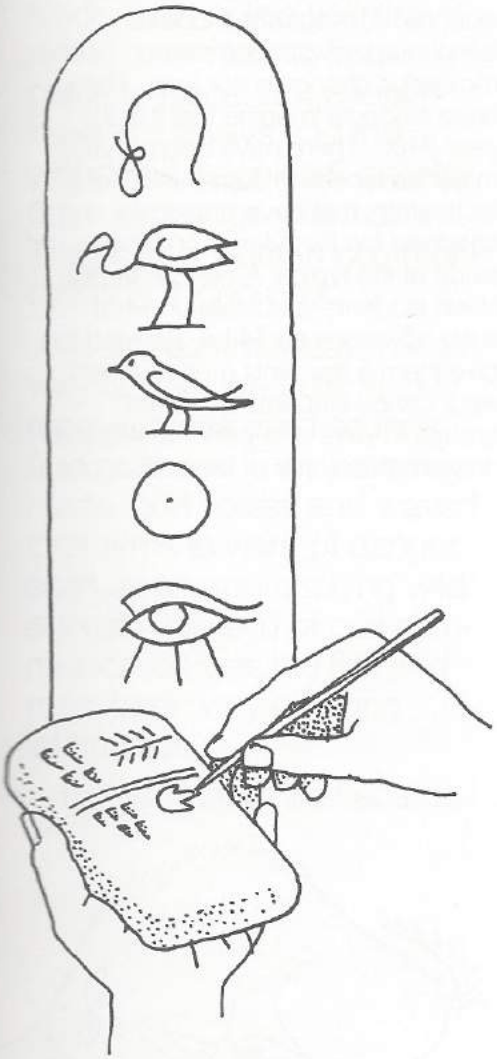


Underline the right answer.

1) The alphabet we use today is like the one developed by
   a) the Phoenicians
   b) the Egyptians
   c) Johan Gutenberg

2) The use of papyrus scrolls was important because
   a) it didn't cost much to make
   b) people were running out of wall space
   c) ideas could now be carried to new places

3) Written communication is one way that people
   a) read books
   b) send mail
   c) save what they say
   d) all of the above

4) When someone makes a gesture, they
   a) make smoke signals
   b) move a part of their body
   c) paint a picture

5) Communication is the way people give _____ to each other.
   a) food
   b) information
   c) clothing

6) Number these sentences in the order in which they occurred.
   a) ___ The printing press made copies of books.
   b) ___ People painted pictures on cave walls.
   c) ___ The telephone was invented.

On the back of this paper, answer questions 7-10.

7) Draw a picture of all the things you use to help you communicate. Label each picture.

8) Pretend that it is one hundred years from now. There are many new ways to communicate. On a separate sheet of paper describe three different ways of communicating.

9) Aliens have just landed on earth. How will you communicate with them?

10) How has Gutenberg's invention affected you and your family?

OBJECTIVES

To introduce an outline of the history of human communication. To provide practice in reading comprehension skills.

PROCEDURE

1) Teachers may want to review the following vocabulary words: communication, primitive, hieroglyphics, Egyptians, Phoenicians, papyrus, ancient, technology, manuscript.

2) Write the word communication on the board. Tell students that they will be reading about communication and that when they are through they should know at least three important facts about the history of communication. Inform the class that a written follow-up sheet will be distributed. (Teachers may want to review the directions before handing out the worksheets.)

3) Distribute reading materials.

EVALUATION

Review answers to the worksheet: (a-3, b-2, c-4, d-1); 1-c; 2-a; 3-b; 4-a; 5-c; 6-d; 7-d; 8-a; 9-c; 10-b; 11-b; 12-Discuss (may be used as extra credit)

Prototype communications technologies on display at EPCOT Center.

SUGGESTIONS FOR FOLLOW-UP ACTIVITIES

1) Divide students into small groups. Have each group choose a feeling, theme, or idea (i.e. joy, fear, childhood, old age). Each person in the group will use a different form of communication to express that theme. For example, one student may write a poem, another may sing a song, one may develop a computer game, or another could produce a script for a short film, video tape, or slide presentation.

2) Students can choose a variety of ways to dramatize important events in the history of communication. Possible formats include a television interview with an important figure, an "eyewitness" news report, a radio bulletin followed by "man on the street" interviews, or a quiz show.

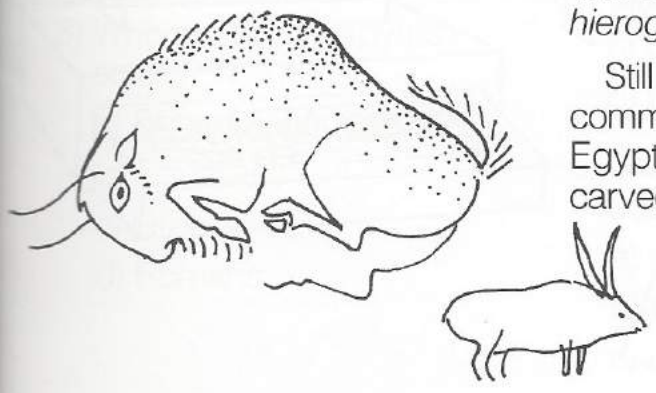
3) Discuss ways in which current communications technology (video recorders, home computers, television, radio, magazines, books, telephone, newspaper, stereo, movies) is changing our lives. Then have students imagine that it is the year 2100: There have been several major advances in communications technology that have drastically changed the lifestyles, work and study of the typical American family. Have students speculate on what such advances could be. Be ready to give them a few hints (optics, lasers, etc.). Divide students into small groups to write and perform skits that demonstrate some of these changes.

The Story of Human Communication

This is an age of advanced communications technology. Satellites bounce signals through space to bring events from the other side of the world into our homes. Computers speed information of all kinds, from police bulletins to airline reservations, from place to place. But people have not always had this wonderful machinery to help them exchange information. The story of human communication is a long one.

At first communication was very simple. We believe that early humans used sounds and gestures. They probably made loud noises and waved their arms to warn of danger, such as an approaching wild animal. This kind of oral communication was the first and most basic way of giving information.

But as human life became more complex, we think oral communication developed and became more complex, too, with different languages and more specialized ways of getting information around. As primitive noises became a spoken language communication greatly improved. Still, sounds always disappeared as soon as they were made. People needed a way to *preserve* their ideas and to share their experiences. And to find a way to talk to a larger or more distant audience. To do this people began to paint pictures on the walls of their caves. These cave drawings were the first kind of written communication.



The next improvement in writing was the use of symbols to stand for certain objects and ideas. The ancient Egyptians developed a complex system of picture-writing, with pictures and symbols to represent words and ideas. This writing was known as *hieroglyphics*.

Still another contribution to communication came from Egypt. At first the Egyptians carved their hieroglyphics into stone. Then they discovered that papyrus plants, which grew plentifully in Egypt, could be soaked, pressed, and dried to make a material like paper. This was an important discovery because papyrus scrolls could be easily transported, while stones could not! As the scrolls travelled from place to place, so did new ideas and learning. The scrolls could be used to record history.

Written language continued to develop. The seafaring Phoenicians developed a simple alphabet of twenty-two symbols. It became the basis of the alphabet we use today. The Greeks added vowels to this alphabet. Without vowels people could not always pronounce the words they had written. Now that they could say exactly what they wrote, the Greeks could preserve an important form of communication: drama. Some ancient Greek plays are still performed to this day.

Other groups added to the growth of communication. Romans built a great network of roads with Rome at the center. This helped to spread information throughout the large Roman Empire. The Muslims translated information from all over the world into their language, providing a rich storehouse of knowledge.

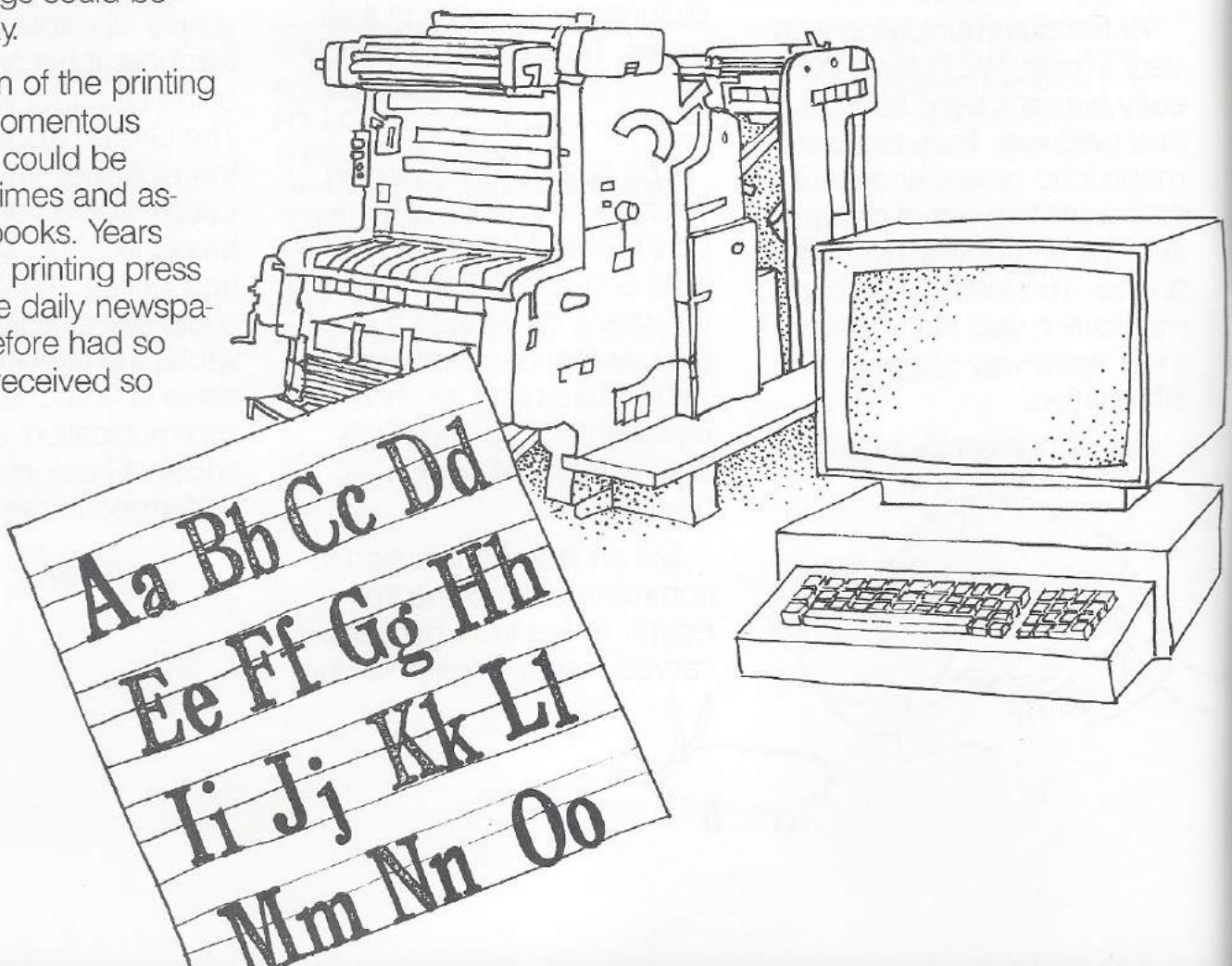
Writing was still a very slow task. In Medieval Europe monks spent long hours copying words onto parchment scrolls. Only a small amount of things could be copied this way.

The invention of the printing press was a momentous event. A page could be printed many times and assembled into books. Years later the steam printing press brought people daily newspapers. Never before had so many people received so much information so fast!

Now that machines were part of the story, communication began to improve swiftly. Soon the telegraph arrived, then the telephone was invented and people could speak directly to someone far away!

New inventions helped people have fun as well as information. The wireless radio entertained thousands of families and also brought the news into their living rooms. In time, pictures combined with sound. Movies and television brought comedy, drama, news, weather, sports, education, and commercials to millions of people.

Today computers speed information around the globe in seconds or less. They also entertain and educate people. But the story of communication does not end here. As long as people have ideas and the desire to share them, the communications story will continue.



Name_____

Date _____

Number these sentences in the correct order.

a) _____ Romans built a large network of roads.

b) _____ Phoenicians developed a simplified alphabet.

c) _____ The printing press was invented.

d) _____ People learned to make papyrus.

Underline the correct answer.

1) Written communication could best be described as
   a) pencil markings
   b) type
   c) preserved speech

2) Hieroglyphics is made up of
   a) symbols
   b) quill pens
   c) the Pharoahs

3) Who wrote on papyrus scrolls?
   a) Phoenicians
   b) Egyptians
   c) Greeks
   d) Romans

4) Why was writing on papyrus an important development?
   a) Information written on walls could not be transported.
   b) Papyrus was plentiful.
   c) Laws were written on papyrus.

5) What made mass production of books possible?
   a) the addition of vowels to the alphabet
   b) papyrus scrolls
   c) the printing press
   d) the telegraph

6) Which word is most like primitive?
   a) private
   b) secretive
   c) difficult
   d) simple

7) A scroll is a
   a) kind of doughnut
   b) scarf
   c) plant
   d) roll for writing

8) Something that is momentous is
   a) important
   b) fast
   c) big
   d) old

9) Adding vowels to the alphabet helped people to
   a) write much faster
   b) invent the printing press
   c) pronounce the written words
   d) speak different languages

10) The new form of expression invented by the Greeks was
   a) music
   b) drama
   c) writing
   d) literature

11) In Medieval times communication was slow because
   a) people were not interested in learning
   b) everything had to be copied by hand
   c) the peasants had no time to read
   d) there were many wars

12) On the back of this paper draw a time line to illustrate the history of communication.

Time-travel to an ancient Greek theater in Spaceship Earth.

OBJECTIVES

To present a summary of the important events in the history of communication. To provide practice in basic reading skills.

PROCEDURE

1) Teachers may want to review these vocabulary words. Cro-Magnon, Egyptian, Phoenician, Medieval, Renaissance, innovation, network, manuscript.

2) Explain that students will be reading about the history of human communication. Students should be able to recall at least four chronological events.in this history. Also inform students that they will be completing a written worksheet to check their reading.

3) Distribute materials.

EVALUATION

Review the answers to the worksheet: (a-3, b-1, c-2,); 1-d; 2-d; 3-e; 4-c; 5-a; 6-c; 7-d; 8-Discuss (may be used for extra credit)

SUGGESTIONS FOR FOLLOW-UP ACTIVITIES

1) Assign students to work in small groups to develop "History of Communications" board games. A game could be an episodic maze in which a figure overcomes obstacles on the way to exchange a secret message. As the game progresses, varying obstacles, messages, and figures could represent the chronology of the history of communication. (i.e. An Egyptian may escape snakes in his search for a papyrus scroll; Phoenicians keep their ships afloat; etc.) Students will have many more ideas! This concept can also be developed into a computer game.

2) Make a list of the communication aids that students use: television, stereo, video recorder, newspaper, magazine, post office, home computer, telephone, radio, books, movies. Divide the class into groups, and assign one device to each. Have each group survey students, stores, periodicals, and other sources in order to create a "consumer's guide," describing the best and worst features of each communication device. Work with students to develop guidelines, such as the minimum number of people to be polled, appropriate questions, and ways to determine credibility of sources. Results can be tabulated and displayed in various ways: as a book, on a chart, graph, or computer file.

3) Advanced communications technology is solving the problem of handling immense amounts of information. But the computer revolution is also creating new problems: delays caused by machine breakdown, unemployment, and computer "illiteracy" are examples. Through a discussion have students identify these problems, predict others, and suggest solutions.

4) To reinforce the difficulty in nonverbal communication, a game of charades or pantomime might help.

From Caveman to Computers: The History of Communication

Is communication an art? The great communicative power of artistic forms such as film, literature, television, theatre, painting, and more suggests this is true. Or is it a science? The recent upsurge in advanced technology such as communications satellites, video equipment, and computer communications networks seems to point to scientists as the master communicators. Today the way we exchange information is often a complex blend of science and art. This has not always been so. The methods of communicating have grown from prehistoric human shouts to futuristic computer "blips." The development of human communication is a compelling story as long as the history of mankind.

Primitive noises marked the beginning of the story. Scientists have theorized that upon noticing a wild animal approaching, an early primitive dweller might have grunted and waved furiously to warn others of the danger. Such basic oral communication may have eventually developed into more organized patterns and become recognizable as speech.

But this first oral form of communication was not enough. Sounds disappeared as soon as they were uttered. People yearned for a way of preserving speech, for some kind of *written communication.* Anthropologists suggest this may be one reason Cro-Magnon people painted pictures of their exploits on the walls of their cave dwellings. These cave drawings were the first form of writing.

The Egyptians expanded on the idea of painting pictures on cave walls. They developed a more sophisticated system of picture-writing: hieroglyphics, which utilized symbols as well as pictures.

The root of another communications advance was found in ancient Egypt. By soaking, pressing, and drying papyrus plants, the Egyptians created a paper-like material which they formed into scrolls. The use of papyrus scrolls was a significant step forward because it meant that written communication was portable (for the first time.)

Seafaring Phoenician traders brought the next improvement in communications. They simplified written symbols into an alphabet of only twenty-two characters. Because they traded scrolls as well as goods, the Phoenicians encouraged widespread use of their alphabet. It became the basis of the alphabet we use today.

The ancient Greeks also added to the legacy of human communication. By adding vowels to the Phoenician

alphabet, the Greeks developed a written language to express ideas of philosophy, drama, and science. This innovation inspired the preservation of important ideas expressed in the theatre.

Although primarily interested in law enforcement and strengthening of their empire, the Romans were responsible for a communications milestone. Their elaborate system of roads with Rome at the hub was the first communication network!

The Eastern World also made a major contribution to the advancement of communications. Muslims translated scientific knowledge from around the world into the Arabic language and, most importantly, stored that knowledge in libraries.

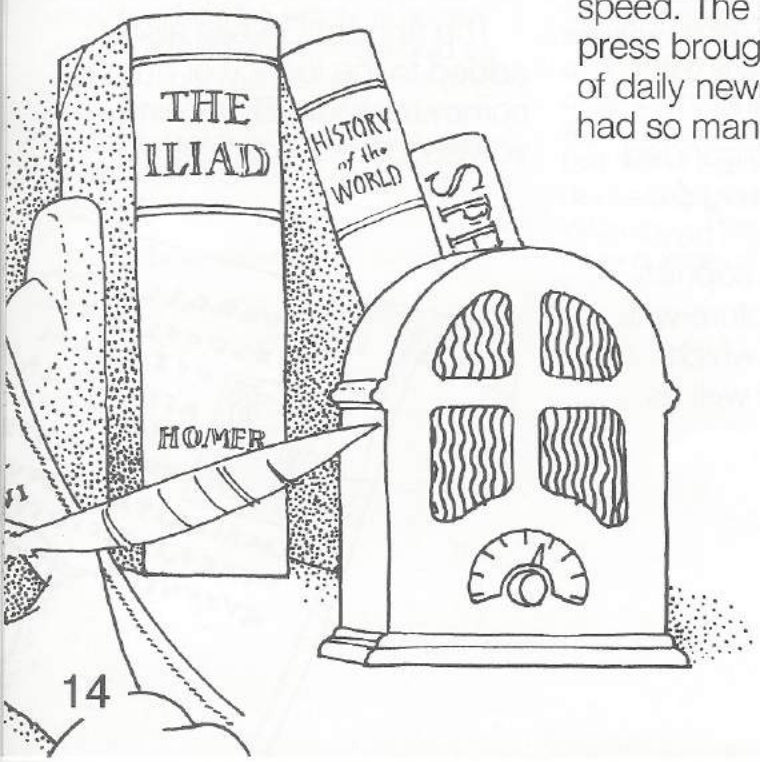
In Medieval Europe, monks continued the laborious tasks of hand-copying manuscripts. This slow procedure limited reading materials to only a privileged few.

The momentous invention of the printing press with movable type finally spread information to the masses. The increased availability of printed books sparked the Renaissance and encouraged an interest in discovery and expression, particularly in painting and sculpture.

Once technology entered the picture, the progress of communications began to move forward with more speed. The steam printing press brought wide circulation of daily newspapers. Never had so many people received so much information so fast. The telegraph marked the advent of instantaneous communication. Later, eliminating the need for dots and dashes, Alexander Graham Bell introduced his telephone — the first direct, long distance, verbal person-to-person communications device.

Having mastered the basics of information transfer, people found ways to use communications technology for entertainment as well. Wireless radio transmitted a combination of fun and news to a vast listening population. Motion pictures combined audio and visual capabilities in a new dramatic form. Soon television, eventually by satellites, brought the events of the world into individual living rooms.

Now complex computers speed information and entertainment around the world and beyond. But the story of communication is far from over. As long as there are people with ideas to share, the story will continue.



Name_____

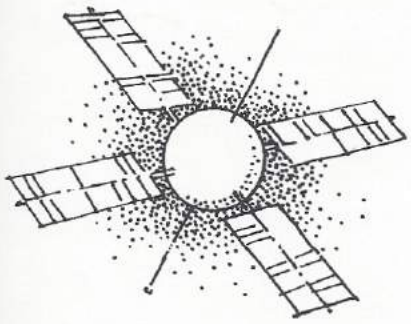
Date _____

Number these sentences in the correct order.

a) ____ Daily newspapers are published.

b) _____ Greeks record drama.

c) _____ Romans build a great network of highways.



Underline the correct answer.

1) What is the most primitive form of communication mentioned in the story?
   a) Egyptian hieroglyphics
   b) The Phoenician alphabet
   c) Medieval manuscripts
   d) None of the above

2) What was the first communications network?
   a) caves
   b) two monasteries in Britain
   c) a group of Greek playwrights
   d) the Roman highway system

3) The purpose of written communication is to
   a) allow people to read good literature
   b) preserve spoken language
   c) record history
   d) none of the above
   e) all of the above

4) Which occupation contributed most to the spread of the Phoenician alphabet?
   a) silversmith
   b) soldier
   c) trader
   d) physician

5) Why didn't the Egyptians write plays?
   a) Hieroglyphics could not be pronounced.
   b) They thought the theatre was frivolous.
   c) The Pharoahs would not permit it.
   d) None of the above.

6) The Renaissance was
   a) the title of the first book printed
   b) the first world's fair
   c) a revival of art and learning in Europe
   d) none of the above

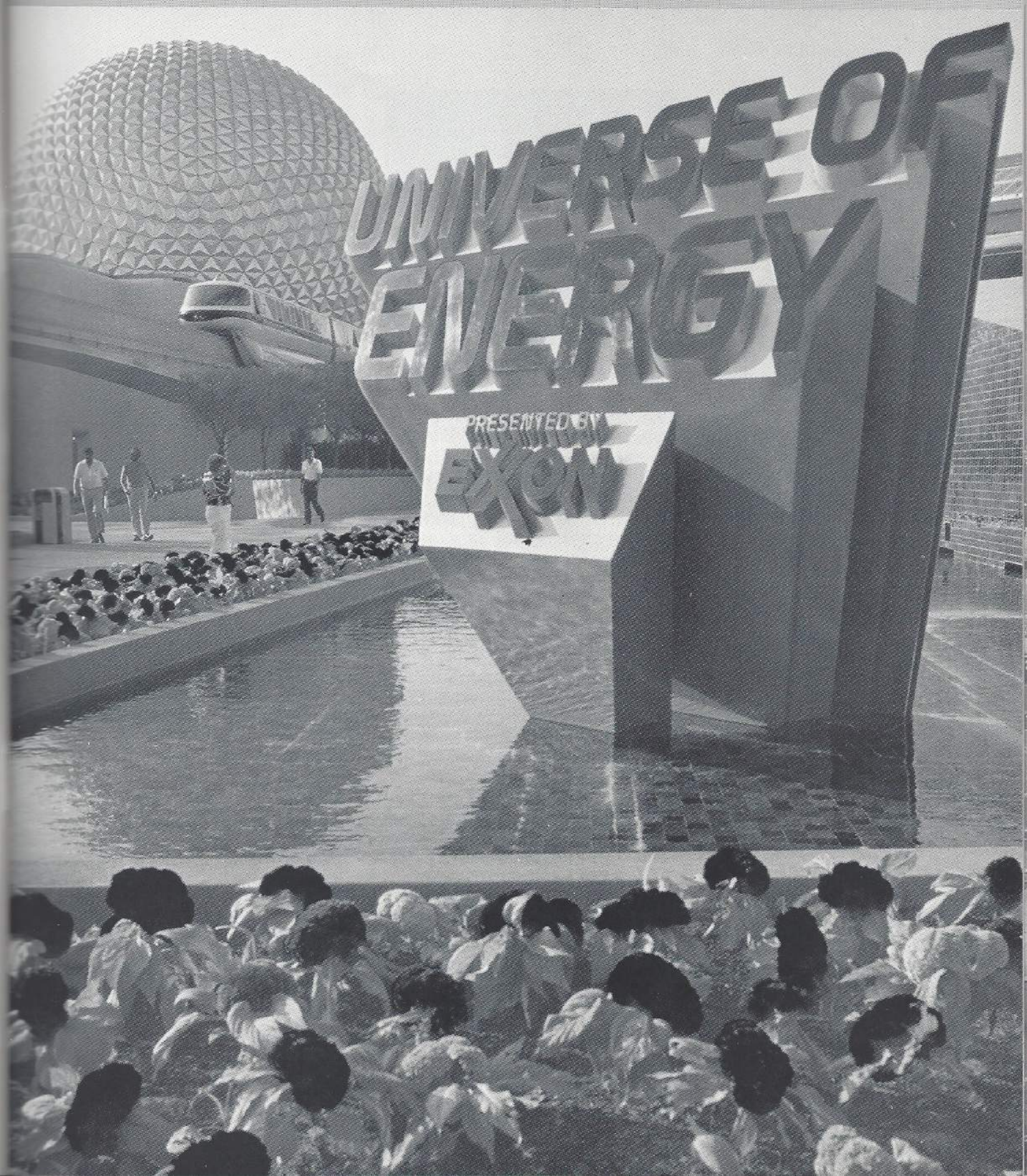
7) The basic purpose of communicating is to
   a) encourage people to read
   b) influence people to do what you want them to do
   c) distribute newspapers
   d) exchange information

8) On the back of this paper draw a time line illustrating the major events in the history of human communication.

A Classroom Guide
to the EPCOT Center Experience

UNIVERSE OF ENERGY

Presented by EXXON



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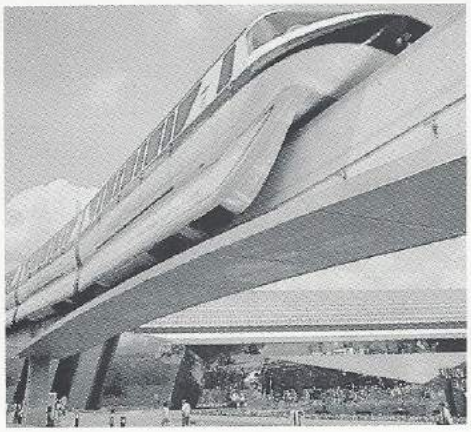

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2) Reading Experience

This is a reproducible sheet that gives students a brief summary of the educational content of *Universe of Energy*. The vocabulary and concepts are appropriate to each instructional level.

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This reproducible page features questions and activities that review the reading material and provide practice in basic reading comprehension skills, such as recalling facts, sequencing, inference, and prediction.

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OBJECTIVES

To define energy
To provide background information on fossil fuels
To give examples of future alternate energy sources
To provide practice in reading comprehension skills

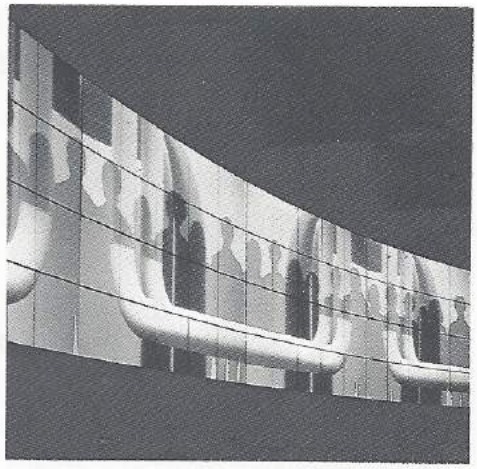
PROCEDURE

1) Teachers may want to review the following vocabulary words: energy, fuel, fossils, remains, dinosaurs, electricity, synthetic, nuclear, solar.

2) Place a heavy object on a table in the front of the room. Have several students take turns moving the object to different spots in the room. Explain that when scientists define energy as the ability to do *work*, they mean the ability to *move*.

3) Tell students that they will be reading about energy and that when they are finished, they should be able to tell you at least two facts about energy. Inform students that they will also be responsible for a written worksheet. You may want to review the directions on the worksheet before handing it out.

4) Distribute the materials.



EVALUATION

1) Ask students to recall important points from their reading.

2) Review the answers to the worksheet: 1) a-3, b-1, c-2, d-4; 2) a-M, b-P, c-M, d-M, e-P; 3) c, 4) c, 5) b, 6) a, 7) c, 8) Discuss

SUGGESTIONS FOR FOLLOW-UP ACTIVITIES

1) Title a bulletin board "ENERGY FOR PEOPLE AND MACHINES." Divide the board in half. Label one side "PEOPLE" and the other "MACHINES." Have students draw or cut out pictures of people and the varied foods they eat. Also have them locate pictures of different kinds of machines and their sources of energy. Let students help affix the pictures on the correct half of the board. Use colored strands of yarn and ask students to attach them from people and machines to the corresponding energy source.

2) Stimulate writing and divergent thinking about energy by asking each student to describe an extremely heavy, mysterious package. Then have students list fifteen different ways to move the box from one place to another.

3) Younger students are fascinated by dinosaurs. They may tell the story of fossil fuels in several ways: by dramatization, with painting, by constructing dioramas (perhaps including their favorite toy dinosaurs), writing songs, and more. Be sure that students mention the current problem with fossil fuels—their diminishing supply.

Universe of Energy

Energy is the ability to do work. For people to work, their bodies must change food into energy. Machines also need energy to work. Fuel is something that is used to create energy, usually by burning. Food is the fuel that the human body uses to get energy. But machines use other fuels to get their energy. Most of the energy used by machines and people began with the sun.

Plants use the sun's rays to grow. They also store some of the sun's energy. People and other animals eat the plants, or the meat of animals who have eaten plants. In this way, the energy stored by the plants is given to animals. Plants and animals have been getting energy from the sun in this way for millions of years.

Fossils are the hardened remains of plants and animals that lived long ago. Fossil fuels are the fuels formed from the remains of plants and animals that lived when dinosaurs walked the earth. Coal, gas and oil are fossil fuels. They contain the stored-up energy of the sunshine that fell on plants and animals hundreds of millions of years ago. This is why fossil fuels are sometimes called "buried sunshine."

Large amounts of fossil fuels are used every day and some supplies, such as oil and natural gas, are running low. New supplies are often in very hard-to-reach places. Some are even beneath the ocean floor. Oil drilling platforms as big as the Empire State Building are used to bring the oil to the ocean surface.

Scientists are developing other sources of energy for the future. Man-made fuels, called synthetic fuels, can be made from coal, tar sands, or a rock called oil shale.

Electricity is an important energy source. Power plants can use fossil fuels, nuclear energy and even water and wind to generate electricity. Coal, a fossil fuel, is a plentiful fuel for electrical power plants. The United States contains more than one-quarter of the world's coal supply. Nuclear power uses energy stored in tiny particles called atoms to make electricity. Windmills use the energy in the wind. There is also energy in the moving water of rivers. Dams trap that energy and turn it into electricity. In the future, the ocean's waves and tides may be used to create electric power.

Direct use of sunlight is an exciting source of energy. This is called solar energy. At EPCOT Center, the roof of *Universe of Energy* is covered with thousands of solar cells that change sunlight into electricity. These solar cells help power the theatre cars that carry visitors through the showcase.

If people use today's energy sources carefully and also continue to learn about new energy sources, there will be enough energy for the future.

Name_____

Date _____

Number these sentences in the correct order:

1) a) ____ Animals eat plants.
   b) ____ Plants use the sun's energy to grow.
   c) ____ Plants store some of the sun's energy.
   d) ____ Animals use the stored energy of plants.

2) Put a *P* next to the fuels that people use. Put an *M* next to the fuels that machines use.
   a) ____ coal
   b) ____ apples
   c) ____ oil
   d) ____ gas
   e) ____ steak

Underline the correct answer.

3) Which is the best title for the pages you have just read?
   a) The Time When Dinosaurs Walked The Earth
   b) Buried Sunshine
   c) Energy: Yesterday, Today, and Tomorrow
   d) Alternate Energy Sources

4) Fossil fuels are sometimes called "buried sunshine" because
   a) They are very hot.
   b) They can only be found in daylight.
   c) They contain the energy of the sun from millions of years ago.
   d) They are used to make solar cells.

5) A *synthetic* fuel is one that is
   a) from deep below the ocean floor
   b) man-made
   c) plastic
   d) easily burned

6) At EPCOT Center the cars that visitors ride through *Universe of Energy* are partly powered by
   a) solar cells
   b) wood
   c) gas
   d) wind power

7) Nuclear power uses energy stored in
   a) moving air
   b) oceans and tides
   c) atoms
   d) oil shale

8) Many scientists feel that wind power does not make a dependable future energy choice. Can you think why they might say this? Explain here: _____

_____

_____

_____

OBJECTIVES

To define energy
To identify and explain the derivation of fossil fuels
To introduce future energy alternatives
To provide practice in reading comprehension skills

PROCEDURE

1) Teachers may want to review the following vocabulary words: fossil, sediment, compressed, generate, converted, synthetic, remote, yields, controversial, nuclei, hydrogen, helium, geothermal.

2) Ask students if they know what dinosaurs have to do with the cars in which they ride. Accept reasonable answers and then tell students that they will be reading a few pages that will explain the connection. Students should be aware that a written follow-up is required.

3) Distribute the materials.

EVALUATION

Review answers to the worksheet: 1-a, 2-d, 3-b, 4-c, 5-c, 6-a, 7-c, 8-b, 9-Discuss

SUGGESTIONS FOR FOLLOW-UP ACTIVITIES

1) Have students research power blackouts that have occurred in the past. As a class, make a list of all the things that are affected by such a blackout. Then instruct students to compile their own lists of fifty ways of coping with such a blackout. For example, students could include several ways of cooking without electricity. After discussing the feasibility of their ideas, students could illustrate their lists, perhaps creating a compelling bulletin board display.

2) Divide students into small groups to develop energy board games or computer games. The objective of the games would be to reach a destination while overcoming several obstacles, such as running out of fossil fuels, a rainstorm interrupting solar power, a hurricane destroying a windmill, etc. Be sure that students include as many alternative energy sources as possible. These games, of course, will differ greatly according to the sophistication and ability of students.

3) Enlist the aid of the art and science teachers in helping students create "Rube Goldberg-type" models that illustrate what happens when someone uses some type of power. Students could have fun with this project by choosing a unique or humorous end result (i.e., a windmill to blow dry hair, a solar-powered hat, etc.).

Universe of Energy

Energy is the ability to do work. People and machines need energy to work. The human body derives its energy from food. For their power, machines use fuels other than food, such as oil, natural gas, or coal — the fossil fuels.

What are fossil fuels? They are the fuels formed from the remains of long-dead plants and animals. Plants convert the energy of the sun into usable energy by a process known as photosynthesis. Plants use some of this energy for growth, but they also store some. This stored energy is then transferred to animals when they eat the plants — or the meat of other animals who have eaten the plants. When prehistoric animals and plants died, their energy-rich remains were buried by mud, sand, sediment, and compressed into rock. The extreme heat and pressure of the earth gradually changed the remains into natural gas, oil, and coal. It is often said that fossil fuels are the "buried sunshine" of the time when dinosaurs walked the earth.

Increasing amounts of fossil fuels are consumed every day and some supplies, such as oil and natural gas, are running low. The search for new reserves is aided by sophisticated technology, including satellite scans and seismic echo devices. Once located, however, the fuels are often hard to retrieve, requiring the use of gigantic oil drilling platforms.

Scientists are searching for new sources of energy. Synthetic oil is now being produced from tar sands. Some day synthetic oil may fuel our cars and airplanes. Coal can also be converted to synthetic oil and gas. Oil shale, a rock that is plentiful in the United States, can yield vast quantities of oil when it is mined, crushed, and heated.

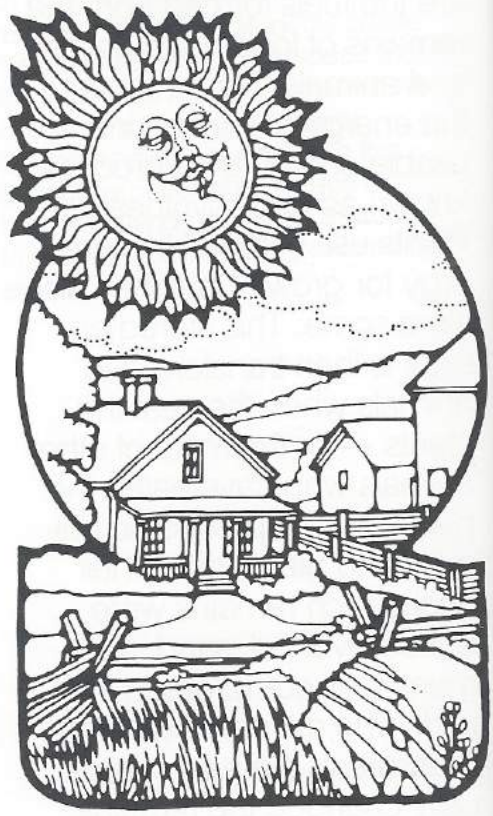
Another important energy source is electricity. Fossil fuels, or nuclear power, and even wind, water and geothermal energy, can fuel power plants generating electricity. Coal is one of the most plentiful fossil fuel sources for electric power plants. When burned in a boiler, the heat from coal is used to produce steam which then turns a turbine, generating electricity. More than one-quarter of the world's coal reserves are located in the United States, ensuring a long-term supply.

Although controversial, nuclear power is growing in importance as a source of electricity. Within 20 years, nuclear energy may contribute about one-fourth of the world's electricity. When the nuclei of certain atoms are divided, tremendous energy is released. Within the highly-controlled conditions of a nuclear reactor, this atom-splitting process, known as nuclear *fission*, creates heat to generate electricity. Scientists are also experimenting with nuclear *fusion*. When the nuclei of two atoms join, they form a new atom and in this process create an enormous amount of energy. Nuclear fusion occurs naturally on the sun. There, atoms of hydrogen combine to produce helium and the resulting energy lights and warms this entire planet. Scientists are striving to duplicate the same powerful process in a safe, usable way here on earth.

Windmills create electricity from the strong movement of air. Geothermal power plants can generate electricity from steam trapped within the earth. The energy contained in moving water, such as water released from dams, can generate electricity. Someday ocean waves and tides may be used as electric "generators."

Another future energy source, solar energy, comes from sunlight itself. At EPCOT Center, the roof of the *Universe of Energy* contains more than 80,000 solar cells. These cells convert sunlight directly into electricity and help power the moving theatre cars that visitors ride throughout the show.

The road to solving tomorrow's energy needs is long and complex. No single source will supply our future energy demands. With careful use of today's energy resources and the development of new sources for tomorrow, humankind may some day harness the entire "Universe of Energy."



Name_____

Date _____

Underline the correct answers.

1) Fuel is something
   a) used to produce energy
   b) in liquid form
   c) only used in the last 20 years
   d) cannot be man-made

2) Which of these are used as fuels?
   a) coal
   b) wood
   c) milk
   d) all of the above
   e) none of the above

3) Photosynthesis is a process by which
   a) dinosaurs stalked their prey
   b) plants convert the sun's energy into usable energy
   c) fossil fuels were formed
   d) none of the above

4) Remains of prehistoric plants and animals were changed into fossil fuels by
   a) the sun
   b) volcanic eruptions
   c) extreme heat and pressure
   d) photosynthesis

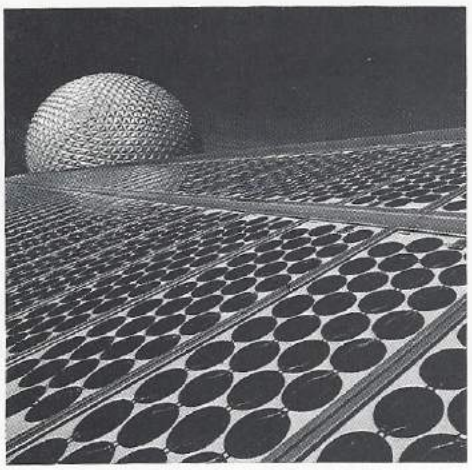
5) When something is *synthetic*, it is
   a) made of plastic
   b) inexpensive
   c) man-made
   d) unbreakable

6) Electricity generated from steam trapped within the earth is known as
   a) geothermal power
   b) wind power
   c) geyser fuel
   d) hydroelectric power

7) The sun's enormous energy is a result of
   a) sunspots
   b) gravity
   c) nuclear fusion
   d) nuclear fission

8) *Universe of Energy* at EPCOT Center provides a living, working demonstration of
   a) coal-mining
   b) solar power
   c) nuclear fission
   d) none of the above

9) Which of the alternate energy sources mentioned in these pages do you think will greatly change your life 25 years from today? Use the back of this paper to explain.



OBJECTIVES

To define energy
To explain the "sun-plant-animal" energy chain
To identify fossil fuels
To introduce alternate sources of energy for the future
To provide practice in reading comprehension skills

PROCEDURE

1) Write the word *energy* on the board. Explain that students will be reading a handout that contains many basic facts about energy. Tell students that they should be able to recall at least three of these facts when they have finished the reading. Also let students know that a written worksheet will follow.

2) Distribute the materials.

EVALUATION

1) Ask several students to recall one or more of the important points from their reading.

2) Review answers to the worksheet: 1-b, 2-c, 3-a, 4-c, 5-a, 6-d, 7-d, 8-c, 9-Discuss

SUGGESTIONS FOR FOLLOW-UP ACTIVITIES

1) Divide students into small groups to design and build models of "dream houses" operated by alternate energy sources. Have students create moving, working parts when possible. For example, a simple solar battery might power a child's outdoor merry-go-round. Encourage students to divide labor in a way that makes best use of the talents of each member of the group. Some students may do the rough draft, some the actual construction, and others may create a clever advertisement that explains the energy benefits of their "dream house".

2) After research, have students debate the issues regarding nuclear energy and the disposal of nuclear waste. Invite two experts supporting each position to answer questions after the debate. Before and after the debate, poll student opinions. Chart the results and discuss any changes.

3) What kinds of cars will your students be driving in twenty years? What kind of fuel will they be using for these cars? Divide the class into groups. Have each group develop a car magazine of the future. The magazine should include feature articles, interviews with experts, futuristic ads for new cars, and more.

Universe of Energy

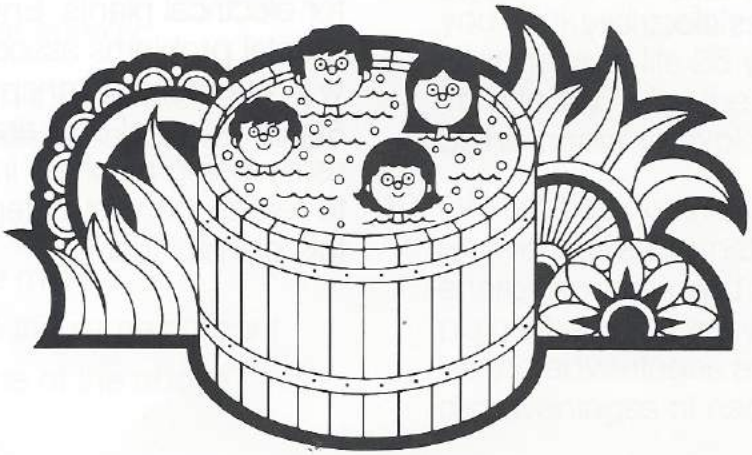
Energy is the ability to do work. People and machines need energy to work. One very complex machine, the human body, derives its energy from food. Through photosynthesis, plants convert the energy of the sun into chemical energy. Some of this energy is used for growth, but much of it is stored in the plant cells. Once people digest the plants (or the meat of other animals who have eaten the plants), their muscles can change the chemical energy into *kinetic* energy, the energy of motion. Thus humans, and other animals, are able to move — or, in terms of physical science, to *work*. For their movement, inanimate machines depend on fuels other than food, such as coal, natural gas, and oil — the fossil fuels. The fossil fuels were created from the remains of prehistoric plants and animals who received their energy in the same "sun-plant-animal" chain. For this reason, the fossil fuels are often referred to as "buried sunshine."

In the past, sources of fossil fuels were plentiful and inexpensive. However, as the demand for energy has increased, fossil fuel supplies have become increasingly expensive and difficult to obtain. At one time, enough fossil fuels could be produced domestically, but now oil and natural gas must be imported from foreign countries as well.

The need to reduce foreign importation and higher costs of fossil fuels have stimulated people to conserve energy. Conservation can be thought of as anything which helps to use less energy, or uses energy more efficiently. Some examples are the insulating of buildings to reduce heating and cooling requirements, and the development of automobile motors which use less fuel.

Even with conservation, the demand for energy has continued to grow, resulting in the search for additional fossil fuel reserves. Exploration for oil and natural gas has intensified, particularly in the Arctic region and ocean waters. This renewed effort is aided by sophisticated technology including satellites, seismic echo devices, and computers.

Much attention is now being paid to the development of alternate fuels which, in the long term, will add to our diminishing natural reserves. Already, synthetic oil can be produced from coal, tar sands, oil shale and even certain plants such as corn and water hyacinths. Scientists are currently working to lower the cost of synthetic oil production for wide-scale use.



The search for a better energy future must include resources such as solar, geothermal and wind. Solar energy, the energy contained in sunlight, can be used both for direct heating and the production of electricity. The sun's energy can heat and cool buildings as well as provide hot water for inhabitants. Another promising use of solar energy is photovoltaics — the direct conversion of sunlight into electricity. At EPCOT Center, the roof of *Universe of Energy* contains more than 80,000 solar cells which help power the moving theatre cars throughout the show.

Geothermal energy is already a reality in several locations around the world. Water from below the earth's surface provides direct heating and, in some instances, produces electricity.

At one time, windmills abounded both in Europe and the United States, harnessing the wind's energy to pump water and grind grain. Today, modern windmills are streamlined machines which contribute to the electrical supply.

No single source can provide all of our future energy needs. Careful use of current resources, coupled with the innovative development of new sources, can eventually harness the entire "Universe of Energy."

Significant sources for generating electricity over the near term include: coal (a fossil fuel) and nuclear and hydropower (both non-fossil fuels). Over one-quarter of the world's supply of coal is located in the United States, ensuring a substantial source for electrical plants. Environmental problems associated with the mining, transportation and burning of coal are currently being resolved in order to realize the vast potential of this plentiful fuel.

Nuclear power also provides a significant contribution to generating electricity. Present-day technology uses nuclear *fission*. In this process, the nuclei of uranium atoms are split, releasing enormous amounts of energy. The resulting heat boils water, producing steam which is then used to generate electricity. Scientists are also hard at work on an opposite nuclear process called *fusion*. In fusion, the nuclei of hydrogen atoms are joined together creating even more energy than fission. As in the case of coal, environmental problems and questions of health and safety are associated with nuclear power, posing one of man's greatest challenges today.

Although limited in its availability, hydropower is an important source of energy. The most common example of hydropower is dams which use the energy contained in moving water to produce electricity. Water stored behind the dam is released through tunnels containing turbines. As the turbine turns by the force of the water, electricity is generated. Energy technology, utilizing ocean waves and even tides, can also provide usable energy.

Name_____

Date _____

Underline the correct answers.

1) Muscles transform chemical energy into
   a) physical energy
   b) kinetic energy
   c) calories
   d) fat

2) In the definition of energy, to "work" means
   a) to get a job
   b) to exercise
   c) to move
   d) to heat

3) Fossil fuels are called "buried sunshine" because
   a) they contain energy stored from the sun millions of years ago
   b) are usually golden in color
   c) are used to light buildings through electricity
   d) all of the above

4) One-quarter of the world's supply of _____ is in the United States.
   a) natural gas
   b) oil
   c) coal
   d) solar energy

5) When the price of energy increases people will tend to
   a) use less
   b) use more
   c) use the same amount
   d) none of the above

6) Synthetic fuels are being produced from
   a) tar sands
   b) oil shale
   c) plants
   d) all of the above

7) Electricity can be produced from
   a) coal
   b) nuclear
   c) hydropower
   d) all of the above

8) The direct conversion of sunlight into electricity is called
   a) fission
   b) fusion
   c) photovoltaics
   d) none of the above

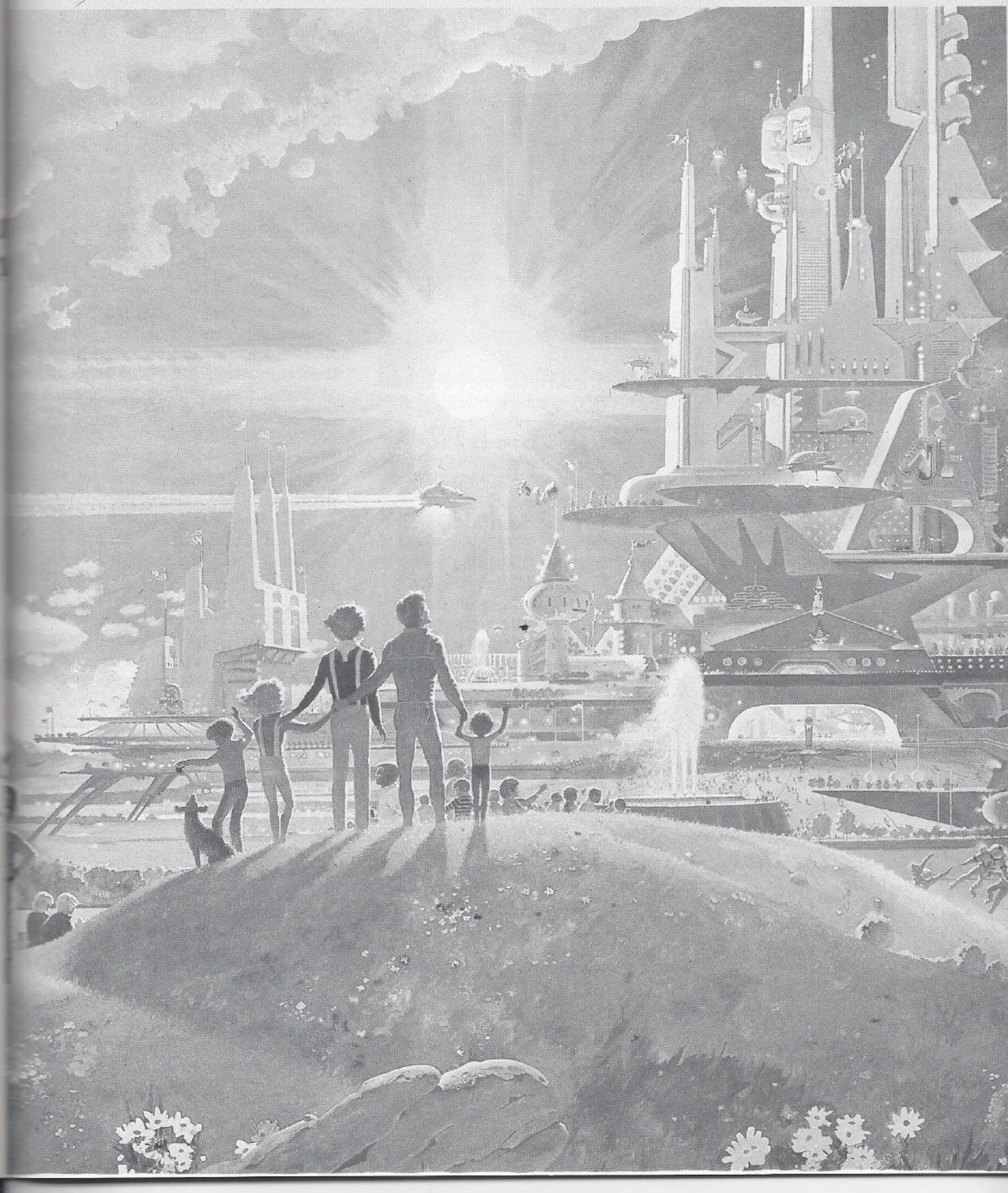
9) Which of the alternate energy sources mentioned in these pages do you think will greatly change your life 25 years from today? Use the back of this paper to explain.

10) ON the back of this paper list *two* future alternate energy sources and explain what you believe to be the advantages and disadvantages of each.

A Classroom Guide
to the EPCOT Center Experience

HORIZONS

Presented by GENERAL ELECTRIC



A Commitment to Education

EPCOT Center combines the Disney expertise in entertainment and communication with a compendium of information from the academic world, industry, and government. The primary goal of this combination is to provide visitors with an exceptional educational experience that *inspires them to actively participate in the shaping of the future*. In classrooms each day teachers try to achieve this same goal. For this reason, teachers, our most important guides to the future, are considered very special guests at EPCOT Center.

Horizons' vision of a future desert farm.

A Field Trip with a Long Memory

Teachers often enrich the curriculum by bringing to it the immediacy of their own experiences. Sharing snapshots and souvenirs is one way of transferring the excitement of travel to a classroom. But EPCOT Center is much more than a sightseeing destination. The discerning educator can stretch an EPCOT Center visit into a functional and lasting part of a curriculum. This Teacher's Guide is designed to help educators tap the vast informational resources of EPCOT Center and put them into a meaningful academic context. Filled with practical, easy-to-use materials and ideas for immediate classroom use, this guide serves as a "take-home" field trip to EPCOT Center!

How to Use this Guide

To assist teachers in a variety of learning situations, the materials in this guide have been divided into three instructional levels.

Almost everything needed for a complete lesson is included. Each level is composed of three parts:

1) Instant Lesson Plan

It is "instant" because very little prior preparation is necessary. Each lesson plan provides specific learning objectives, brief teacher directions, and answers to the corresponding reproducible worksheets. Suggested follow-up activities are also included. These ideas will help teachers who choose to cover these educational ideas in greater detail. Designed to be flexible, these suggestions can be applied to math, language arts, computer literacy, or other subject areas.

2) Reading Experience

This is a reproducible sheet that gives students a brief summary of the educational content of Horizons. The vocabulary and concepts are appropriate to each instructional level.

3) Follow-Up Worksheet

This reproducible page features questions and activities that review the reading material and provide practice in basic reading comprehension skills, such as recalling facts, sequencing, inference, and prediction.

BEFORE YOU START . . .

Before the lesson begins, you may want to describe your own experience at EPCOT Center. This not only personalizes Horizons; it also gives you a chance to share photos and souvenirs! The subject area specialists and classroom teachers who have contributed to this and other EPCOT Center educational materials hope that this Teacher's Guide will be among the most useful of your mementoes of EPCOT Center.

OBJECTIVES

To show that life in the future can be exciting, enjoyable, and productive

To illustrate technology's vital role in the future

To encourage students to study math and science as preparation for their future

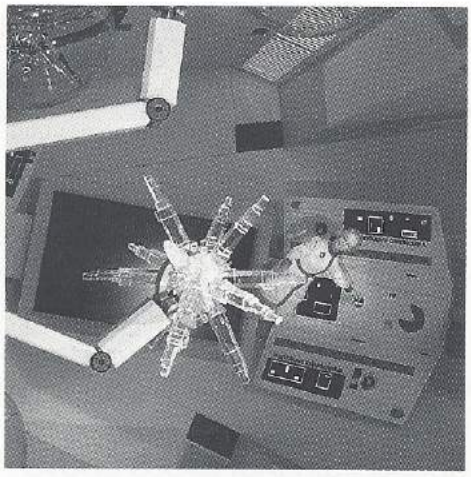
To provide practice with reading comprehension skills

PROCEDURE

1) Write the word *technology* on the board. Say the word and ask students to define it. Write some of the reasonable answers on the board. If they cannot define this word, perhaps students can tell you where they have heard or seen it used.

2) Write the word *future* on the board and repeat the above procedure. Tell students that you will now be giving them a reading assignment having to do with these two words. When finished reading, students should not only know the definition of the word *technology*, but they should also be able to explain its importance in the future.

3) Inform students that they will have a written follow-up to their reading. Before handing out reading materials, you may want to review all or some of these vocabulary words: science, machines, computers, calculators, video games, magnetic, communicate, robot, harvesters. You may also want to go over the directions for the worksheet before the students begin.



Laser technology will continue to improve with future study.

EVALUATION

1) Once again write or point out the words *technology* and *future* on the board. Ask students to explain the connection between the two words.

2) Review the answers to the worksheet:
1-b; 2-a; 3-a; 4-d; 5-d; 6-c; 7-c; 8-b; 9-a.

SUGGESTIONS FOR FOLLOW-UP ACTIVITIES

1) Locate parents or other people in the community whose jobs are technology-oriented. Invite these people to speak to your class. Encourage speakers to emphasize the relevance of their academic preparation to their current work. Arrange field trips for students to see high-tech careers in action. You will probably find that many nearby businesses, from television stations to supermarkets, are anxious to show off their latest high-tech equipment.

2) Divide the class into four groups. Have each group write and perform a skit about life in a future environment such as a high-tech city, a desert farm, a space colony, or an undersea city.

3) Have students write a journal of their trip to a space colony, a desert farm community, or an undersea city. If possible, have students write and edit their journal on a computer with word processing equipment.

4) Divide class into small groups. Each group will construct a detailed model of an environment of the future. Careful measurement and correct scale should be used.

5) Have students draw or paint a picture, or construct a diorama representing the futuristic environment in which they would choose to live. Have students accompany the artwork with a paragraph or two explaining the reasons for their choice.

Horizons

You've probably heard the word *technology* a lot these days. But you may not know just what it means. Technology is the science of machines. Computers, calculators, and video games are new machines that are changing our lives. Scientists and engineers know that technology will make the world very different and exciting in the years ahead.

In the future we may be living and working in places that we never have before. Scientists are talking about cities under the oceans and farms in the middle of deserts! Space cities, or colonies, may orbit the earth. These new communities could be much like the town you live in right now. Try to imagine going to an underwater school, or playing a space basketball game in which you can float up to the basket. Technology can make all these things possible.

A holographic telephone will let you see callers in 3-D.

How will people travel to all these different spots? Your family could ride through space in a mini-spaceship. Back on earth you might zoom to school on a high-speed train that glides above a magnetic track. Maybe you'd have your own personal submarine to travel underwater.

People will also need to communicate in new ways. You might have a friend living in space, another in an underwater city, and another on a desert farm. With a holographic telephone you could see and hear them all at once — and in "3-D"! People will also do a lot of communicating with machines. You might fix yourself dinner by talking to your electronic pantry. And when a computer helps you with your homework, it will talk back to you!

The foods of the future will also be very different. Can you picture a pinana, a fruit that tastes like a pineapple and a banana? Imagine a watermelon-sized orange that you drink with a straw! Crops may also grow in places they never have before — in space, in the desert, or even beneath the sea. In your mini-sub you could care for your underwater farm. From the computer control room of a desert farm you could give orders to your robot harvesters. Perhaps you'd be a space farmer, growing lettuce in spinning drums!

No one can know for certain what the future will bring. But we can be sure of this: technology will help make the future very exciting. Because you will be living in this future, it is important that you start learning about technology now. You can do this by studying subjects such as math and science now. If you understand math and science, you will be able to understand and use technology later. Right now you can make the choices to study subjects that will help you in the future. Other subjects such as English, social studies, art and music are also important because they will help you to express yourself and give you many new ideas. With the right education *you* could be one of the scientists or engineers that helps build the first space colony or underwater city! If you can dream it, you can do it.

Name_____

Date _____

Underline the correct answer.

1) Technology is the science of
   a) living things
   b) machines
   c) space
   d) water

2) The main idea of the story is that _____.
   a) technology will make the future exciting
   b) people will live in space
   c) people will drive mini-submarines
   d) you should study music

3) A pinana is a fruit that _____.
   a) tastes like a pineapple and a banana
   b) you drink with a straw
   c) is easy to pick
   d) tastes like a pineapple and an orange

4) In the future you may get around in a _____.
   a) mini-submarine
   b) magnetic train
   c) mini-spaceship
   d) all of the above

5) In the future you might be able to _____.
   a) play basketball in space
   b) ride a mini-spaceship
   c) have a 3-D telephone
   d) all of the above

6) A space colony will be like a _____.
   a) farm
   b) cave
   c) city
   d) desert

7) A robot *harvester* is a machine that would _____.
   a) fly a plane
   b) eat food
   c) pick crops
   d) build homes

8) Studying math and science will _____.
   a) not be important in the future
   b) help you to understand technology
   c) make you a happy person
   d) be easier when you get older

9) English is an important subject because it helps you _____.
   a) express yourself
   b) be happier
   c) make friends
   d) think fast

OBJECTIVES

To show that life in the future can be exciting, enjoyable and productive

To illustrate technology's vital role in the future

To encourage students to study math and science as preparation for their future

To provide practice in reading comprehension

PROCEDURE

1) Write the words *high technology* on the board. Ask students to define it. By a show of hands, have students acknowledge how many of them plan to have careers in high-tech fields. Make a note of this count.

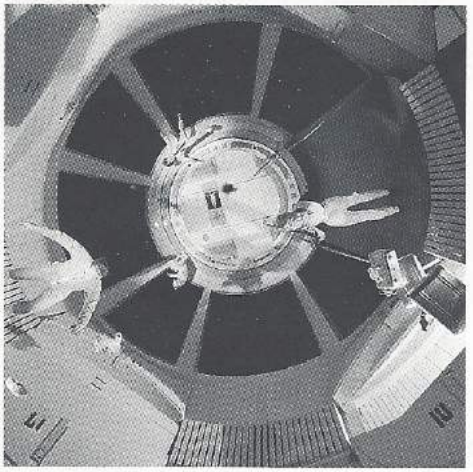
2) Tell students that you will be giving them a reading assignment about technology and the future. Inform students that when they are finished reading they should not only be able to define *high technology*, but they should be able to fully explain its role in the future.

3) Explain that a written follow-up will help students to check their reading. Before handing out the reading materials, you may want to review some or all of these vocabulary words: industrial, environment, flourish, utility, vehicle, hover, three-dimensional, cultivation.

EVALUATION

1) Take the informal occupational survey again. Have the results changed? Discuss why and why not.

2) Review answers to the worksheet: 1-b; 2-c; 3-d; 4-b; 5-c; 6-b; 7-d; 8-b; 9-c; 10-d; 11 & 12: Discuss.



A zero-gravity space colony is one vision of tomorrow.

SUGGESTIONS FOR FOLLOW-UP ACTIVITIES

1) As a class project create a futuristic world's fair. Enlist the support of art, music, and physical education specialists. Students could plan and present activities such as: simulating a zero gravity Olympics exhibition; recording and listening to music of the future; displaying models of genetically engineered foods; dramatizing conversations on a holographic party line. One corner of the fair could feature a display of antiques — telephones, televisions, video games, and other relics from the latter part of the twentieth century!

2) Have students research and answer this question: How would zero gravity affect everyday life on a space colony?

3) Have students develop their own board game in which the players go after high-tech career options. For example, in this game players might draw cards on which math and science questions are written. Players gain points or move ahead when they correctly answer the questions. Answering enough questions could win players futuristic career options such as: a place in an expedition to seek out new sites for space colonies; a job as an artist who paints with holography; or a position as a gourmet chef who cooks with a voice activated computer. Students will be able to design a game of intrigue and fun — and they could also translate the idea into a video or computer version.

4) Divide the class into four groups. Assign each group a futuristic environment: the desert farm, a space colony, an earth city, an underwater city. Have each group write a newspaper or present a simulated television news show representing a typical day in this environment. If possible, newspapers should be written and edited on computers. Students familiar with computer graphics could illustrate this electronic newspaper.

5) Divide the class into groups. Have each group write, produce, and perform a short play which begins: "A teenage _____ is finishing *his/her* _____. There is a knock on the door. A person hands *him/her* a large envelope. It is a certificate good for unlimited hours of course study in math and science. Already our hero thinks how different things can be . . ." Each play or skit should show the important (and amusing) ways that studying math and science can improve one's future job opportunities.

Horizons

High technology. You're probably hearing that term a lot these days. Just what does it mean? And what does it have to do with you? Technology is the science of machines. The term high technology refers to the development of advanced machines such as computers. This kind of technology is already changing your life. If you use a pocket calculator or play a video game, you are involved in the world of "high tech". Experts predict that technology will drastically change our world in the years to come. When you examine some of these predictions, you will understand what technology has to do with you — and what *you* will have to do with technology.

How we live in the future is bound to change. But *where* we live may also change. For a long time people have imagined what it would be like to live in space. Technology will make it quite possible for people to live and work in space colonies. These orbiting space cities may be similar in many ways to the community in which you are living right now. For instance, you could play basketball; but because of zero gravity you could literally float up to the basket for a shot! Space is not the only new territory that can be opened up by technology. Scientists and engineers will be able to change earth environments so that people could live where they never have before. Deserts could be turned into farms. Cities might flourish beneath the sea.

Technology would also provide new forms of transportation for these new living spaces. Imagine riding to a space colony in your own mini-shuttle! In cities on earth you could zoom to your destination on a high-speed train gliding above magnetized tracks. In the desert you might drive a hoverlift utility vehicle. Beneath the ocean you'd pilot a one-person submarine.

Communication technology is ever-changing.

As people branch out to new environments, they will demand new methods of communication. Space colonists, desert dwellers, and undersea citizens will be able to see and hear each other through three-dimensional holographic telephones. In a world of advanced technology people will have to communicate with machines as well as they do with humans. On a desert farm, for example, a farmer may use a video computer to send orders to his field harvesters — who happen to be robots. The farmer's family could order meals by simply speaking to their computerized electronic pantry. Such person-to-machine communication will hardly be one-sided: computers will certainly answer back.

Technology will also improve the cultivation of natural resources. Farmers will not just *grow* crops: they will *genetically engineer* them. This means that the genes of plants will be combined or changed to produce entirely new varieties of plants. Think about vines of multi-colored grapes, or huge oranges you can drink with a straw. Scientists are already developing plants that can grow without soil. In the future some trees may grow fruit only on the outer limbs — for easy picking. Some plants could even grow sideways, defying gravity. Undersea kelp farms will supply food and fuel materials. Space colonists will not only be able to grow their own foods, they will also grow large amounts of crystals, which then will be used in technological devices. Underwater miners will vacuum mineral-rich manganese nodules from the floor of the ocean.

Tomorrow's undersea cities, space communities, desert farms, and much more are taking shape in the minds of today's engineers and scientists. They are already taking these dreams steps closer to reality. Robots now work in factories; computers respond to the human voice and touch. Machines make life easier and better in countless ways. They also create many job opportunities for those people with the necessary skills. We need more people who can develop new ideas, people who can build machines, people who can repair equipment, and people who can teach others how to use computers.

Today's technology beams information around the world in seconds.

What, then, does technology have to do with you? It is the door to the future — *your* future. What do *you* have to do with technology? You must start preparing yourself to use it, to understand it, to dream with it. You can do this by making sure you take plenty of courses in math, science, computers, and physics. English, social studies, and the arts will also help you express ideas clearly and will give you many new ideas. Technology is the door to tomorrow. Your key to that door is the right education. If you can dream it, you can do it.

Robots might contribute more to our future lifestyle.

OBJECTIVES

To illustrate the significance of technology in our present and future society

To encourage students to obtain a solid background in math and science in preparation for the future

To provide practice in basic reading skills

PROCEDURE

1) Briefly discuss this question: Do the subjects you study in high school really have anything to do with getting you a job in the future?

2) Inform students that you will be giving out a reading assignment dealing with this question in a unique way. Let students know that a written worksheet will also follow. Before handing out the reading material, you may want to review all or some of these vocabulary words: intriguing, industrial, mechanical, prediction, transform, environment, feat, hover, utility, genetic.

EVALUATION

1) In light of the reading, have the students' opinions changed regarding the question with which you opened the lesson? Why or why not?

2) Review the answers to the worksheet: 1-b; 2-a; 3-c; 4-d; 5-d; 6-b; 7-a; 8-a; 9-c; 10-b; 11 & 12: Discuss.

SUGGESTIONS FOR FOLLOW-UP ACTIVITIES

1) Dramatize the importance of studying math and science. For example, students could write and perform a parody of Dickens' "A Christmas Carol". In this tale a reluctant math student is visited by ghosts of the past, present, and future. These spirits covince the student that studying math and science today will bring a better tomorrow.

2) Invite as many speakers as possible to discuss their own careers. Always make sure that you have at least a few broad objectives for your speakers — and discuss them with your guests in advance. Most people appreciate a brief list of anticipated questions. Seek out people whose occupations are not overtly technical, but who use technology in many ways. For example, call upon a journalist who uses a word processor or video tape equipment, an athlete who uses computerized feedback, or a chef who uses a computerized supply closet. Most successful people in traditionally non-technical fields (music, art, advertising, publishing, etc.) still need math and science skills to get their jobs done. Such people can impart valuable lessons to your students.

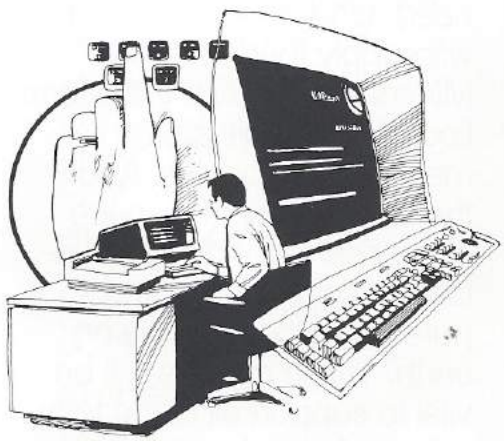
3) Have student choose one of the futuristic environments (desert farm, high-tech city, underwater city, space colony) and use it as a setting for a short story, poem, song, comic book, video movie, or computer adventure game.

4) Ask the media specialist to help you locate works by classic science fiction writers such as Jules Verne or George Orwell. (The media specialist may be able to find lesser known, but equally relevant authors.) Assign individual readings or read aloud some selections and discuss them with students. Some discussion questions could include: Which of these predictions came true — or even close to the truth? What probably influenced the writer's idea? How are these predictions different from scientific predictions made today?

Horizons

High technology. Everyone's talking about it. But do you know what it means? Simply defined, technology is the science of mechanical or industrial arts. High technology refers to advanced mechanical developments in such fields as computer science and robotics. How is this significant to you? You already see how personal computers, hand-held calculators, and video games are changing the ways you work — and play. But the impact of technology will be far more pervasive in the future. It may change the foods you eat, the places you live, the jobs you choose. Let's examine some of the latest and most intriguing predictions for the future. Once you glimpse tomorrow through the eyes of today's engineers and scientists, you may understand not only what technology can do for you — but what you should do about technology.

Technology can create startling changes in environments. Hostile environments can be transformed into liveable, workable spaces. Technology will enable people to grow luxuriant crops in the midst of deserts. To make productive use of the incredibly rich resources of the sea has long been a dream of scientists, explorers, and story-tellers. Technology has the potential to turn even our wildest dreams into reality. Cities could flourish underwater as people mine, farm, and research there. What about the science fiction tales of living in space? Such tales may not be fiction for much longer. The technology to enable people to live in orbiting space colonies is rapidly developing. These space communities may be similar, in some ways, to your own home town. You could probably still play basketball for your high school; but in a zero-gravity game you could literally float up to the basket for a layup shot! And you'd probably want to work out in the gym before or after the big game. In a space gym you could give yourself a complete physical with a scanner that takes an electronic snapshot of your body and gives you an instant reading on every aspect of your health. You wouldn't even have to take off your tee-shirt. Living in a technologically enhanced environment would be unique, exciting, and fun.



High technology serves communication needs.

Technology will also provide appropriate forms of transportation for these unique living spaces. You might visit a friend on a nearby space colony by taking a jaunt on your mini-shuttle. Urban mass transit here on earth may be quite different, too. You could travel on a "mag-lev" train, a high-speed system that zooms above magnetic tracks. Many other vehicles will be specially designed for new earth environments: hoverlift utility vehicles could carry harvests from the deserts; one-person submarines may transport people to undersea destinations.

Person-to-person communication will be increasingly changed by technology. You may have already heard about holography, three-dimensional photography made possible by the use of laser light beams. In the years to come you may be hearing and *seeing* your friends on holographic telephones. In fact, on a holographic "party line" you could have a 3-D "visit" with your friend living on a space colony, another friend on a desert farm, and another in an undersea city.

Person-to-*machine* communication will be very important in the years ahead. If you live and work on a desert farm, for example, you might use your video control room to send orders to the harvesters — who happen to be robots. You could cook up a delicious meal by merely mentioning it to your computerized electronic pantry. If you now use a personal computer to help you with your studies, you can probably easily imagine working with a computer that talks to you in clear English instead of tones and beeps. Computers activated by the human voice and computers that talk back are fast being developed by today's engineers and scientists.

Genetic engineering is another term that you may have heard recently. By combining or altering the genes of living organisms to create new ones, scientists are already beginning to create new and more nutritious species of plants. There are now crops that can grow in special nutrient solutions with no soil. In the future, scientists may develop fruits that grow only on the outer limbs of trees — for easy harvesting. They may create spectacular new fruits and vegetables, such as watermelon-size oranges or multi-colored grapes. The first experiments in genetic engineering are now laying the groundwork for tomorrow's desert farms.

Places below and beyond the earth will be cultivated to provide the materials we will need. Underwater kelp farms will supply food and fuel. Miners will vacuum the ocean floor for mineral-rich manganese nodules. And in the zero-gravity of a space colony semi-conductor crystals will grow bigger and purer than those made on earth. These crystals will be vital to support all of the technological wonders that will surround us.

These predictions are not as far-fetched as they may first appear. Robots now work in factories; computers respond to human voices and to our touch; the science of genetic engineering is growing fast. But today's scientists and engineers have just begun. They need more technicians, more computer scientists, more mathematicians, more dreamers — more people who can work with technology. Technology is the door to your future. You must start preparing yourself to use technology, to understand it, to dream with it. You can do this *right now* by getting a solid background in math, science, computers, and physics. Don't forget that English, social studies, and the arts will help you express ideas as well as give you many new ones. Math and science are the key to the world of technology. With the right keys, you can be sure that all the doors will be open for you. If you can dream it, you can do it.

Name_____

Date _____

Underline the correct answer.

1) A high-tech world means a world of _____.
   a) high finance
   b) advanced machines
   c) microchips
   d) none of the above

2) The word most like *transform* is _____.
   a) change
   b) experiment
   c) extend
   d) create

3) Technology will be more *pervasive* in the future: This means that technology will be _____.
   a) dangerous
   b) difficult to use
   c) everywhere
   d) expensive

4) Technology may allow you to _____.
   a) live in the desert
   b) work on a space colony
   c) live underwater
   d) all of the above

5) A future kind of transportation may be a _____.
   a) a mag-lev train
   b) mini-shuttle
   c) one-person submarine
   d) all of the above

6) Holography is _____.
   a) a way of delving into the earth's core
   b) three-dimensional laser photography
   c) microphotography
   d) all of the above

7) A computer that is *voice-activated* will _____.
   a) respond when you speak to it
   b) respond when you touch it
   c) make human sounds
   d) none of the above

8) Genetic engineering may create plants that _____.
   a) grow without soil
   b) grow without water
   c) grow without light
   d) none of the above

9) Miners will vacuum the ocean floor for _____.
   a) crystals
   b) kelp
   c) manganese nodules
   d) all of the above

10) _____ are the subjects that can best help you to understand technology.
   a) music and art
   b) math and science
   c) math and music
   d) none of the above

On the back of this paper write your answers to these questions:

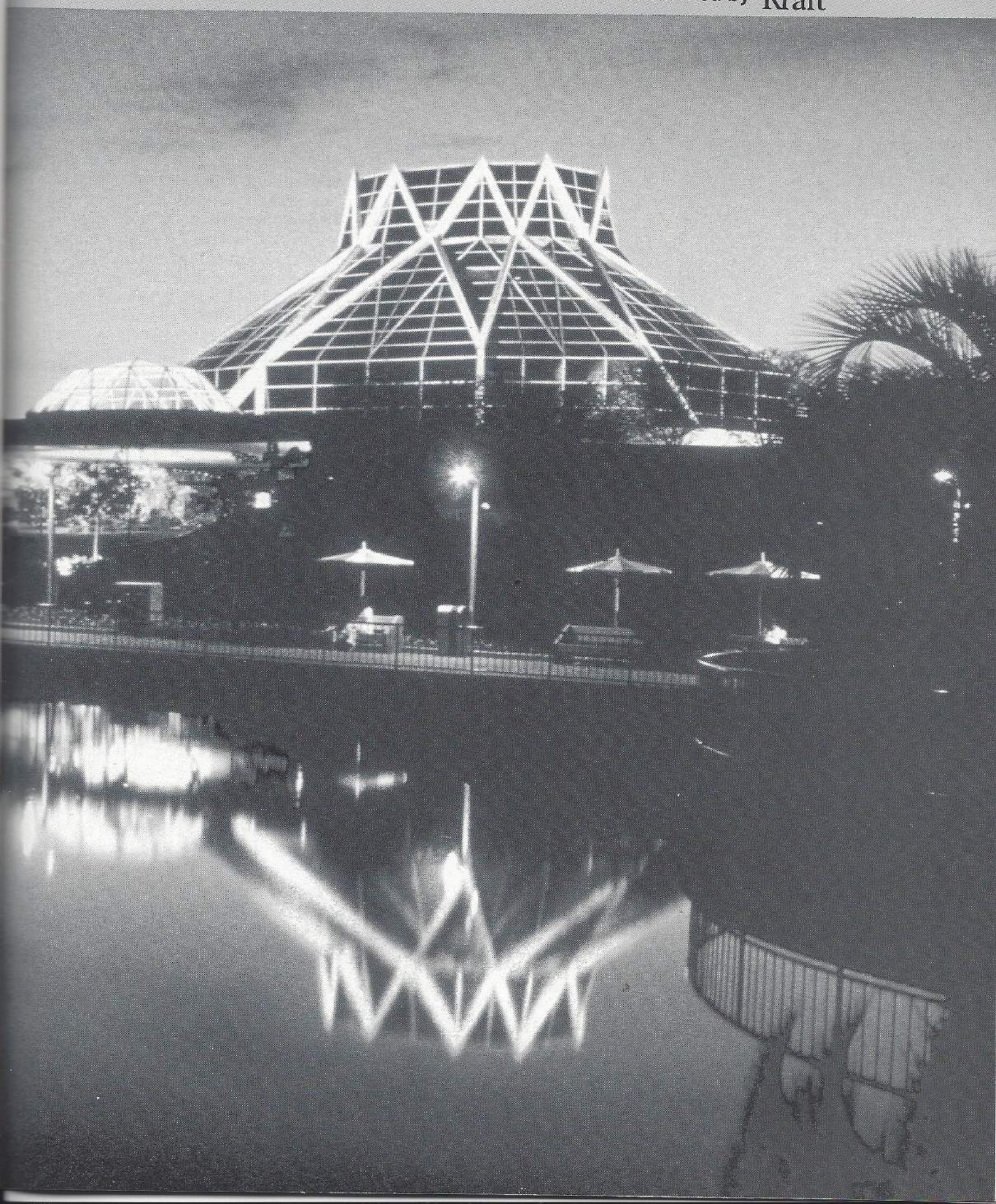
11) If you could have the career of your choice, what would it be? List the ways in which advanced technology could be used in this career.

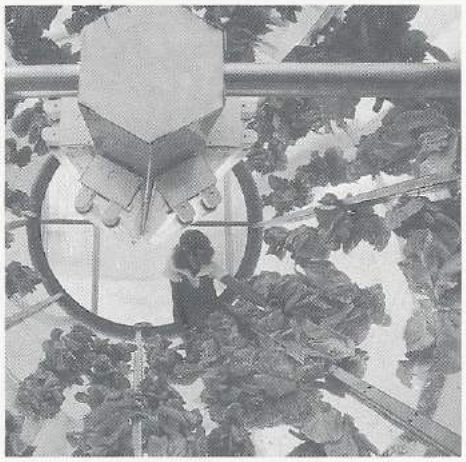
12) What school courses are you now taking that can help you to understand technology? What courses could you take next year?

A Classroom Guide
to the EPCOT Center Experience

THE LAND

Presented by Kraft





Revolving drums simulate gravity for plants.

A Commitment to Education

EPCOT Center combines the Disney expertise in entertainment and communication with a compendium of information from the academic world, industry, and government. The primary goal of this combination is to provide visitors with an exceptional educational experience that *inspires them to actively participate in the shaping of the future*. In classrooms each day teachers are striving to achieve this same goal. For this reason teachers, ultimately our best ambassadors to the future, are considered very special guests at EPCOT Center.

A Take-Home Field Trip

Teachers often enrich the curriculum by bringing to it the immediacy of their own experiences. Sharing snapshots and souvenirs is one way of transferring the excitement of travel to a classroom. But EPCOT Center is much more than a sightseeing destination. The discerning educator can stretch an EPCOT Center visit into a functional and lasting part of a curriculum. This Teacher's Guide is designed to help educators tap the vast informational resources of EPCOT Center and put them into a meaningful academic context. Filled with practical, easy-to-use materials and ideas for immediate classroom use, this guide serves as a "take-home" field trip to EPCOT Center!

How To Use This Guide

To accommodate teachers in a variety of learning situations, the materials in this guide have been divided into three instructional levels.

Everything needed for a complete lesson is included. Each level is composed of three parts:

1) Instant Lesson Plan

It is "instant" because very little prior preparation is necessary. Each lesson plan provides specific learning objectives, brief teacher directions, and answers to the corresponding reproducible worksheets. Suggested follow-up activities are also included. These ideas will help teachers who choose to cover these educational concepts in greater detail. Designed to be flexible, these suggestions can be applied to math, language arts, computer literacy, or other subject areas.

2) Reading Experience

This is a reproducible sheet that gives students a brief summary of the educational content of The Land. The vocabulary and concepts are appropriate to each instructional level.

3) Follow-Up Worksheet

This reproducible page features questions and activities that review the reading material and provide practice in basic reading comprehension skills, such as recalling facts, sequencing, inference, and prediction.

BEFORE YOU START . . .

Before the lesson begins, you may want to describe your own experience at EPCOT Center. This not only puts The Land into perspective; it also gives you a chance to share photos and souvenirs! The subject area specialists and classroom teachers who have contributed to this and other EPCOT Center educational materials hope that this Teacher's Guide will be among the most useful of your mementoes of EPCOT Center.

OBJECTIVES

To illustrate ways in which farmers and scientists are developing innovative food production techniques.

To provide practice in basic reading comprehension skills

PROCEDURE

1) Teachers may want to review some or all of the following vocabulary words: nutrient, nutritious, experimenting, irrigation, cultivation, simulate.

2) Give each student a piece of drawing paper that is folded in half. Have students use the left half of the paper to draw the images that come to mind when you write the word *farm* on the board. Take a few minutes for students to share pictures and ideas.

EVALUATION

1) Write the words *Farm of the Future* on the board. Have students use the other half of their drawing paper to sketch images of such a farm. Discuss the ways these pictures differ from the previous ones.

2) Review answers to the worksheet: 1-c, 2-d, 3-a, 4-c, 5-a, 6-b, 7-b, 8-c, 9-d, 10-b.

SUGGESTIONS FOR FOLLOW-UP ACTIVITIES

"Kitchen Kabaret" presents good nutrition.

1) Show pictures of different types of farms to your class. Include pictures of small truck farms, large corporate farms and even farms which have aquaculture projects. Provide students with interesting information on each type of farm. Invite a farmer, or another agricultural expert, to your class for more first-hand knowledge. Ask students to draw detailed pictures of the type of farm which they would like to own. Ask them to list the reasons for their choice.

2) Ask the class to pretend they are living and working on a space station. Students are to write a letter to friends or family members explaining what foods they are growing and how they are growing them. Encourage them to draw pictures for added detail.

3) Show your class pictures of farm equipment from the past, present, and experimental ones of the future. Discuss the way scientists are experimenting in making the present-day equipment more efficient. Ask each student to draw an ad for a farm equipment magazine, showing the new ideas in farm equipment for the future. Give them a chance to create original designs, too!

Scientists and Farmers Working Together

People need nutritious food. Scientists are looking for ways to grow more nutritious food by making sure plants are strong and healthy.

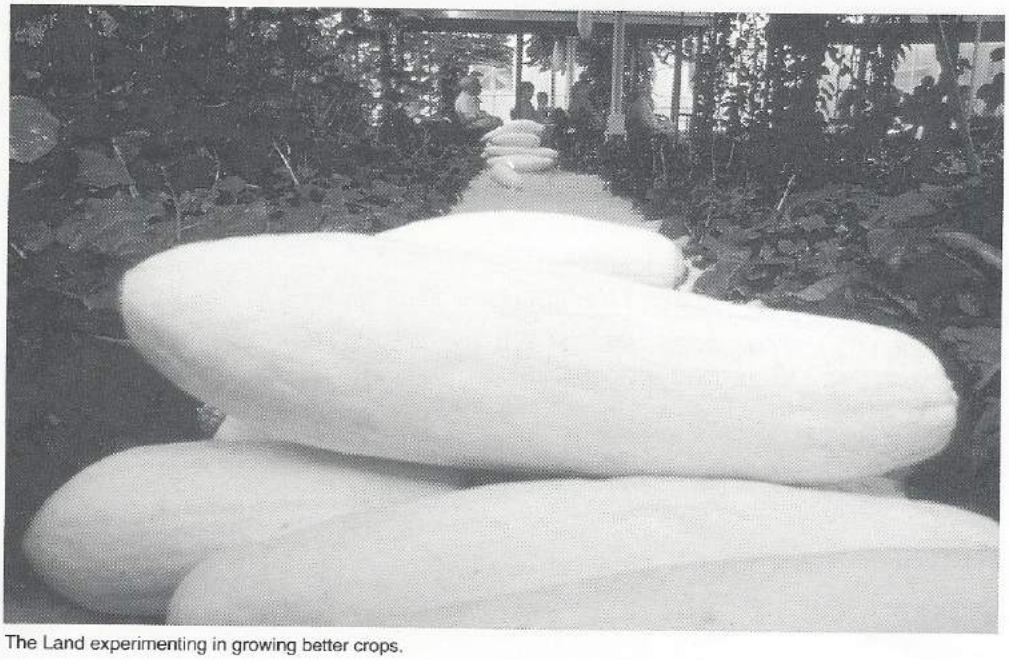
Farmers and scientists look at what foods people need. They also find the conditions in which plants grow best. They can put this information into a computer. This helps them decide which crops to grow and the best way to grow them.

Water is the most important resource in farming. All plants need water to grow. A good method of watering plants is called *trickle irrigation*. It places the correct amount of water at the plant's roots. This method of watering is already being used in some places. It will help us save water in the future.

When we talk about food production, we can't forget about animals like fish. Fish are also grown by farmers. Growing fish is called *aquaculture* ("aqua" meaning water). Today, most aquaculture is in outdoor ponds. In the future, people will depend more on this kind of farming.

Earth may not be the only place for farming in the future. People living and working on space stations may need to grow their own food. Scientists are already growing crops in space-like conditions. One example of this is lettuce which can be grown in spinning drums to simulate gravity.

In the future, our food will be basically the same food we have today. But, farmers will learn how to grow crops better. They will also be able to grow them in new places. The world will have enough food if people everywhere work together, sharing new ideas for growing food.



The Land experimenting in growing better crops.

Name_____
Date _____

Underline the right answer.

1) What is the main idea of this article?
   a) In the future food will be very different from today's.
   b) Computers will be the farmers of the future.
   c) Food in the future will be basically the same but farmers will know how to grow crops better in order to meet food needs.

2) Modern computer technology can help farmers
   a) know what foods people need
   b) decide what crops to grow
   c) become more efficient
   d) all of the above

3) Trickle irrigation is a way of _____ plants
   a) watering
   b) harvesting
   c) planting

4) The word conserve means to
   a) grow
   b) experiment
   c) save

5) Growing plants or crops is called
   a) agriculture
   b) aquaculture
   c) conservation

6) Growing fish for food is called
   a) agriculture
   b) aquaculture
   c) irrigation

7) Space stations may have to grow their own food because
   a) there won't be room for their crops on earth
   b) sending food from earth would be very hard
   c) most food would spoil before it got to the space station

8) In the future farmers will
   a) raise one crop at a time
   b) send crops to space stations
   c) have to know about computers

9) Future food needs can be met if
   a) nations work together
   b) we share new ideas for growing food
   c) scientists and farmers keep experimenting
   d) all of the above

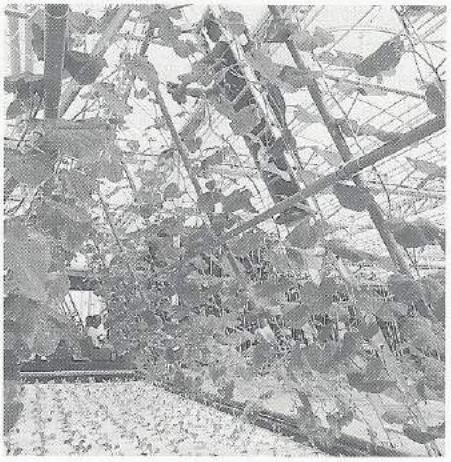
10) Why are scientists looking for better ways to grow crops?
   a) water is important
   b) people need nutritious food
   c) computers are becoming helpful

OBJECTIVES

To discuss the future of agriculture

To illustrate several important food production techniques

To give practice in basic reading comprehension skills



A greenhouse controls the plants' environment.

PROCEDURE

1) Teachers may want to review some or all of the following vocabulary words: efficient, vegetation, cultivate, agronomist, agriculturalist

2) Write the following guide questions on the board:
   a) What is the biggest problem facing farmers of the future?
   b) What is *now* being done to solve the problem?

3) Tell students that they will be reading an article which provides answers to these questions. At the completion of their reading, students should be ready to discuss the answers, as well as complete the written worksheet. Distribute materials.

EVALUATION

1) Discuss answers to the guide questions.

2) Review answers to the worksheet: 1-d, 2-b, 3-b, 4-b, 5-b, 6-b, 7-a, 8-c, 9-b, 10-d.

SUGGESTIONS FOR FOLLOW-UP ACTIVITIES

1) Look for a university or college with a department on *agronomy*. If possible, invite several teachers and some students to speak to the class concerning the future of farming. Find out if there are any ongoing agricultural experiments that students can observe.

2) Create a new magazine or newspaper dealing with food and the energy it takes to process and deliver food to us. Make each student or group responsible for writing feature articles, designing ads, special columns and more. Provide guidelines for the format of the magazine or newspaper. Some ideas to get your students started are: Snack of the Month, Food Products of the Future, and Cartoons about Nutrition. Your students will think of many more!

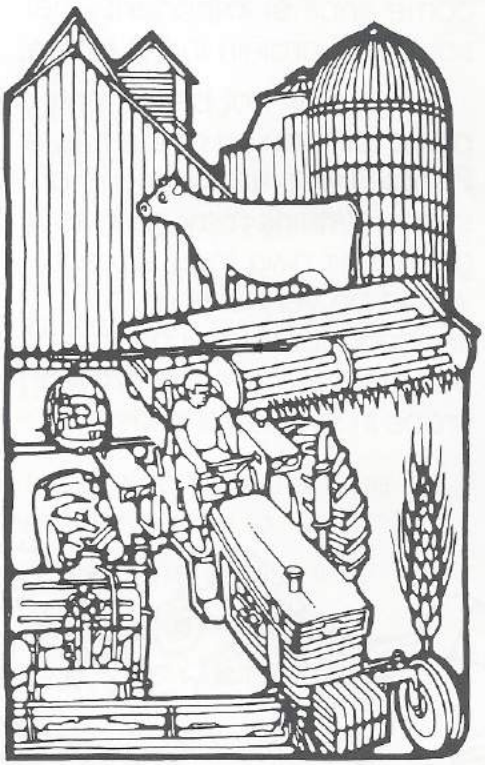
3) Are your students upset when they find small insects on any food they eat? Ask them to research what forms of pesticides are used to keep insect infestation under control and list the ways these pesticides are applied. Have the class prepare a questionnaire to send to a local or state Environmental Protection Agency (EPA) office dealing with the potentially adverse effects that some pesticides have on the environment. List which ones are hazardous to humans.

Science and Technology: Improving Agriculture

Throughout history farmers have worked to improve farming techniques. Scientists soon joined in this effort. Farmers and scientists are now experimenting with new ways to grow crops more efficiently.

The science of farming is called *agriculture*, and the people who study it are called *agriculturalists*. These people are aided in their work by today's *technology*. One good example is the computer, which provides them with information to help farmers decide whether to increase or reduce crop production. Computers also help them decide when to plant and harvest crops, how to direct farm machinery and much more. Technology is helping agriculturalists make farms more efficient.

Today an important part of farming is conservation. Conservation will play an even



more important role in the future. For *arid*, or dry, farmland one way of conserving water is through *trickle irrigation* which supplies plants with the correct amount of water at their roots. Farmers also try to conserve soil which sometimes washes or blows away. They can use a process called *minimum tillage* which allows them to plant new crops without exposing the soil by plowing up old crops.

In areas where soil doesn't contain the nutrients plants need to grow, a *hydroponic system* can be used. In this system all the essential nutrients needed by plants are provided in the plant's water. Using hydroponics, even the sandy soil of deserts can be made into fertile farmland.

Disease and certain insects cause damage to plants. This can be controlled by a system called *integrated pest management* (IPM). With IPM a farmer takes an overall look at the environment of the farm. Then the farmer decides which pest control technique would work best in that particular situation. The farmer

manages the pests and the crops together.

Growing fish and other aquatic animals is called *aquaculture*, from the word "aqua" meaning water. As natural fishing areas lose their fish populations, aquaculture will become more important as a source of animal protein in the future. Today most aquaculture is conducted in outdoor ponds, but in the future farmers may use closed tanks which recirculate water for better conservation.

Since 99% of the water on earth is in the form of sea water or ice, scientists are cultivating plants that thrive on sea water. These plants, called *halophytes*, may become another important source of protein in the future.

Earth may not be the only place for farming of the future. People living and working on space stations may need to grow their own food since it would be very difficult to transport food from earth. Scientists are already growing crops in simulated space conditions. Lettuce, for example, may be grown in revolving drums which substitute for the gravity plants need to grow.

In the future, our farmers will be able to grow crops more efficiently and in places where they couldn't grow things before. The world's food needs can be met if all nations work together, sharing new ideas for growing food.

Name_____
Date_____

Underline the right answer.

1) The main idea of this article is
   a) the world population is increasing
   b) there will be unusual foods in the future
   c) farmers will be using computers
   d) science and technology are helping farmers to improve farming in order to meet food needs

2) In the future farmers will be able to determine whether to increase or reduce crops based on
   a) scientists
   b) computer data
   c) rain

3) Minimum tillage helps farmers conserve
   a) water
   b) soil
   c) seed

4) A hydroponic system:
   a) controls pests
   b) provides nutrients to plant
   c) recycles water

5) Integrated pest management is a way to
   a) run farm equipment
   b) control insects
   c) develop better crops

6) Growing fish and other aquatic animals is called
   a) agriculture
   b) aquaculture
   c) halophytes

7) Halophytes thrive on
   a) sea water
   b) insects
   c) soil

8) What percentage of the earth's water is in the form of sea water and ice?
   a) 60%
   b) 80%
   c) 99%
   d) 40%

9) Scientists are experimenting in growing crops in outer space because
   a) there won't be enough room for crops in the future
   b) people on space stations may need to grow their own food
   c) it's easier to grow plants in artificial conditions

10) Future food needs can be met if
   a) nations work together
   b) we share new ideas for growing food
   c) scientists and farmers keep experimenting
   d) all of the above

OBJECTIVES

To discuss the farm of the future

To describe several innovative food production methods

To give practice in basic reading comprehension skills

PROCEDURE

1) Teachers may want to review all or some of the following vocabulary: technique, economize, innovative, conservation, infertile, erosion, genetic engineering.

2) Write on board as follows:

population
land FOOD SUPPLY
energy

Ask students to surmise how the first three words relate to the phrase on the right. After a brief discussion, tell students that they will be reading an article that will explain what these words mean to each other. Students should be ready to discuss these interrelationships when they finish reading. Also inform students that they are responsible for completing a written worksheet to check their reading. Distribute materials.

Growing areas employ new agricultural methods.

EVALUATION

1) Discuss the ways in which the factors written on the board affect the future food supply.

2) Review answers to the worksheet: 1-b, 2-c, 3-b, 4-a, 5-c, 6-b, 7-a, 8-d, 9-b, 10-a.

SUGGESTIONS FOR FOLLOW-UP ACTIVITIES

1) Invite a nutritionist to speak on the basics of a well-planned diet. Encourage the nutritionist to discuss new alternative choices such as tofu lasagne or whole wheat pasta with cheese. Have students plan, shop for, cook, and sample a meal with such different tastes.

2) Debate the different ways farmers can control insect infestation. What effects, negative or positive, does each approach have on the environment? Divide the class into small groups to do research. Encourage the students to read the most recent information and contact experts in the field to verify their findings.

3) The cost of food is related to the costs incurred by the farmers. Farmers must manage their farms with maximum efficiency to earn some profits. Have your students work in pairs to develop a questionnaire dealing with the costs of production with which to interview two or three local farmers. Questions such as the cost of seeds, water, fertilizer, equipment and land should be included. Find out if any farmers are using computer technology to improve their farming efficiency. If local farmers are not available, contact local or state officials for other resource people. Share the results of the interviews and list the key factors which enable a farmer to maximize his yield of crops per acre.

Improving Worldwide Agriculture

Today science and technology are helping farmers to make great strides in agriculture. As the world's need for food increases in the future, its production must become more efficient and expand into new regions of the world where farming has been difficult — like *arid* regions of Africa. The world's food needs can be met if all nations work together, sharing new ideas in the development of food systems.

Vast information resources are now available to farmers thanks to our *computer technology*. Every day farmers are becoming more computer-oriented as they begin to utilize computer information. Computers are helping by providing data on consumer *supply and demand*. They also help measure acres to be planted, and to determine when and how to plant. Computers can warn of possible plant diseases or pests and how to control them, and much more. In short, computers are helping farmers manage their farms with maximum efficiency.

A vital part of farm efficiency is *conservation*. Farmers must learn to make the best use of resources available. Two resources essential to farming are water and soil. The most efficient watering system used today is *trickle irrigation* which places the correct amount of water needed by a plant directly at the plant's root, where it is easily absorbed. Another interesting and potentially useful watering system used in *infertile* soil is called a *hydroponic system*. Plants receive oxygen and carbon from the air and absorb through their roots hydrogen from water and from soil they get nitrogen, phosphorus, potassium, calcium, molybdenum, zinc, copper and chloride, boron, iron, magnesium, sulfur, and manganese. Infertile soil like sand lacks these latter elements. A *hydroponic system* provides these necessary elements or nutrients by mixing the right proportions of each in the irrigation water. This system holds future potential for dry, sandy desert areas and is already being used commercially on a limited basis.

By the year 2000 it is estimated that at least 60% of all farms will be using a soil conservation method called *minimum tillage*. This allows farmers to plant new crops without plowing under old crops, causing less wear and tear on the land by heavy farm equipment, less *erosion* from stripping fields and less loss of organic matter from the soil.

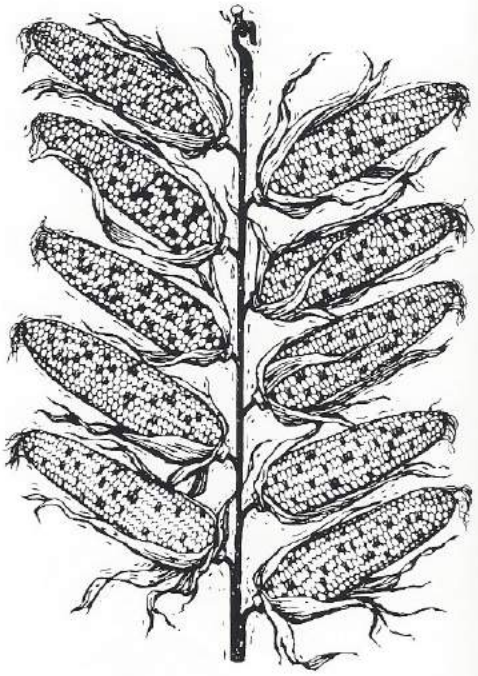
The science of genetics is also helping farmers. By carefully studying the genetic make-up of plants, scientists are learning to *genetically engineer* plants to produce higher yields, to be more nutritious, or to be more hardy by developing resistance to insects and disease. The result for farmers is better crops.

Where genetics leave off in protecting plants from disease and insects other controls take over. One excellent system for pest control now under research is called *integrated pest management* (IPM). This is a *decision-making* approach to agricultural production that considers a variety of techniques to maintain pest populations below damaging levels. IPM opts for one or a combination of pest controls including *biological*, such as releasing predatory insects; *mechanical*, such as vacuuming small flying pests; *physical*, such as steam sterilization; or *chemical*, such as pesticides when necessary or appropriate. Using this system the farmer manages the pests and the crops together.

Taken from the word "aqua" meaning water, aquaculture is the farming or raising of fish and other aquatic animals for food. Most aquaculture today is conducted in outdoor ponds, but *closed-system aquaculture* using a recirculating, water-conserving system is now being used experimentally. As natural fishing areas are depleted due to over-fishing, aquaculture will become an increasingly valuable renewable source of protein in the future. In fact, it is the fastest growing food industry of the future!

Space agriculture is another field of interest to scientists. In the future there may be space stations in which people will have to raise some of their own food, due to the difficulty and high cost of transporting food from earth. Scientists are now growing crops in simulated space conditions. Lettuce plants, for example, are planted through holes in a drum which revolves to simulate the pull of gravity.

The combined intelligence of science and technology will bring the world important agricultural innovations in the next decades. Though food in our future will be essentially the same food we have today and, for the most part, will be produced in fields much the same as today, agricultural innovations will help the farmer become more efficient and productive. Most importantly, these advances may assure that there will be enough food to feed everyone on earth — or beyond.



Name_____
Date_____

Underline the right answer.

1) What is the major idea behind this article?
   a) agriculture will change drastically in the future
   b) science and technology are improving agriculture
   c) aquaculture will replace agriculture in the future

2) Computers can provide farmers with information on
   a) consumer supply and demand
   b) how many acres to plant
   c) pest control
   d) all of the above

3) Trickle irrigation works by
   a) releasing a steady trickle of water above plants
   b) placing the correct amount of water at a plant's roots
   c) turning off and on at 5 minute intervals

4) Sandy soil can provide plants nutrients with
   a) a hydroponic system
   b) minimum tillage
   c) genetic engineering

5) What percentage of farms is expected to use *minimum tillage* by the year 2000?
   a) 90%
   b) 40%
   c) 60%

6) Name a decision-making approach to agriculture
   a) genetics
   b) integrated pest management (IPM)
   c) Closed-system aquaculture

7) Plants receive oxygen and carbon from
   a) air
   b) water
   c) soil

8) Integrated pest management uses the following
   a) biological control
   b) mechanical control
   c) chemical control
   d) all of the above

9) Aquaculture is
   a) the study of water
   b) the raising of fish and other aquatic animals for food
   c) a type of irrigation

10) Food in the future will be
   a) essentially the same as today
   b) grown only in outer space
   c) drastically different from what we now eat