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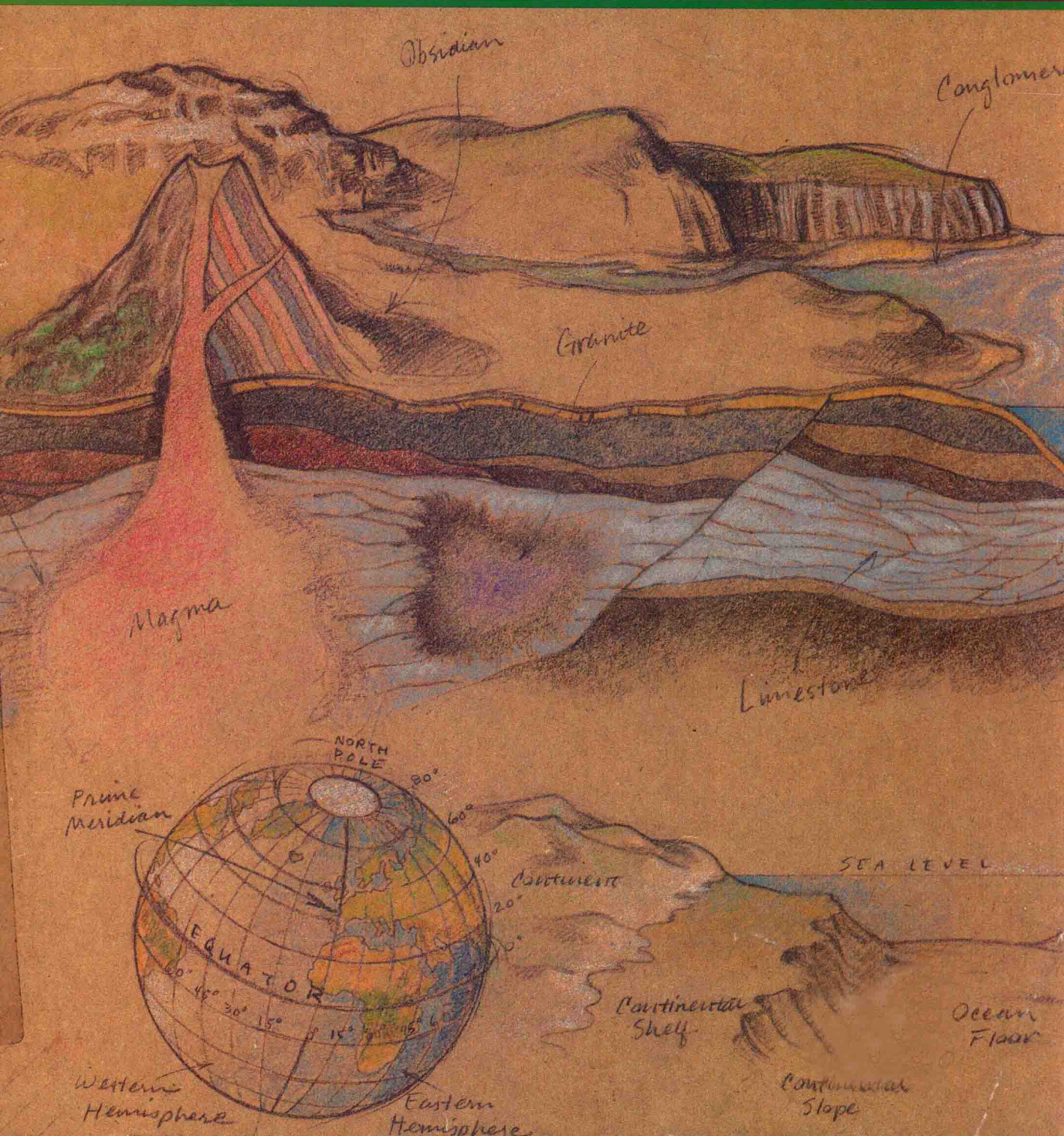
BASIC SCIENCE FOR LIVING

EARTH AND LIFE SCIENCE



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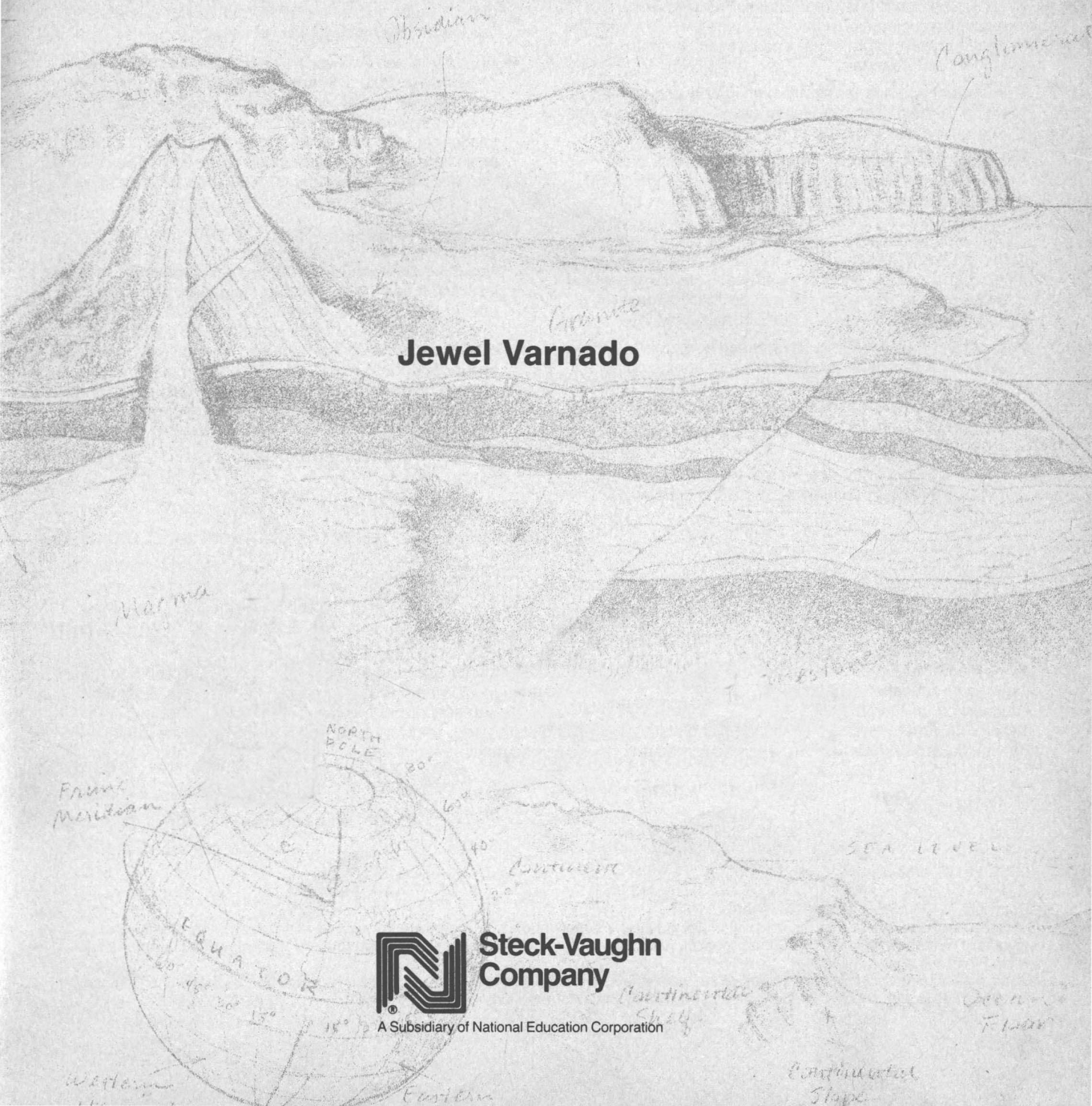

Jewel Varnado

Steck-Vaughn Company

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To the Teacher and the Student

Basic Science for Living is a two-book program specially designed for students who need to learn or review the basic scientific facts covered in a general science course. In *Earth and Life Science,* and *Physical Science,* students are introduced to science concepts through an explanation of the real-life science they experience every day. Students gain a thorough understanding of scientific terms and concepts from the relevant setting in which terms and concepts are presented. Mastering science is a challenging task. Special care has been taken in preparing both the organization and content of these books to guide the student to meeting this challenge with success.

- Each worktext is written in a manner that develops a high degree of reading comprehension and vocabulary, while providing a thorough survey of basic science. The author uses a conversational style of writing and consistent method of introducing, defining, and explaining scientific terms and processes to make the content lively, informative, and relevant for both student and teacher.
- Important science terms are highlighted and defined within the text. These terms are also defined and page referenced in a glossary at the back of each book.
- In each book, scientific facts and ideas have been grouped into seven units of related knowledge. *Earth and Life Science* begins with a discussion of the universe and our planet's place in the universe, then proceeds to discuss water, air, plants, animals, the human body, and health. *Physical Science* explores force and energy, thermal energy and heat, magnetism and electricity, light, sound, matter, and radioactivity and how these properties relate to our daily lives.
- Each unit is divided into several self-contained lessons. A review at the end of every lesson comprehensively tests the lesson's content. Lesson reviews follow five consistent, standardized formats that prepare students for other types of standardized assessment tools.
- Two black dots in the left margin of each lesson review signal critical thinking questions specially prepared to challenge students to apply knowledge they have gained to new situations.
- Each unit also presents two special features to make science more relevant to students lives. An *Issues in Science* lesson points out current science-related topics that are the subject of controversy or part of a trend in general science today. A *Careers* feature at the end of each unit points out careers in which general and/or specific science knowledge is important. Each career feature also provides a bibliography of books and associations for obtaining more information about careers in the area of science being discussed.
- A Mastery Review at the end of each book provides a chance to check mastery of important concepts and gives students practice with the commonly used separate-answer-sheet format. Clearly explained directions for the review allow it to be administered by the teacher or by students themselves.
- An easy-to-use Answer Key can be found at the back of each worktext. The answer key was prepared with both teacher and student use in mind. Students working independently will find the answer key an invaluable resource for checking their mastery of each lesson's concepts as presented in the lesson review. However, the answer key is perforated to allow easy removal for use in more traditional settings.
- The *Basic Science for Living* program was designed to bring science to students in a meaningful and useful way. The clarity of presentation, self-contained lessons, timely reviews, interesting features, glossary, mastery review, and answer key facilitate learning in a variety of educational situations—traditional classroom, small group seminar, tutorial instruction, and independent-study. The current and comprehensive content of *Basic Science for Living* provides students with the knowledge essential to understanding the world in which we live—a most exciting and interesting place.

About the Author

Jewel Varnado earned her bachelor's and master's degrees in educational psychology and her Ph.D. in adult education from Florida State University. She has received the Florida Adult Education Association's Outstanding Service Award and has successfully served as an instructor and a supervisor of adult education in Florida. She is the author of several children's books, a series of high-school English books *(English: Practice for Mastery),* and an English refresher course for adults *(English Essentials).*

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Contents

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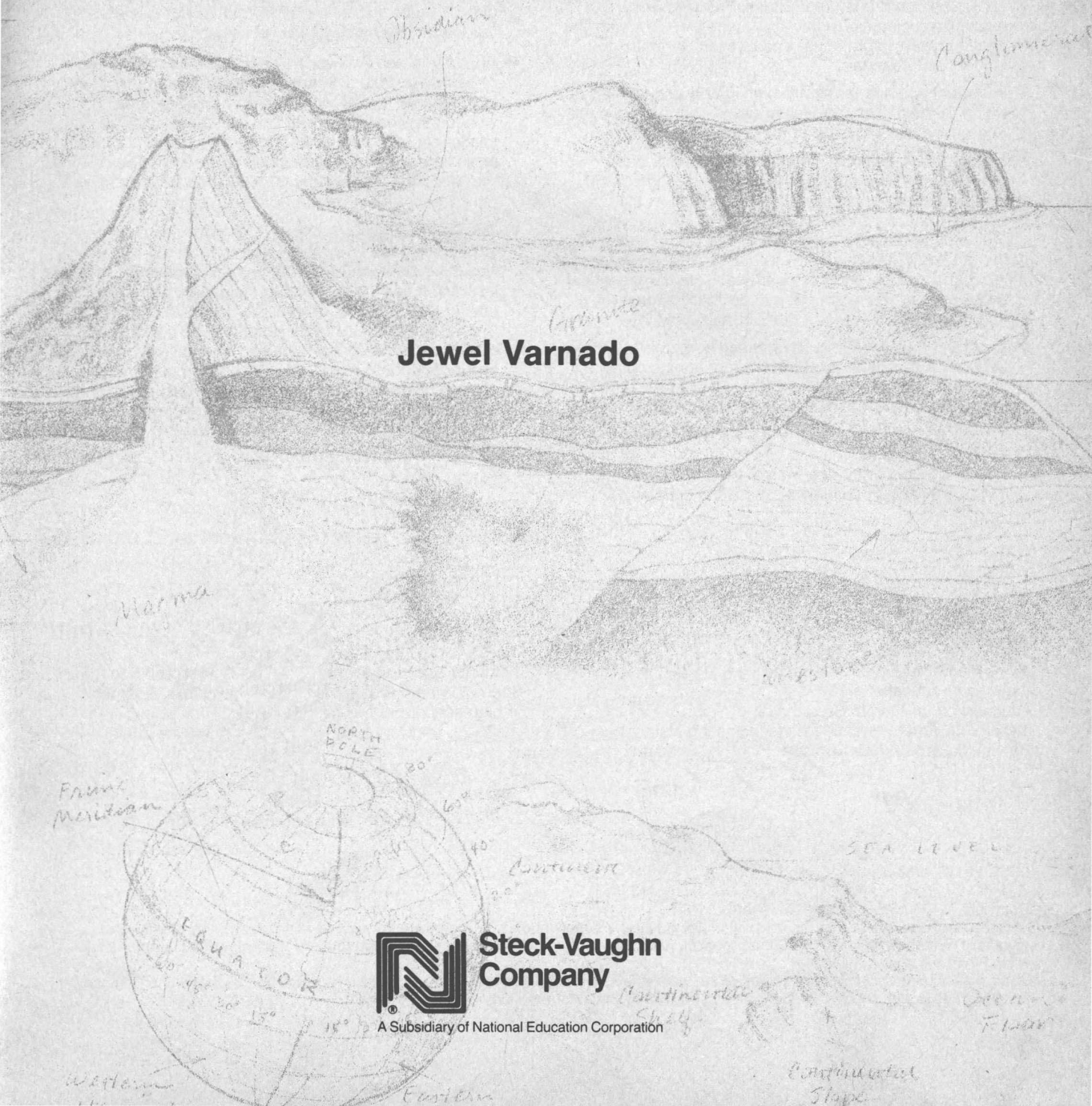

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Contents

The Universe

Stars are one type of matter that makes up the universe.

Lesson 1

The Universe

The **universe** is made of all matter and energy and the space occupied by them. No one knows how large the universe is or, for that matter, if it has a definite size. Most scientists believe that the universe is constantly expanding. Others believe that the universe is expanding and contracting with time. Few scientists believe that the size of the universe is always the same.

How did the universe begin? There are many theories about its beginning. Theories are explanations that are backed by results that come from repeated tests or experiments. Today, most scientists who study the universe believe that it began with a **Big Bang.** According to this theory, an explosion about 15 billion years ago threw matter and energy in all directions. Much less than a second after the explosion, the universe was merely the size of a softball. As the original material cooled down from temperatures of billions of degrees, it went through many other changes. These changes resulted in what we observe today as the universe—from the smallest atoms to the largest stars.

Several centuries ago, some astronomers, scientists who study space, believed that Earth was the center of the universe. It was thought that the moon, the sun and other stars, and the planets circled about Earth. Today, it is known that Earth is only a tiny speck in the universe. Planet Earth is part of a single galaxy. A **galaxy** is a large grouping of billions of stars, dust, and gas.

The galaxy that includes Earth is called the **Milky Way.** There are over a hundred billion stars in the Milky Way. The Milky Way is so large that it would take a beam of light traveling at 186,282 miles per second about 100,000 years to travel from one end of it to the other! The Milky Way is a disc-shaped galaxy with arms that turn about a dense

center. Earth is located in one arm of the Milky Way, about 170,000,000,000,000,000 (170 quadrillion) miles from the center of the galaxy.

The part of our galaxy that includes Earth is called the solar system. The **solar system** includes the sun and all the natural objects that travel around it. In addition to Earth and eight other planets, the solar system contains asteroids, meteoroids, and comets.

Asteroids are fragments of matter similar to the matter that formed the planets. Asteroids are solid and have irregular shapes. They come in different sizes. The largest asteroid is nearly 500 miles in diameter. The smallest is less than a mile in diameter.

Meteoroids are small chunks of iron and rock. Most meteoroids probably form from collisions among asteroids. Some meteoroids enter Earth's atmosphere and burn up before they strike the ground. **Meteors** are streaks of light given off by these burning meteoroids. Meteoroids that reach Earth's surface without burning up are called **meteorites.**

Comets are masses of frozen gases, dust, and small pieces of rock. A comet has a solid head and a dust and gas tail. The tail of a comet points away from the sun. Halley's Comet is visible from Earth every 75 or 76 years.

The sun is the hub of our solar system. It is a huge star that is 330,000 times more massive than Earth. The sun is a very hot, bright sphere of gases. Our sun is an average star in terms of temperature and brightness when compared to other stars in the Milky Way. But to us, the sun is basic to life. We, along with other forms of life, are dependent upon its light and heat. Scientists estimate that the sun is about 4.5 billion years old. They believe that this nuclear furnace will exist for another 5 billion years. ■

Lesson Review

In the space before each number, write the letter of the word or group of words in Column 2 that matches the description in Column 1.

Column 1	Column 2
_____ 1. a large group of billions of stars, dust, and gases	a. asteroids
_____ 2. the light from meteoroids that burn up in Earth's atmosphere	b. Big Bang
_____ 3. fragments of matter ranging in size from less than a mile to 500 miles in diameter	c. comets
_____ 4. the sun and the other objects that travel around it	d. galaxy
_____ 5. masses of frozen gases, dust, and rocks	e. meteorites
_____ 6. one theory on the origin of the universe	f. meteors
_____ 7. Earth's galaxy	g. Milky Way
_____ 8. meteoroids that strike Earth	h. solar system
_____ 9. all stars, planets, galaxies	i. sun
_____ 10. star halfway through its life cycle	j. universe

Lesson 2

The Planets

On a clear night, away from city lights, the sky above Earth glows with light. In addition to Earth's moon and countless stars, six of the eight other planets in our solar system are visible. Mercury, Venus, Mars, Jupiter, Saturn, and Uranus reflect light from the sun and thus are visible without the aid of a telescope. A star, like the sun, produces its own light. A planet is visible because light from the sun is reflected, or bounced, off its surface.

Like Earth, each planet moves in a set **orbit,** or circular path, around the sun. The orbits of the planets are oval-shaped. Therefore, a planet is closer to the sun at certain times and farther away at other times. Table 1 lists the average distance of each planet from the sun and Earth.

Mercury is the closest planet to the sun. However, it does not reflect much of the sunlight that falls on it and is difficult to see from Earth. Mercury's surface is made of flat, open areas and sharply rising cliffs. Numerous craters mark the landscape of the planet.

Venus is the second planet from the sun. Its diameter is about 400 miles less than Earth's. Venus receives about twice as much sunlight as Earth and is the brightest planet in the sky. Its average surface temperature is the highest of any planet in the solar system.

Earth is the third planet from the sun, followed by **Mars.** Viking spacecraft have been making observations of Mars since the mid-60s. The observations have shown that the Martian surface is made of steep ridges and valleys. Many volcanoes cover the rugged terrain. One of these, Olympus Mons, is the largest volcano in the solar system. The spacecraft observations have also shown that the polar caps of Mars are made of frozen carbon dioxide, or dry ice. A reddish dust gives Mars a pink hue.

Jupiter, the largest of the planets, is the fifth planet from the sun. The diameter of Jupiter is nearly 11 times that of Earth's. Scientists think that Jupiter is made of mostly hydrogen and helium gases, much like the

Table 1 **Facts About the Planets (All figures are approximate.)**

	Average Distance in Miles from Sun	Average Distance in Miles from Earth	Time to Orbit Sun (in Earth-days and years)	Diameter in Miles	Average Surface Temperatures in Fahrenheit	Moons
Mercury	36,000,000	57,000,000	88 days	3,031	550°F	0
Venus	66,800,000	25,700,000	225 days	7,520	900°F	0
Earth	93,000,000	----------	365 days	7,926	80°F	1
Mars	142,500,000	48,700,000	1.9 years	4,200	−76°F	2
Jupiter	480,000,000	390,700,000	12 years	88,700	−236°F	16
Saturn	888,000,000	762,700,000	29.5 years	74,980	−285°F	20
Uranus	1,700,000,000	1,700,000,000	84 years	31,570	−288°F	15
Neptune	2,754,000,000	2,821,000,000	165 years	30,200	−369°F	8
Pluto	3,666,000,000	3,583,000,000	248.5 years	~1,400	−387°F	1

sun. The planet is circled by white to reddish-brown cloud bands.

Saturn is the sixth planet from the sun. Although it is the second largest planet in our solar system, Saturn is not very dense. In fact, Saturn would float on water! More than 1,000 rings circle the planet and gleam with light.

Uranus and **Neptune** are the seventh and eighth planets from the sun. Voyager spacecraft have revealed that Uranus has at least ten rings around it and 15 satellites or moons. Neptune also is a gaseous planet. It is surrounded by dense clouds made of carbon dioxide and sulfur. Neptune has eight moons.

Pluto is often the most distant planet from the sun. Sometimes, however, Pluto orbits inside the orbit of Neptune. Pluto is thought to be made of frozen water and gases. Pluto has a single moon.

Many people wonder if there is life on the other planets in our solar system. The average surface temperatures listed in Table 1 clearly show that life as we know it here on Earth could not exist on the other planets. Other forms of life, however, may exist. Perhaps some day we will know. ■

Lesson Review

Fill in the circle containing the letter of the term or phrase that correctly completes each statement. Check Table 1 to answer some of the questions.

1. All of the following planets are visible from Earth except _____.
   ⓐ Mercury ⓑ Mars ⓒ Venus ⓓ Pluto

2. _____ are visible because they reflect light from their surfaces.
   ⓐ Stars ⓑ Planets ⓒ Orbits ⓓ Viking spacecraft

3. The closest planet to the sun is _____.
   ⓐ Pluto ⓑ Earth ⓒ Venus ⓓ Mercury

4. The average surface temperature of _____ is the highest of any planet.
   ⓐ Earth ⓑ Mercury ⓒ Pluto ⓓ Venus

5. The polar caps of Mars are made of _____.
   ⓐ frozen water ⓑ frozen carbon dioxide ⓒ helium ⓓ hydrogen

6. _____ is the largest planet in our solar system.
   ⓐ Pluto ⓑ Saturn ⓒ Neptune ⓓ Jupiter

7. Although it is the second largest planet, _____ would float on water.
   ⓐ Saturn ⓑ Earth ⓒ Venus ⓓ Mars

8. _____ is usually the outermost planet in our solar system.
   ⓐ Mercury ⓑ Neptune ⓒ Pluto ⓓ Venus

• 9. _____ and _____ have hotter temperatures than Earth.
   ⓐ Saturn, Mars ⓑ Mercury, Venus ⓒ Uranus, Neptune ⓓ Mars, Venus

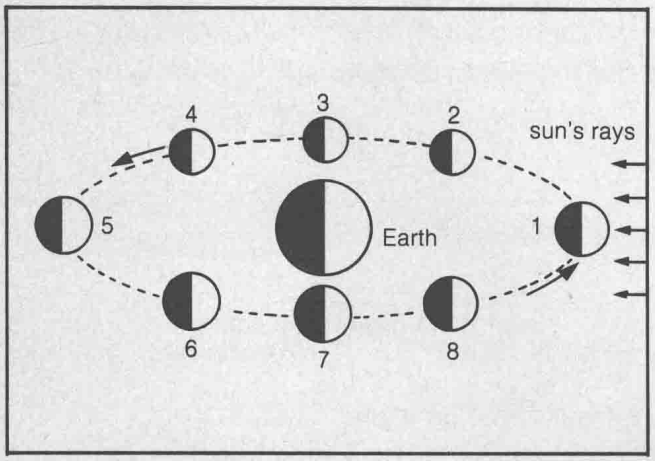
• 10. The planets _____ and _____ will never complete their orbits in a human's lifetime.
   ⓐ Earth, Venus ⓑ Jupiter, Uranus ⓒ Neptune, Pluto ⓓ Pluto, Mercury

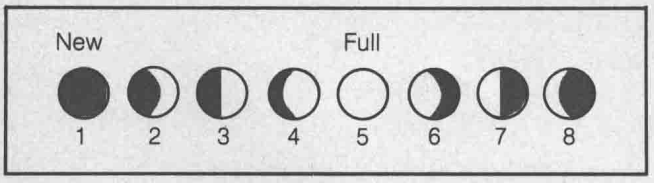
Lesson 3

Earth's Moon

The moon is Earth's only natural satellite. A **satellite** is an object that revolves around a larger, primary object. Much of what we know about our moon comes from observations made by spacecraft. An uncrewed Soviet spacecraft landed on the moon in 1959. Ten years later, an American spacecraft, Apollo 11, with astronauts aboard landed on the lunar surface. This and five other Apollo landings allowed astronauts to gather samples of the lunar soil and rocks. Today, scientists continue to examine these samples.

The moon appears larger than most of the planets in the solar system because it is so close to Earth. At the shortest point in its orbit, the moon is about 220,000 miles from Earth. At its farthest distance, the moon is over 250,000 miles away. (Venus, the planet closest to Earth, is over 25 million miles away.)





The top diagram shows how Earth's moon would look to an observer in space. The bottom diagram illustrates the moon as it appears to an observer on Earth.

Although the moon appears large, it is really quite small. It has a diameter of 2,160 miles, about one-quarter of Earth's diameter.

Gravity is the attraction between two objects due to their masses. The pull of gravity among Earth, the moon, and the sun causes tides. The moon's gravity causes a bulge of ocean water on the side of Earth that faces the moon. A second bulge forms on the side of Earth away from the moon. The bulges of water are called high tides. The area between the bulges is called low tide. The tides at a particular place rise and fall as Earth turns. Most coastal areas on Earth have two high tides and two low tides each day.

It takes the moon about $27\frac{1}{3}$ days to **revolve** around, or circle, Earth. The moon's **rotation**, or spinning about its axis, also takes about $27\frac{1}{3}$ days. Therefore, because both its rotation and revolution take the same amount of time, an observer on Earth always sees the same side of the moon. Due to the tilt of the moon's axis at different times, an observer can see about 59 percent of its surface by watching the moon over a period of time. No one had ever seen the dark side of the moon until pictures were sent back to Earth in 1959.

Many of the features of the side of the moon that could be seen were known before spacecraft landed. Early astronomers discovered that the moon's surface was made up of dark areas and light areas. The dark areas are smooth, flat plains; the light areas are rocky and mountainous.

Craters, bowl-shaped areas on the moon's surface, have been clearly visible through telescopes since the 1600s. Craters range in size from less than one mile to over 150 miles in diameter. Most of the moon's craters formed when meteoroids struck the moon's

surface billions of years ago. Because the moon has no atmosphere, there is no weather to change its surface. Most of the craters have not changed since they were formed.

Before astronauts explored the moon, people imagined what it would be like to visit. From the moon, astronomers would have a better view of the universe. Scientists could study the moon firsthand. The average vacationer, however, probably would not want to rush to the moon. The moon has no atmosphere and no water. Human beings can't breathe on its surface. Average temperatures during the two-week lunar day reach 270°F and plunge during the 14-day lunar night to −250°F. Due to the moon's weak gravity, a person who weighs about 100 pounds on Earth would weigh less than 20 pounds on the moon. Living on the moon would be very inconvenient! ■

Lesson Review

Fill in the circle containing the letter of the term or phrase that correctly completes each statement.

1. A(n) _____ is an object that revolves around a larger, primary object.
   ⓐ orbit ⓑ satellite ⓒ spacecraft ⓓ axis

2. The moon appears larger than most of the planets in our solar system because _____.
   ⓐ it is larger than all the planets except Pluto
   ⓑ its rotation equals its revolution
   ⓒ it is a satellite of Earth
   ⓓ it is close to Earth

3. _____ is the attraction between two objects due to their masses.
   ⓐ Orbit ⓑ Gravity ⓒ Tide ⓓ Rotation

4. Tides occur on Earth due to the gravity among _____.
   ⓐ the sun, moon, and Earth
   ⓑ the sun and moon
   ⓒ the sun and Earth
   ⓓ the sun, Earth, and other planets

5. To an observer on Earth, almost _____ percent of the moon's surface is visible.
   ⓐ 10 ⓑ 25 ⓒ 60 ⓓ 75

6. The dark areas of the moon are _____.
   ⓐ mountains
   ⓑ bodies of water
   ⓒ plains
   ⓓ shadows cast by Earth

7. Lunar craters formed billions of years ago when _____ struck the moon's surface.
   ⓐ spacecraft ⓑ volcanoes ⓒ water ⓓ meteroids

8. A lunar day is about _____ long.
   ⓐ 12 hours ⓑ 24 hours ⓒ 14 days ⓓ 27 days

• 9. The diameter of Earth is about _____ times _____ than the diameter of the moon.
   ⓐ 3, larger ⓑ 4, larger ⓒ 3, smaller ⓓ 4, smaller

• 10. To an observer on Earth, the moon orbits Earth from _____.
   ⓐ east to west ⓑ west to east ⓒ south to north ⓓ north to south

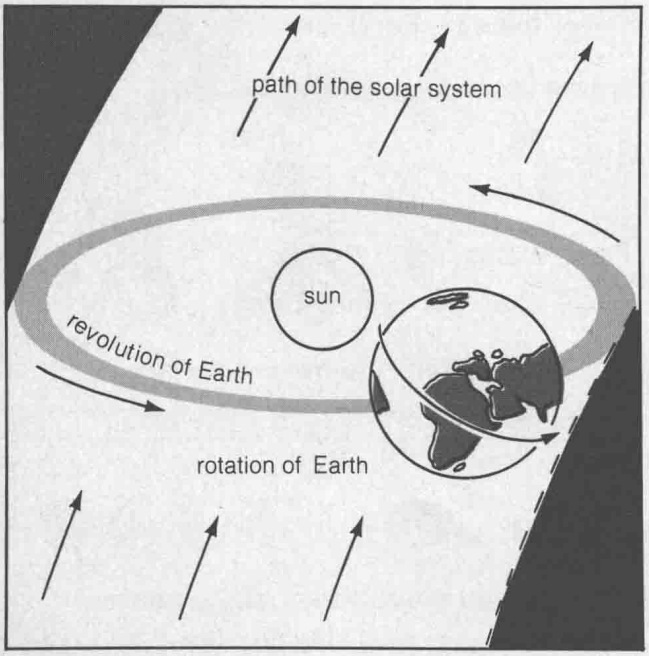
Lesson 4

Earth's Profile

Earth is about 4.5 billion years old. There are several theories about its formation. Most scientists believe that the sun, Earth, and the other planets formed from a slowly spinning, gigantic cloud of dust and gas.

Thanks to various branches of science, we have learned a great deal about Earth. The highest point on Earth is Mt. Everest. It towers over 29,000 feet above **sea level**. Sea level is defined as zero feet elevation. The lowest point on Earth is in the Pacific Ocean. It is in an underwater canyon called the Mariana Trench. The canyon's lowest point is more than 36,000 feet below sea level. Scientists, using mathematics rather than a scale, have calculated that Earth weighs over six sextillion (6,000,000,000,000,000,000,000) tons!

From space, Earth appears to be a perfect sphere. In reality, however, it is slightly flattened at its poles. The diameter of Earth from the North Pole to the South Pole is about 7,900 miles. The **equator** is an imaginary line that separates Earth into two hemispheres: the Northern Hemisphere and the Southern Hemisphere. Earth's diameter at the equator is roughly 7,926 miles.



Seasons on Earth are due to the tilt of Earth's axis and the angle at which the sun's rays strike a given location.

Look closely at a globe of Earth. Earth has been called the "Blue Planet" because almost three fourths of Earth is covered with water. Although water is the most common substance found on Earth, only three percent of Earth's water is drinkable. Most of Earth's water is salt water contained in the oceans.

Earth's surface area totals almost 197 million square miles. Of this total, less than 58 million square miles is land. Plains, plateaus, and mountains are the three basic landforms that cover Earth's surface. **Plains** are large, flat, low-lying areas. The Great Plains extend through much of the central United States. **Plateaus** are high, relatively flat areas. The Colorado Plateau, into which the Grand Canyon was carved, is located in the western United States. **Mountains** are any area of land that rises sharply above the surrounding area. The Appalachians, the Rockies, and the Great Smoky Mountains are only a few of the mountain chains in the United States.

Although we can't feel it, planet Earth is constantly in motion. Earth moves in three ways. It rotates, or spins on its axis, once every 24 hours. Day and night are caused by Earth's rotation. As it rotates, Earth also revolves around the sun. Earth's revolution takes about $365\frac{1}{4}$ days, or one year, to complete. Earth also moves in a third way through space. Together with the sun and the other planets in our solar system, it travels around the center of its galaxy, the Milky Way. Earth completes this journey once every 225 million years.

Recall that Earth's orbit, or revolution, around the sun is oval-shaped. In January, Earth is about 88,000,000 miles from the sun. In July, Earth is about 91,000,000 miles from the sun. Why then is it hotter in the United States in July than in January?

The seasons occur for two reasons. First, Earth's axis is tilted about $23\frac{1}{2}$ degrees. This tilt causes the amount of daylight to vary at a given location. Secondly, the angle at which the sun's rays strike a certain location changes throughout the year. Refer to the illustration. When the North Pole is tilted toward the sun, the Northern Hemisphere has summer. At this time, the Southern Hemisphere has winter. When the North Pole is tilted away from the sun, the Northern Hemisphere has winter. Therefore, at the end of December, it is winter in Minneapolis, Minnesota, and summer in Santiago, Chile.

Earth is a dynamic planet. It changes constantly in response to the many forces and processes acting upon it. Hurricanes, tornadoes, thunderstorms, landslides, ocean waves, volcanic eruptions, earthquakes, rivers, lakes, and streams are just a few of the agents that change our planet daily. Some of these changes are quite noticeable; others take millions of years to occur. ■

Lesson Review

In the space provided, write the word or words that best complete the statement.

1. Earth is about _____ years old.
2. The highest point on Earth is _____.
3. Earth's shape is _____.
4. Nearly _____ of Earth's surface is covered with water.
5. _____ are large, flat, low-lying areas.
6. Earth _____ on its axis once every 24 hours.
7. Earth is closest to the sun in the month of _____.
8. Seasons occur due to the tilt of Earth's axis and the change in _____ _____.
- 9. If it is winter at the South Pole, it is _____ at the North Pole.
- 10. The amount of relief, or change in elevation, between Mt. Everest and the Mariana Trench is _____ feet.

Lesson 5

The Structure of Earth

Geology is the study of planet Earth and the processes that change it. Geologists are scientists who study the origin, history, and structure of our planet. Geologists have learned that shortly after it formed, parts of the inside of Earth melted. Denser materials sank to Earth's center. Lighter materials floated upward. With time, these materials hardened to form our planet.

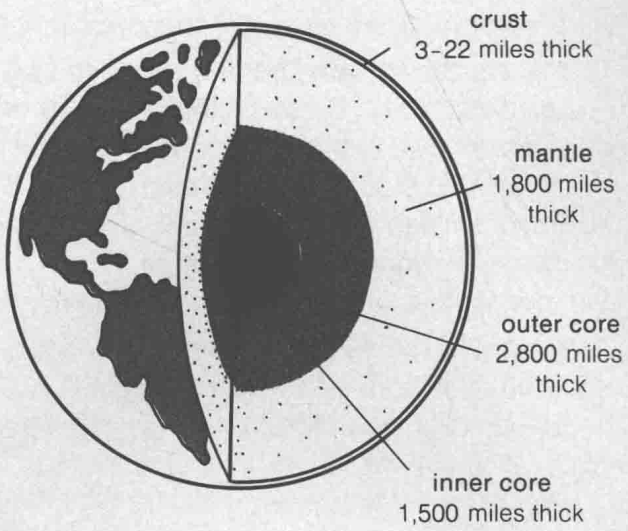
Geologists divide Earth into three distinct layers. The innermost region of Earth is called the **core.** A molten, or partly melted, outer core surrounds a solid inner core. The inner core is rich in iron and nickel and has a diameter of about 1,500 miles. Temperatures here may be as high as 9,000°F. Earth's outer core has a diameter of about 2,800 miles. Temperatures in the outer core are about 4,000°F.

Surrounding the core is the **mantle,** or middle layer, of Earth. Much of the mantle is solid. At depths of about 60 to 400 miles, the mantle is partly melted and acts like putty. The mantle is about 1,800 miles thick and makes up over 80 percent of Earth's volume.

The outer layer of Earth is called the **crust.** Its thickness varies between three and 22 miles. The crust that makes up the continents averages over 20 miles in thickness. Ocean crust is about three miles thick.

Rocks make up much of Earth's crust, mantle, and core. Geologists classify rocks into three groups: igneous, sedimentary, and metamorphic. **Igneous rocks** form when hot, molten material cools and hardens. If the material cools below Earth's suface, rocks such as granite are formed. If the molten material reaches Earth's surface through erupting volcanoes, then lava and pumice may form.

Sedimentary rocks are rocks that form when pieces of material, such as clay and sand,



Earth can be divided into three layers: the crust, the mantle, and the core.

become cemented together by natural processes. Sedimentary rocks can form in water or on land. **Fossils,** the remains of animals and plants preserved in Earth's crust, are commonly found in sedimentary rocks.

Metamorphic rocks are rocks that are changed by intense heat and pressure. Marble is the metamorphic equivalent of the sedimentary rock, limestone. Slate is metamorphosed shale. Gneiss is metamorphosed granite.

The continents are parts of the rocky crust that covers about one fourth of Earth's surface. Look closely at a world map. Compare the eastern coastline of South America with the west coast of Africa. Notice the puzzlelike fit of the edges of these continents. Scientists have attempted to explain why, when moved around and rotated, the continents seem to fit together like pieces of a puzzle. This evidence, and fossil, climate, and rock-structure data, led scientists to conclude that the continents were once a single landmass. But how could such massive pieces of land move such great distances?