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SCIENCE

STUDENT BOOK

7th Grade | Unit 3

Alpha Omega PUBLICATIONS

SCIENCE 703

Earth In Space: Part 1

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Earth In Space: Part 1

Introduction

"In the beginning God created the heaven and the earth...And God said, Let there be light: and there was light. And God saw the light, that it was good: and God divided the light from the darkness. And God called the light Day, and the darkness he called Night....And God said, Let there be lights in the firmament of the heaven to divide the day from the night; and let them be for signs, and for seasons, and for days, and years: And let them be for lights in the firmament of the heaven to give light upon the earth: and it was so. And God made two great lights; the greater light to rule the day, and the lesser light to rule the night: he made the stars also. And God set them in the firmament of the heaven to give light upon the earth, and to rule over the day and over the night, and to divide the light from the darkness: and God saw that it was good. And the evening and the morning were the fourth day." (Genesis 1:1, 3-5, 14-19)

God created the earth and the moon and the sun and all the stars in the heavens. God put each one in its place and set it in motion. God created the universe and established the rules and laws by which it moves. As man has observed and studied the movements in the heavens, he has discovered the wonders of God's creation and the laws which keep them functioning smoothly.

In this LIFEPAC® you will learn about the earth in space, about the ancients whose observations laid the groundwork for astronomy, about the men who discovered God's laws for the universe, and about the heavenly bodies God created.

Objectives

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIFEPAC. When you have finished this LIFEPAC, you should be able to:

1. Describe the motions seen in the heavens.
2. Describe and illustrate the geocentric theory.
3. Name some of the constellations.
4. Explain why the "wanderers" created problems in the geocentric theory.
5. Define *meteor*, *meteoroid*, and *meteorite*.
6. Identify and describe refracting and reflecting telescopes.
7. List the major contributions of early astronomers.
8. Identify flaws in the geocentric (transparent-globe) theory.
9. Describe and illustrate the heliocentric theory.
10. Construct and describe the characteristics of an ellipse.
11. Name Kepler's Laws of Planetary Motion.
12. Write an illustration of Newton's Law of Universal Gravitation.
13. Identify the tools of the astronomer and name their uses.
14. Define celestial terms.
15. Construct and use an astrolabe.

Survey the LIFEPAC. Ask yourself some questions about this study and write your questions here.

1. STARGAZING

To a great extent, the way we interpret our observations depends on our point of view. Because modern communications media provide us with many points of view, we have a better understanding of the natural world than our ancestors had. We no longer rely on legends to explain the movements of sun, moon, and stars. We know instead that they are part of a vast system that is far more wonderful than any legend.

We as Christians do not seek direction for our lives and predictions of the future in the stars, as the astrologers of old did. The stars hold a different kind of mystery today—the mystery of blazing nuclear furnaces scattered in the vastness of space. We are not frightened by eclipses and comets. Scientists have discovered the physical laws that govern such dramatic **celestial** events, and we have access to their explanations.

As you study this section you will learn that the ancient peoples thought of the earth as the center of the universe. You will look at the patterns of the stars. You will think about the "wanderers"—those "stars" that do not behave normally—and you will read what the Bible has to say about the stars.

SECTION OBJECTIVES

Review these objectives. When you have completed this section, you should be able to:

1. Describe the motions seen in the heavens.
2. Describe and illustrate the geocentric theory.
3. Name some of the constellations.
4. Explain why the "wanderers" created problems in the geocentric theory.
5. Define *meteor*, *meteoroid*, and *meteorite*.

VOCABULARY

Study these words to enhance your learning success in this section.

apparent (u par' unt). According to appearances; that which appears to be.

axis (ak' sis). A straight line about which an object turns or seems to turn.

celestial (su les' chul). Of the sky.

constellation (kon' stu' lā shun). A group of stars having a certain pattern or shape.

cosmology (koz mol' u jē). The science or theory of the whole universe.

meteor (mē' te ôr). A mass of rock or metal that enters earth's atmosphere from space.

meteoric (mē' tē ôr' ik). Having to do with meteors.

meteorite (mē' tē u rīt). A mass of rock or metal that has reached earth from space.

meteoritic (mē' tē u rit' ik). Having to do with meteorites.

meteoroid (mē' tē u roid). Body of rock or metal traveling through space.

Milky Way (mil′ kē wā). A broad band of faint light that stretches across the sky at night. Our solar system is part of the Milky Way Galaxy. The Milky Way is made up of billions of stars.

myth (mith). Legend or story that usually attempts to account for something in nature.

mythology (mi thol′ u jē). A body of myths relating to a particular country.

North Star (nôrth stär). The bright star directly above the North Pole.

planet (plan′ it). One of the heavenly bodies (except comets and meteors) that move around the sun in elliptical orbits.

retrograde (ret′ ru grād). Moving backward.

solar system (so′ lur sis′ tum). The sun and all its planets, satellites, comets, and other heavenly bodies that revolve around it.

summer triangle (sum′ ur trī′ ang gul). A group of three bright stars: Vega, Deneb, and Altair, especially prominent in the summer sky.

wanderer (won′ dur ur). The name given to the planets by the ancients because they appeared to wander among the stars.

zenith (zē′ nith). Point in heavens directly overhead. The opposite of nadir.

zodiac (zō′ dē ak). An imaginary belt in the heavens extending about 8 degrees on both sides of the path of the sun and including the paths of major planets and the moon.

Note: *All vocabulary words in this LIFEPAC appear in* **boldface** *print the first time they are used. If you are not sure of the meaning when you are reading, study the definitions given.*

Pronunciation Key: h**a**t, **ā**ge, c**ã**re, f**ä**r; l**e**t, **ē**qual, t**ė**rm; **i**t, **ī**ce; h**o**t, **ō**pen, **ô**rder; **oi**l; **ou**t; c**u**p, p**u̇**t, r**ü**le; **ch**ild; lo**ng**; **th**in; /*ŦH*/ for **th**en; /*zh*/ for mea**s**ure; /*u*/ represents /*a*/ in **a**bout, /*e*/ in tak**e**n, /*i*/ in penc**i**l, /*o*/ in lem**o**n, and /*u*/ in circ**u**s.

THE ANCIENTS

Before electric lights, people could easily see the night sky. In ancient times, man would gaze at the magnificent sky. In his mind he imagined the outlines of people and animals. The early Greeks gave names to these star-shaped figures from their religious and cultural stories. These stories are known today as **myths**.

For centuries some men have looked up at the night sky and have wondered whether those numberless specks could affect their lives. People who studied the stars were called astrologers. Astrology was part of the Babylonian religion. To them the **zodiac** was a sacred pathway for the sun and the planets. Others have continued to see in the myriads of stars the mighty hand of God in creation and in preservation of design and order in the universe. The Psalmist wrote (Psalm 19:1) "The heavens declare the glory of God; and the firmament sheweth his handywork."

Stars became familiar signposts in the sky to sailors and travelers. Some of the first inventions were used by sailors to find their way in the vast oceans.

Ancient peoples told time by the sky. The sun and stars marked the time of day and night. The moon measured the month. Stars marked the year and its seasons. Observers noticed that stars set about four minutes earlier each night and concluded that the star day is four minutes shorter than the sun day.

As people studied the sky they observed at least four different motions:

1. Most stars rise in the east and set in the west,
2. Both the sun and moon rise in the east and set in the west,
3. The sun rises farther north in summer and farther south in winter, and
4. The moon does not always rise at the same time.

Complete these exercises.

1.1 Write at least four different motions that can be observed in the sky.

a. ______________________ b. ______________________

c. ______________________ d. ______________________

1.2 List three ways the ancients told time by the sky.

a. ______________________ b. ______________________

c. ______________________

1.3 Name two ways that the stars aided ancient man.

a. ______________________

b. ______________________

1.4 How did the Psalmist react to his stargazing?

____

____

____

1.5 Locate an identifiable group of stars that you will recognize each time you look for it. On the first line of the table, record the data and the time the stars are directly over some feature such as a church spire, a flagpole, or one wall of a building. Go to the same observation post about ten days later and note the time the same group is in the same position. Record the date and time of your second observation on the second line. Make the same observation ten days later and again ten days after that. Record the dates and times on the table.

Observation	Date	Observation Time
First observation		
Ten days later		
Ten days later		
Ten days later		

1.6 What do you conclude from this thirty-day observation?

____

____

____

____

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CONSTELLATIONS

The imaginary figures that the ancients observed are star groups that seem to travel together in space.

Do you think you are sitting still in your chair right now? If you could look at yourself from outer space, you would see that you are turning a giant somersault once every twenty-four hours as the earth turns on its **axis** at about sixteen hundred kilometers per hour. You are also making a circle around the sun at the speed of 107,200 kilometers per hour. Also, our **solar system** revolves around the center of our galaxy, the **Milky Way**, at the rate of 69,200 kilometers an hour. The whole galaxy is traveling toward the star Vega at about twenty kilometers per second. So you see, you are definitely not sitting still in your chair.

The Milky Way is the home of our solar system. On an early summer evening you can see the cloud of stars stretching across the sky. You can see a great number of stars. With a telescope you can see many more stars. People in ancient times thought that all stars were part of the Milky Way. Today we know of many other galaxies similar to the Milky Way.

To study the Milky Way as a whole is difficult for scientists on the earth because we are located within it. We cannot look at the Milky Way galaxy from the outside to observe its size and shape. It is so large that light travels about one hundred thousand years from one side to the other. Outer space is so staggering that a unit of measurement was invented to express the great distances. A *light year* represents the distance that light travels in one year. One light year is almost 6 trillion miles. The nearest star, other than the sun, is Proxima Centauri, which is one of 3 stars in the Alpha Centauri system. It is 4.3 light years away.

Calculate a light year.

1.7 Light travels at a speed of 186,000 miles a second. Calculate the distance light travels in a year.

Complete these activities.

1.8 Suppose a star is 300 light years away. The number tells you the distance to the star. It also tells you that the light you are seeing started on its journey from the star 300 years ago. If a star that is nine light years away blew up today, when would we know about it?

____

1.9 Explain your answer in 1.8. ____

____

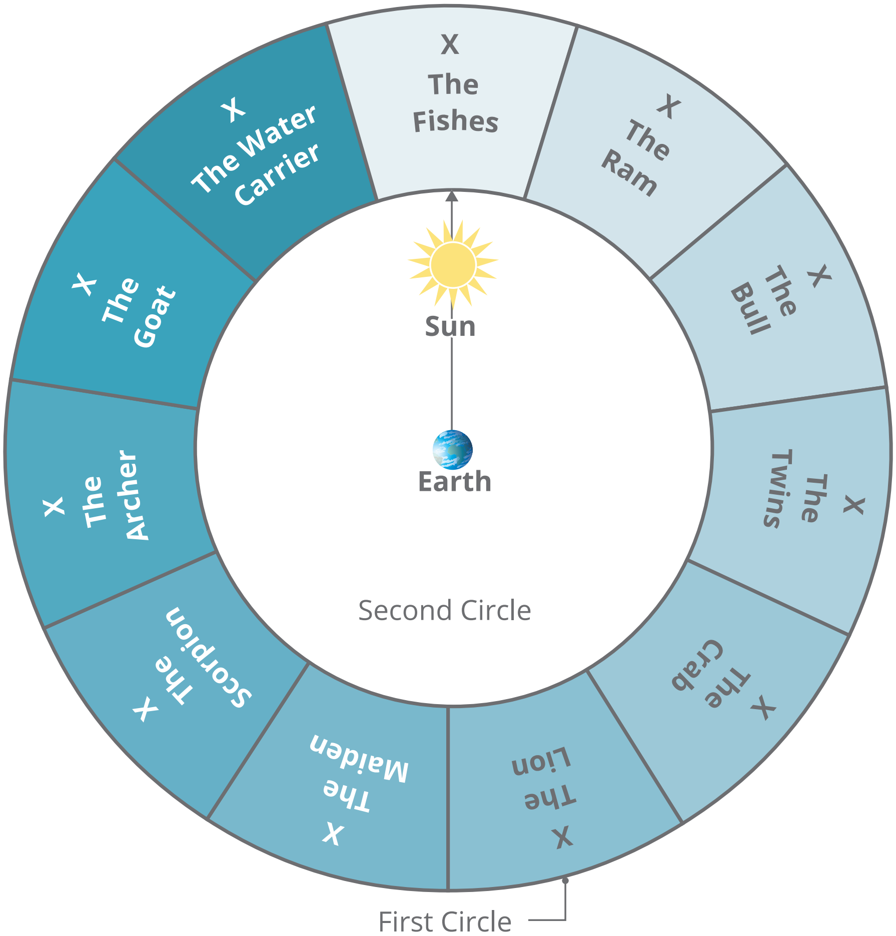
____

A set of twelve **constellations** in the sky is called the zodiac. The zodiac constellations can be seen in the part of the sky traveled by the sun and the moon. Different ones are visible at different seasons of the year. The following activity model will help you understand why.

View 703 Constellations, from the Grade 7 SCIENCE EXPERIMENTS Video

Complete these activities.

1.10 Cut a cardboard circle about twenty-five centimeters in diameter (twice the diameter of the one shown here). Mark an X at each point where an hour would be on a clock face. At each X write the name of a zodiac constellation as shown in the figure.



Draw and cut out another circle about twenty centimeters in diameter. At the edge of this circle draw a small picture of the sun. Fasten the two circles together with a paper fastener through their centers. The paper fastener will represent the earth. Draw a line from the earth through the sun.

1.11 Complete the following chart by writing in Column 1 the name of the constellation that is in the line with the earth and sun. In Column 2 write the name of the constellation that would set just after the sun sets. Turn the constellation circle *counterclockwise* one constellation. Each time note which constellation is in line with the earth and the sun and which one would set just after sunset each time.

Constellations Experiment

	Column 1 Constellation in Line with Earth and Sun	Column 2 Next Constellation to Set
a.		
b.		
c.		
d.		
e.		
f.		
g.		
h.		
i.		
j.		
k.		
l.		

Star charts have been developed to help follow the ever-changing picture formed by the heavenly bodies. Each season and hemisphere has its own pattern of stars. Once you learn to recognize the principal constellations of each season, you can use them as a guide along with your star chart to find other stars. The charts in this unit are for the northern hemisphere.

Early evening darkness is the best time for stargazing. Hold the star chart over your head. Make sure that north on your chart is lined up with true north. Use a flashlight covered with red cellophane to read your chart and compass. White light deadens the ability of your eyes to see the stars.

The winter sky. Of all the months of the year, February is best for stargazing. It has an exciting parade of stars.

Orion, the hunter, is one of the best- known constellations in the sky. Three stars make up Orion's belt. Betelgeuse, a giant red star, marks his right shoulder. Betelgeuse is one of the largest stars man has found. Its diameter is 400 million miles. Rigel, a brilliant blue star, is positioned at Orion's left knee. He appears to be holding his right arm over his head. If you imagine a line drawn along Orion's belt toward the southeast, you will find the star, Sirius, the dog star. Sirius is the second brightest star in the sky. Sirius is the nose of one of Orion's hunting dogs, Canis Major.

The imaginary line made by Orion's belt toward the northwest passes just under the horn of Taurus, the bull. The horns of Taurus form a V-shape in the sky and contain the star, Aldebaran. Pleiades, the seven sisters, are located on the shoulder of Taurus. Usually only six stars can readily be seen; but when viewed with a telescope, many more stars can be seen.

The horns of Taurus point toward two stars located above Orion's second dog, Canis Minor. These stars are the Gemini twins, Pollux and Castor.[1]

[1] This LIFEPAC has an appendix of constellation names and descriptions.

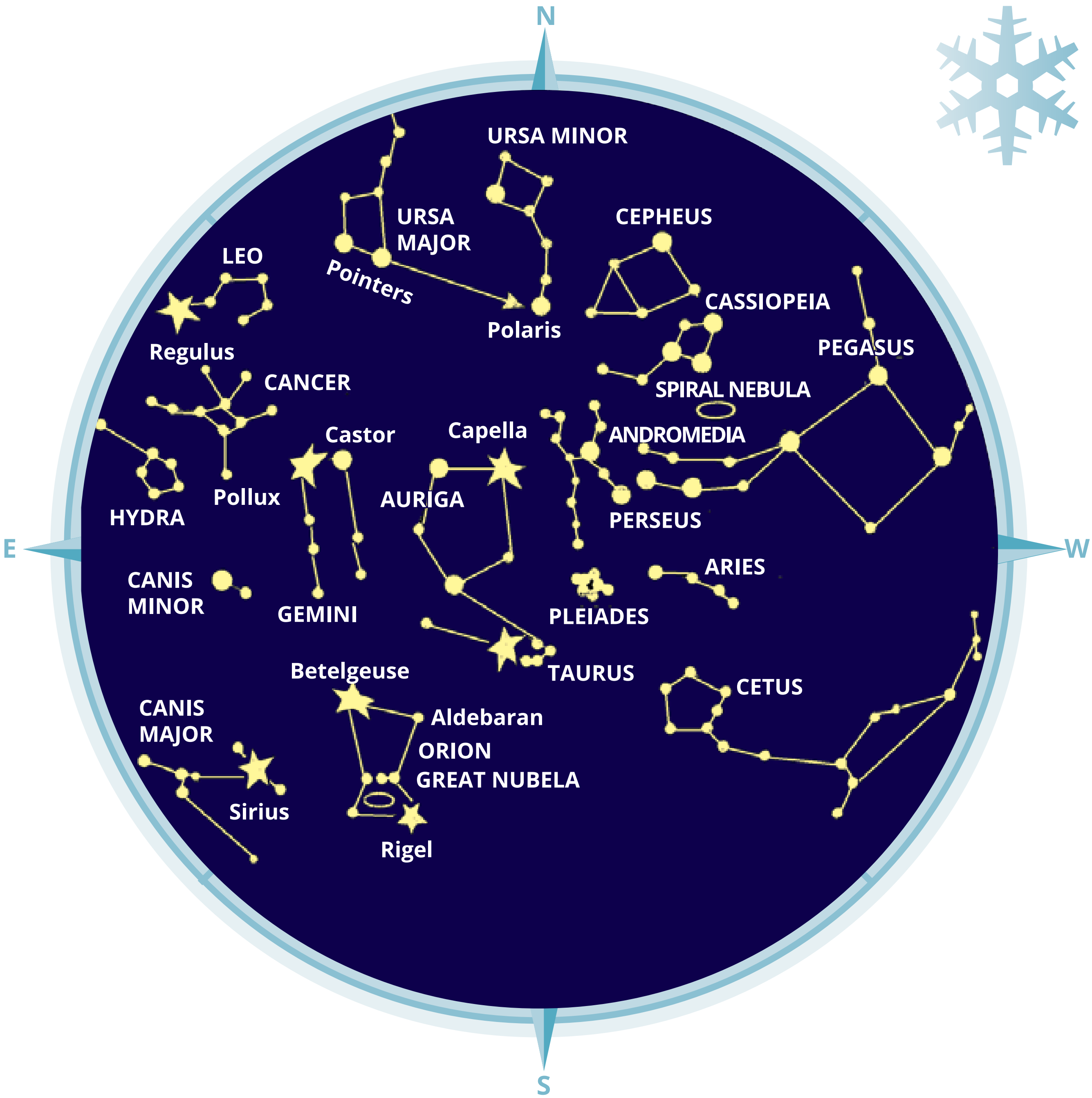


Figure 1 | Constellations of the Winter Sky

The spring sky. The spring sky contains the best-known of all the constellations—the Big Dipper, also known as Ursa Major, the big bear. It can be seen all night because it does not rise or set. The spring sky is not as spectacular as the winter sky. Locate the Big Dipper. How many stars are in the Big Dipper? The two end stars in the bowl of the Dipper are called the pointer stars because they point to Polaris, the **North Star**.

Figure 2 | Constellations of the Spring Sky

Polaris is not one of the brightest stars, but it is one of the most useful to man. The North Star can be used to find direction. It is located almost directly over the North Pole. All other stars appear to rotate around it during the night. Polaris is the end star in the handle of the Little Dipper. The Little Dipper is also called Ursa Minor, the little bear.

Notice the gentle arc in the handle of the Big Dipper. Follow that arc toward the southeast to a bright star called Arcturus. Arcturus is in the constellation Boötes.

To the east on the horizon is the constellation Libra, the scales. This constellation is the symbol for justice.

The most prominent constellation in the spring sky is Leo, the lion. Leo is almost overhead at the **zenith**. Leo's head resembles a backward question mark. The star Regulus is the period. The rear end of the lion is shaped like a small triangle.

Complete this writing assignment.

1.12 Research some area related to the study of constellations. Use encyclopedias , online resources, and other reference books. Try to limit your report to less than six pages.

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initials date

The summer sky. Darkness comes much later in the summer, so your observation of the stars will be at a later hour than during other seasons. The summer sky has three bright stars that form what is known as the **summer triangle**.

The constellation Lyra, the harp, will be found near the zenith. This group of stars is easy to locate because it contains the bright star Vega.

East of Lyra is the constellation Cygnus. *Cygnus* means *swan*; but because of its shape, this constellation is often called the Northern Cross. The brightest star in Cygnus, Deneb, is located in the tail of the swan.

Below Cygnus to the southeast is Aquila, the eagle. Aquila's brightest star is called Altair. Altair, Vega, and Deneb make up the summer triangle.

West of Lyra is found the constellation that immortalized Hercules, a most popular hero of ancient **mythology**. With his foot on the head of Draco, the dragon, he is about to club him. In his other hand Hercules holds the golden apples from the garden of Hesperides which Draco guarded.

To the south of Lyra is Sagittarius, the archer. Sagittarius was a centaur who lived on a mountain in Thessaly.

On the southwestern horizon is Scorpius, the scorpion. Orion appears in the winter sky and Scorpius in the summer sky.

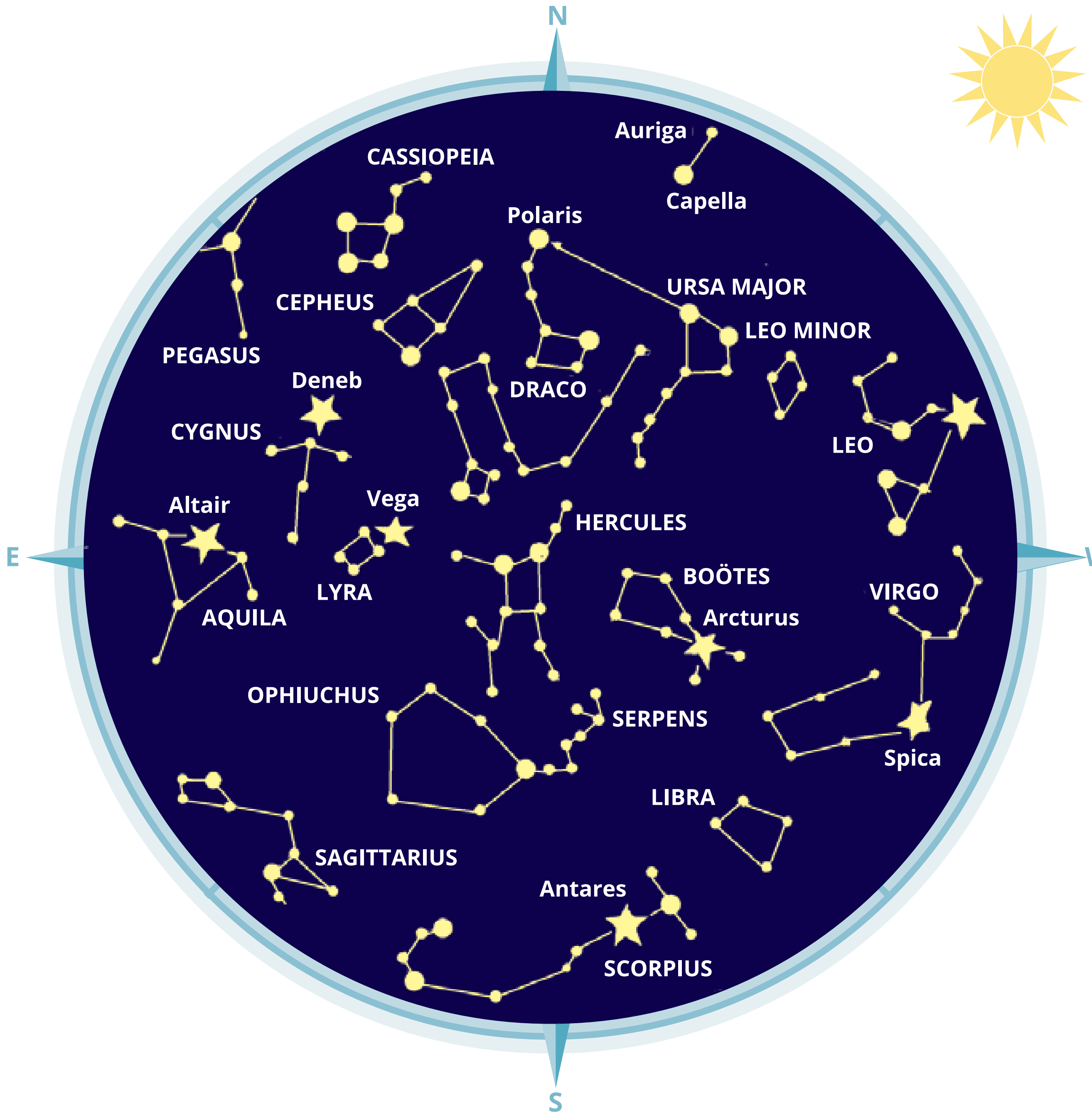

Figure 3 | Constellations of the Summer Sky

Use a dictionary to define these terms.

1.13 centaur ____

____

1.14 myth ____

____

1.15 perennial ____

____

The autumn sky. The parade of stars across the autumn sky is the least spectacular of the four seasons. The summer triangle has moved off to the west and Orion is just rising on the eastern horizon.

Overhead is the Great Square of Pegasus, the winged horse. The horse is really made up of two constellations, Pegasus and Andromeda.

South of Pegasus and between Aquarius and Cetus lies Pisces, the fishes. To the west of Aquarius, the water carrier, is Capricornus, the goat.

The perennial sky. The polar stars are the stars found around Polaris, the North Star. These stars belong to every season for they never set. They are called circumpolar stars because they seem to revolve around the North Star and because they do not go below the horizon. The constellations are these: the Little Dipper; the Big Dipper; Draco, the dragon; Cassiopeia, the queen; Cepheus, the king; and Camelopardalis, the giraffe. Cepheus resembles a house; Cassiopeia, his queen, looks like the letter *W*.

Do not be in a hurry to find all the constellations at once. Locate one or two at a time and watch them for several nights. Then look for another group of stars. The constellations on your star map are extremely small when compared to the constellations in the sky. The spaces between the real stars are much larger than you imagined and they will cover huge areas of the sky.

Figure 4 | Constellations of the Autumn Sky

Answer these questions.

1.16 What is a constellation? ____________________

____

1.17 What are the names of three winter constellations? ____________________

____

1.18 What stars make up the summer triangle? ____________________

____

1.19 If you were standing on the North Pole, how many circumpolar stars would you see? ______

____

1.20 If you were standing on the equator, how many circumpolar stars would you see? ________

____

____

1.21 What is the closest star to us, other than the sun? ____________________

____

1.22 If Sirius is the second brightest star in the sky, what is the brightest star? ____________

____

Complete these projects.

1.23 A planetarium is a place where images of stars and constellations are projected onto the ceiling of a dome. Find out if a planetarium is located near your home. If one is, plan to visit it.

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1.24 Make a planetarium. Using a salt carton and a flashlight, you can make a planetarium to study star constellations. Remove the top of the salt carton. Punch holes in the other end in the pattern of a constellation. Make small and large "stars" with nails of different sizes. Shine a flashlight into the open end of the carton and project the constellation onto the wall of a darkened room. Use several lids, punching a different constellation into each one.

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GEOCENTRIC THEORY

The geocentric theory of the universe originated with Aristotle and was later modified by Ptolemy. According to these men, the earth, not the sun, was the center of the universe.

Aristotle. For almost two thousand years after his death, Greek philosopher Aristotle reigned as the supreme authority in scientific matters. Many of his ideas were adopted by the church. Among these ideas was the geocentric theory, which held that the earth was the center of the universe and that all heavenly bodies revolved around it.

According to the theory, the heavenly bodies are fastened to a series of crystalline spheres concentric with the earth. The nearest sphere is the atmosphere. The next four spheres are the four "elements": earth, water, air, and fire. Beyond the sphere of fire is a region containing ether, a mysterious substance supposedly found in space. The heavenly bodies occupy other spheres stretching away from earth in this order: the moon, Mercury, Venus, the sun, Mars, Jupiter, Saturn, and the fixed stars. At the outermost limits of the universe is the sphere of the *Prime Mover*, the *First Cause*. The Prime Mover is the source and origin of all motion and life. The Prime Mover is the force that keeps each of the spheres in motion. The Prime Mover of Greek thought in reality is Jehovah God.

The elements—earth, water, air, and fire—supposedly were also found on the earth as the building blocks of all things, living and nonliving. Aristotle divided the physical world into two realms—the organic and the inorganic.

Aristotle's written work, *On the Heavens*, presents his **cosmology**. He argued entirely from theoretical principles. Aristotle reasoned in this way:

a. The universe should be spherical because the universe is divine and the sphere is the divinely perfect figure.

b. The universe must rotate in a circle because circular motion has no beginning and no end and is, therefore, eternal.

c. The center of a rotating body is at rest; therefore the earth, the center of the universe, is at rest.

d. The earth consists of the four elements: earth, water, air, and fire. The region of the earth is one of change and therefore the natural movement of these four elements is up and down. This movement produces an intermixing of the elements.

e. The region of the eternal and divine begins with the moon, where movement is always circular.

f. The substance of the heavens must be different from those of the earth. Aristotle said the heavens were composed of ether, and that the natural motion of ether is circular and at constant speed.

This last principle, however, contradicts observations. Several heavenly objects periodically show a slower or even **retrograde** motion. The unusual motions of these objects were explained with the assumption that their *true* motion was always regular and circular. The **apparent** movement of each planet was ingeniously explained as the result of the combined motions of a number of spheres. Altogether over fifty separate circular motions were required to explain the puzzling phenomenon.

The simplest explanation is generally the most accurate one. If we ask why the Aristotelian model should have carried such authority until the Renaissance, the answer is the genius of Aristotle for system-building. Biology and cosmology did not stand as separate structures. Aristotle looked for a link between them and found it by declaring that earthly happenings were dependent on heavenly events.

It was obvious to the Greeks that the cycle of life on earth is dependent on the **celestial** cycles. Morning awakens us and evening brings us to our rest. Morning and evening depend on the daily revolution of the sun (in terms of Greek cosmology). The annual progress of the sun accounts for the change in the seasons, for growth and decay, for the birth of spring, the maturity of summer, the decline of autumn, and the death of winter. The biological world is thus part of the heavenly world; and so also is man, in another and special sense. Aristotle taught the mortality of the soul but claimed immortality for the mind. Through our minds, we are sharers in the divine and in eternity.

Everything that moves is moved from outside itself, but where do celestial bodies derive their motion? Aristotle argued that at some point exists an *unmoved mover*—in other words, a god. We know this god to be Jehovah God.

A problem in Aristotle's concept of the universe was obvious from the first. Several stars did not move in the same direction and with the same regularity as did all the others. These few mavericks appeared to wander through the constellations—sometimes moving forward, sometimes standing still, sometimes even moving backward against the backdrop of the regular stars. Aristotle's spheres could not explain these **wanderers** and their sometimes retrograde travel.

Ptolemy. In the third century A.D., Ptolemy modified Aristotle's model and developed a series of mathematical explanations for the unusual movements of the wanderers. Like Aristotle, Ptolemy taught that the earth was fixed and at the center of the heavens. The sun, the moon, and the known **planets** revolved around the earth in circles. Beyond them the stars were attached to a crystal-clear sphere. Beyond all was the Prime Mover.

Figure 5 | Epicycles

Ptolemy's modification contained the explanation that each planet moves in a small circle, the center of which is carried on the circumference of a larger circle (see Figure 5). The center of this larger circle is the earth. By this system of epicycles, Ptolemy explained the apparently erratic planetary movements.

Observe these two drawings (Figures 6 and 7).

1.25 One is of the universe as Aristotle described it. The other represents Ptolemy's view of the universe. Tell how they are alike and how they differ.

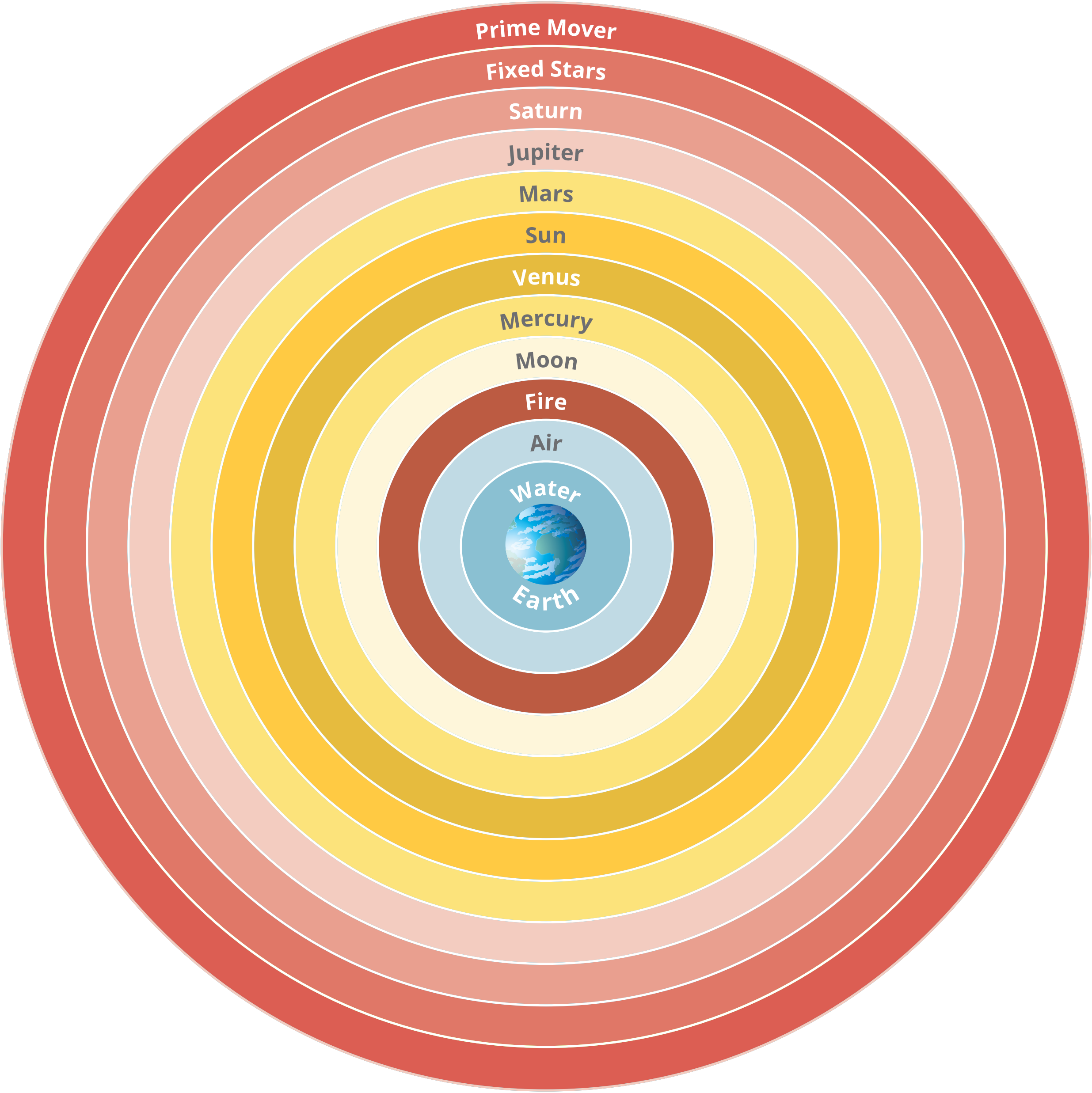

Figure 6 | Aristotle's Cosmology

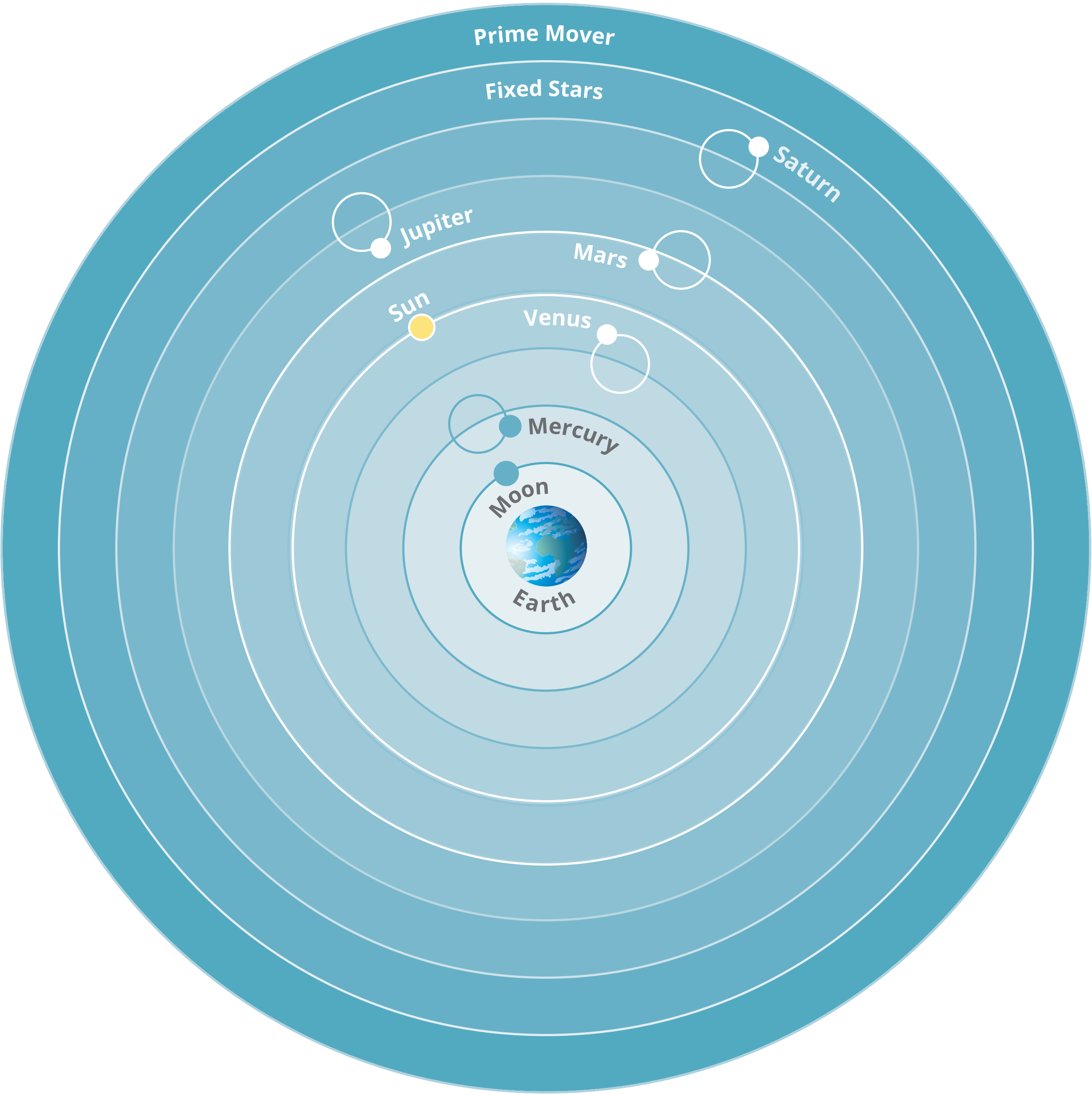

Figure 7 | Ptolemy's Cosmology

WANDERERS

If you watch the night sky for some time, you would find five bright objects that do not move the same way that the fixed stars move. They do not belong to constellations. They move among the constellations at different speeds. They even change directions. The Greeks called these bodies *wanderers*. We call them *planets*.

Like the sun, the planets appear to travel eastward through the fixed stars. Periodically they appear to slow down. They seem to stop briefly and then move backward. They slow down again, stop, and then move eastward again. This different pattern of movement makes the term *wanderer* appropriate.

Mars, Jupiter, and Saturn always appear brightest when they are halfway along their backward paths.

Most of the sky-watchers long ago thought that the earth was the center of the universe. Their conclusion was based on appearances. The sun, moon, stars, and planets were thought to be fastened to spheres that spun around the earth. This explanation did not satisfy Aristarchus, a teacher at Alexandria, Egypt, in 290 B.C. If the planets were fastened to spheres, he reasoned, they would always be the same distance from the earth. Then why did they change in brightness, he asked? Aristarchus suggested that the sun was at the center of the universe. He said that the earth was a planet and that the planets moved around the sun. Very few scholars agreed with him, so in time his idea was forgotten.

View 703 Elliptical Orbits, from the Grade 7 SCIENCE EXPERIMENTS Video

Perform this activity with a friend.

1.26 Stick a styrofoam ball on one spoke of an umbrella. The styrofoam ball represents a planet. Ask a friend to carry the umbrella upright and walk in a circle around you. As your friend walks, he should slowly rotate the umbrella (spin it by its handle) in the direction he is walking (clockwise or counterclockwise).

Watch the "planet."

a. When does it move in the same direction in which your friend is walking? ____________

b. When does it go in the opposite direction? ____________

c. How is this motion like the backward (retrograde) movement of a planet, seen from the earth? ____________

d. If the ball was a light, when would it appear brightest? ____________

1.27 The path of the styrofoam ball represents the path that Ptolemy thought the planets traveled.

a. How did Ptolemy's theory explain what appears to be a backward movement of planets?

____

b. How did it explain the changing brightness of some planets? ____________

Ptolemy's theory seemed to be a good one. It was accepted by scholars for almost fifteen hundred years.

1.28 On a sheet of paper draw a diagram to show the motion of the planet in your activity. Show both motions of the ball—the motion as it moved around your friend and the motion as it moved around you.

Elliptical Orbits Experiment

METEORS

Most people have seen streaks of light in the sky and called them “shooting stars,” or “falling stars.” A better name for the light is **meteor**. Space is full of metal and rock that move at high speed. When they are in space, the pieces of metal and rock are called **meteoroids**. When they enter our earth’s atmosphere, they heat up and give off light. If the piece manages to get completely through the atmosphere without being consumed by heat, the portion of a meteor that hits the ground is called a **meteorite**.

The average speed of a meteoroid in space is about 85,000 miles per hour. When a meteoroid enters the atmosphere, friction with the atmosphere causes it to heat up. Most meteoroids vaporize and disappear well above the earth’s surface. Meteoroids range in size from grains of sand to great boulders. Approximately two tons of **meteoric** dust is estimated to fall on the earth every twenty-four hours.

Most of the dust is composed of iron and nickel. Since both iron and nickel-iron are magnetic, small **meteoritic** particles can be recovered by dragging a small magnet over the ground. About ten percent of the material clinging to the magnet will be dust from outer space. Examine some of it under a low-powered microscope if one is available.

Meteor “showers” are named according to the constellation from which they appear to fall. Meteors radiating from the constellation Leo are called Leonids; those from Orion are called Orionids. The following table lists the main annual meteor showers and the dates of maximum shower activity.

Name of Shower	Number of Days It Will Last	Date of Maximum Activity	Hours of Maximum Activity	Approximate Number of Meteors Per Hour
Quadrantids	4	January 3–4	12-4 a.m.	60
April Lyrids	4	April 22	12-4 a.m.	12
Eta Aquarids	8	May 5	12-4 a.m.	30
June Lyrids	8	June 15–16	12-4 a.m.	10
Delta Aquarids	3	July 28–29	12-4 a.m.	25
Perseids	25	August 12–13	12-4 a.m.	69
Draconids	1	October 8–9	12-4 a.m.	10
Orionids	11	October 20–21	12-4 a.m.	25
Leonids	5	November 17–18	12-4 a.m.	20
Geminids	14	December 13–14	12-4 a.m.	60

Figure 8 | Table of the Main Annual Meteor Showers

Complete these activities.

1.29 Check the definitions of *meteoroid*, *meteor*, and *meteorite* in the vocabulary. Use these definitions as a basis for comparing the three. Then, beside the following terms, write short definitions that will indicate the similarities and differences among the terms.

a. meteoroid ____

____

b. meteor ____

____

c. meteorite ____

____

1.30 Without looking in the vocabulary define meteoric and meteoritic.

a. meteoric ____

____

b. meteoritic ____

____

1.31 Surface tension causes molten meteoric material to form spheres ranging from less than 0.01 millimeter to about one millimeter in diameter.

a. Draw a circle that is 1 millimeter in diameter.

b. How many 0.01 millimeter spheres of meteoric dust could sit on a line that is one millimeter long? ____

1.32 Gather some meteoritic dust. Dust samples that may contain some meteoritic dust can be collected from rain gutters. Place a powerful magnet inside a plastic bag and pass it through the debris in a rain gutter. What kind of meteoritic dust are you gathering?

____

Place the plastic bag in a jar of water and remove the magnet. Swish the bag around and remove all the dust from it. Take small samples of the dust from the jar by using a medicine dropper. Examine these samples under a microscope. If you observe small spheres, you may be looking at matter which originated somewhere in space. In the following space and at the top of the next page draw representative samples of some of the tiny objects you saw during your microscope observations.

1.33 Optional Activity:

Meteors or meteor showers can be recorded on a star chart. Pick a clear, dark moonless night and watch the sky for “shooting stars.” Usually three or four can be seen in an hour. The best time for meteor-watching is after midnight. When a meteor is spotted, note the constellation in which you first saw it and record the information on a chart similar to the one illustrated. Do this meteor-watching for several nights and keep a record of it.

Record Chart for Meteor Sighting			
Date	**Time**	**Number**	**Constellation**

If you wish to do a more professional job with your meteor-watching, locate the American Meteor Society, through the World Wide Web for directions on making reports of your sightings.

TEACHER CHECK ____________ ____________
initials date

Review the material in this section in preparation for the Self Test. The Self Test will check your mastery of this particular section. The items missed on this Self Test will indicate specific areas where restudy is needed for mastery.

SELF TEST 1

Complete the statements (each answer, 3 points).

1.01 The star day is shorter than the sun day by ____________________ minutes.

1.02 If you were standing at the ____________________ , all the stars you see would rise and set.

1.03 Early astronomers believed that the ____________________ was the center of the universe.

1.04 The Greek scientist who first theorized that the sun and planets revolved around the earth was ____________________ .

1.05 Ptolemy's "improvement" of Aristotle's cosmology attempted to explain the odd movements of the ____________________ .

1.06 The ancients nicknamed those celestial objects with the odd movements " ____________________ ."

1.07 Pieces of rock or metal moving through space are called __________________________________ .

1.08 Pieces of rock or metal that enter the earth's atmosphere are called ____________________ .

1.09 Pieces of rock and metal that have struck the earth's surface are called ___________________ .

Complete the activities (each answer, 3 points).

1.010 List three ways the ancients told time by the sky.

a. ____

b. ____

c. ____

1.011 List three apparent motions of the celestial objects.

a. ____

b. ____

c. ____

1.012 List three of the motions we make as we ride the earth through space.

a. ____

b. ____

c. ____

Complete these activities (each answer, 5 points).

1.013 Make a drawing of the geocentric theory proposed by Aristotle.

1.014 Make a drawing to show how Ptolemy modified Aristotle's cosmology (geocentric theory).

Match the terms (each answer, 2 points).

1.015	_______	light year	a.	measure of distance
1.016	_______	Milky Way	b.	of the sky
1.017	_______	constellation	c.	winter constellation
1.018	_______	Orion	d.	summer constellation
1.019	_______	Polaris	e.	home of the solar system
1.020	_______	Cygnus	f.	circumpolar constellation
1.021	_______	Cassiopeia	g.	path of Polaris
1.022	_______	cosmology	h.	star pattern
1.023	_______	celestial	i.	theory of the whole universe
1.024	_______	wanderers	j.	planets
1.025	_______	zodiac	k.	twelve constellations in the sky
			l.	North Star
			m.	measure of time

Complete these activities (each numbered answer, 5 points).

1.026 Explain why the "wanderers" created a problem for those who believed the geocentric theory.

____

____

1.027 Name the three stars in the summer triangle.

a. ____________________ b. ____________________

c. ____________________

77/96 **SCORE** ____________ **TEACHER** ____________ ____________

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