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SCIENCE

STUDENT BOOK

6th Grade | Unit 9

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SCIENCE 609

Astronomy and the Stars

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Astronomy and the Stars

Introduction

Have you ever stood outside at night and looked up at the stars in the dark sky? It is a wonder to behold! Thousands of stars are visible to the human eye in the night sky. Viewing the heavens and the stars at night can make us appreciate the majesty, beauty, and power of God who created all of these stars. Genesis 1:16 says, "He (God) made the stars also."

People have gazed upon the majesty of the stars in the night sky for thousands of years. Over time, they gave names to the stars and groups of stars. They learned that certain stars and groups of stars appeared only during certain times of the year. Other stars were visible during the entire year. More and more, people wanted to know about the stars and the wonders of the Universe that God created. Perhaps you have wondered about the stars. What are they made of? How far away are they? Are they different from one another? In this LIFEPAC®, you will learn the answers to these questions and more.

The science of **astronomy** deals with the study of the stars and other celestial bodies in our Universe. In this LIFEPAC, you will learn more about the science of astronomy, including some important people and events in the history of astronomy. You will also learn about important characteristics of stars and about some of the major groups of stars observable in the night sky.

Objectives

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

1. Define and describe the science of astronomy.
2. Correctly interpret findings of astronomy in light of faith in God and His creation of the universe.
3. Know some of the important people and events in the history of astronomy.
4. Describe some important developments occurring in astronomy today.
5. Describe the composition of most stars.
6. Describe how stars vary in color, size, temperature, and brightness.
7. Tell how spectra are used to investigate stars.
8. Define a light-year and an astronomical unit.
9. Know and identify some major constellations and stars.
10. Understand how the stars are used to determine location.

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

1. ASTRONOMY

God made the stars in the heavens to be glorious and wonderful to behold. Looking at the stars that God created often prompts important questions for people. Is there a God? How did all this vast creation begin? Who are we as humans in the midst of the vastness of the universe? Throughout the ages, as man gazed upon the vastness of space and the stars at night, he wondered about the Creator, the meaning of creation, and his own role in that creation. King David expressed it well in Psalm 8: *"When I consider thy heavens, the work of thy fingers, the moon and the stars, which thou hast ordained; what is man, that thou art mindful of him, and the son of man, that thou visitest him?"* (Psalm 8:3-4).

Fortunately, the Bible tells us that God does exist and that He created everything that exists, including human beings. Furthermore, He has a wonderful plan for us in His Son, Jesus Christ! Gazing upon the stars and the universe at night can help Christians give thanks for so wonderful a Creator and a Savior. Learning more about the stars and the universe can also help us understand the majesty, power, and wisdom of God, our loving Creator. In fact, some Christians may be inspired to make the study of the stars an enjoyable hobby or even a life's work!

The study of the stars and other objects in the universe is called **astronomy**. It is one of the oldest sciences. It is also one of the most fascinating sciences! People have studied the stars and their patterns for thousands of years. This study was somewhat limited, however, by what could be seen and observed at night with the naked eye. Beginning in the early 17th century, tools began to be developed that helped man discover more about the stars and other heavenly objects. The invention of the telescope increased what man could observe

| Modern telescopes help astronomers

in the heavens. Other tools and methods of observation were later used to increase what people knew about the stars and the universe. Today, astronomy is one of the most advanced sciences of all. It uses powerful means of observation (including telescopes in space orbit) together with sophisticated computer systems. Our knowledge of God's creation has greatly increased in the last 400 years through the science of astronomy.

In this Section of the LIFEPAC, you will learn more about astronomy. You will learn how the science of astronomy can be correctly applied to help our human knowledge and our faith in God. You will learn how to reject theories and opinions coming from some astronomers and scientists that would deny God or His part in the creation. In this Section, you will learn about some of the important people and events in the history of astronomy. Finally, you will learn about some of the more interesting developments in astronomy today.

Section Objectives

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

1. Define and describe the science of astronomy.
2. Correctly interpret findings of astronomy in light of faith in God and His creation of the universe.
3. Know some of the important people and events in the history of astronomy.
4. Describe some important developments occurring in astronomy today.

Vocabulary

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

astrology (ə strol ə jē). The supposed influence of the positions of stars and planets on human affairs and events upon earth. It is an occult practice.

astronomy (ə stron ə mē). The study of the stars, planets, and other objects that make the universe.

compatible (kəm pat ə bəl). Capable of existing together in harmony.

nebula (neb yə lə). Gigantic clouds of dust and gas in space.

reflector telescope (ri flek tər tel ə skōp). A telescope which uses a system of mirrors.

refractor telescope (ri frak tər tel ə skōp). A telescope which uses a system of lenses.

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/ or /ə/ 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.

GOD, ASTRONOMY, AND THE UNIVERSE

By faith, we know that God created the heavens and the earth. He created the stars and determined the number of them. Psalm 147:4 says: "He (God) determines the number of the stars, He gives to all of them their names." There are many things about the stars and the universe that we still are yet to discover; however, by faith, we know that God created all that exists, including the stars and all other objects in the heavens. For Christians, any explanation of the universe and its workings must be **compatible** with our belief that God created the universe and that He is in control of it all.

Throughout the ages, as people tried to understand the world and universe around them, they sometimes developed understandings of the universe that did not acknowledge God as its creator and sustainer. For example, they established religions that made the stars and other heavenly objects into "gods." Some people worshiped the sun and moon. Others attempted to explain and predict events on earth or in the lives of people by the positions of the stars and planets. This is the way the occult practice of **astrology** began. As Christians, we cannot accept such understandings of the creation and universe. Only the one true God is the Creator of all things, and only God ultimately controls what happens in the universe.

As the science of astronomy developed, explanations of the universe sometimes appeared to conflict with the belief of Christians about God and the creation. For example, when some early astronomers taught that the earth circled around the sun rather than the sun around the earth, some Christians thought this explanation denied the creation of the world as described in the Bible. However, today we know that the earth does indeed orbit around the sun and that this truth does not conflict with the teaching of the Bible.

In our day, some astronomers and other scientists may develop explanations of the universe that openly deny the presence or action of God. Christians cannot accept such explanations or understandings of the universe. By faith, we know that such explanations cannot be true. Astronomy, as a science, *can* help explain many things about our universe. Furthermore, we can be confident that the science of astronomy can be compatible with our faith. Truth cannot contradict truth. We need good astronomers who also have a strong faith in God. Such people would help us to learn much more about creation and the Creator!

God wants us to know about and care for His creation. We can use the discoveries of astronomy to do this. As Christians, we must always maintain our faith that God is the Creator and Sustainer of the stars and all other objects in the universe.

Answer true or false.

1.1 _____ Astronomy is the study of the stars, planets, and other objects that make up the universe.

1.2 _____ Astrology is helpful to understand events on earth.

1.3 _____ People have studied stars and their patterns for thousands of years.

1.4 _____ Astronomy is one of the oldest sciences.

1.5 _____ The invention of the telescope was not important to astronomy.

1.6 _____ For Christians, the discoveries of astronomy must be compatible with our faith in God as the Creator and Sustainer of the universe.

1.7 _____ The Bible teaches that the sun orbits around the earth.

1.8 _____ Astrology is based on scientific studies and fact.

HISTORY OF ASTRONOMY

Ancient astronomy. People have observed the stars in the night sky for thousands of years. As early as 1300 B.C., Chinese observers made charts of the positions of the stars and recorded eclipses of the sun and moon. The Babylonians made some accurate predictions of the planets and their visibility by about 700 B.C. The ancient Egyptians also made predictions of springtime by observing certain stars in the sky.

Beginning about 600 B.C., the Greeks developed a number of important ideas about the earth, stars, and planets. One of the Greeks, Ptolemy, wrote about a number of these Greek astronomical ideas in the 2nd century A.D. He had a lasting influence on astronomers for almost 1500 years. One of Ptolemy's ideas was that the sun circled around the earth. This was the accepted view of the universe for a long time, up to about the 16th century A.D.

Modern astronomy. Modern astronomy is considered by most people to have begun in the 16th century with a Polish astronomer, Nicolaus Copernicus. In 1543, Copernicus proposed that the sun was the center of the solar system and that the earth and other planets orbit around the sun. This idea was opposed to the accepted belief that the sun and planets revolved around Earth! Eventually, Copernicus was proven to be correct.

In the late 1500s, a Danish astronomer named Tycho Brahe analyzed the motions of the planets and predicted their motions more accurately than anyone else before his time. In 1609, Brahe's assistant, Johannes Kepler, proposed that the planets orbited the sun in *elliptical* orbits. Kepler's work greatly improved the accuracy of predicting the positions of the planets and provided much support for the acceptance of Copernicus's ideas.

In 1608, Hans Lippershey, a Dutchman who made eyeglasses, invented the *telescope* by placing some simple lenses on the ends of a tube. He used his telescope to observe objects on earth. An Italian scientist, Galileo Galilei, heard about Lippershey's invention and developed his own telescope. His telescope was a simple form of a **refracting telescope**, with a series of lenses. However, Galileo used his telescope and observed the heavens at night.

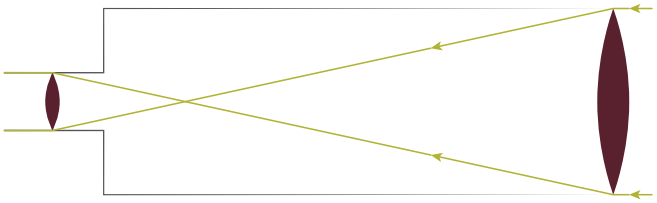
He made many important astronomical discoveries. For the first time, he saw mountains and craters on the moon. He discovered four of Jupiter's moons. He saw that Saturn had a ring and that the Milky Way had individual stars. Finally, he observed the phases of the planet Venus as it orbited around the sun.

A year after Galileo died, Isaac Newton was born in England in 1642. His contributions to astronomy were to have immense importance. Newton discovered the law of gravitation and showed how it explained the motions of planets, comets, and other objects. Newton also discovered that visible light can be broken down into a spectrum. This was to be of great importance in the study of the stars by spectral analysis, as you will learn in the next section of this LIFEPAC. Finally, Newton invented another form of telescope called a **reflecting telescope**. This kind of telescope used a series of mirrors and a lens to observe the stars and the heavens.

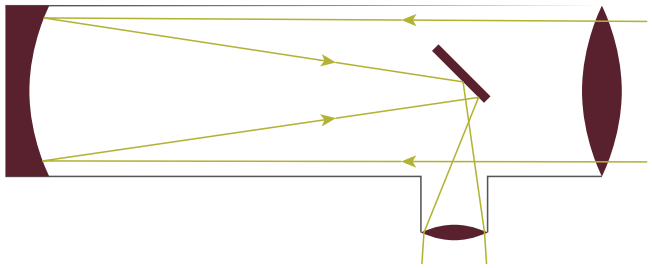
Another important event in the history of astronomy was the discovery of the planet Uranus in 1781 by the British astronomer, William Herschel. Herschel built many of his own telescopes. One of them was the largest telescope on earth until 1845. Herschel also published important catalogues of *double stars* and **nebulae**, which are gigantic clouds of glowing dust and gases in the universe.

After the discovery of the planet Uranus, astronomers noticed that its orbit varied from the path predicted. In 1843 two astronomers working independently of each other, John C. Adams of Britain and Urbain Leverrier of France, predicted the existence of another planet beyond Uranus that would explain the variation in the orbital path of Uranus. Using the predictions of Adams and Leverrier, a German astronomer named Johann Galle and his assistant, Henrich d'Arrest, discovered the planet Neptune in 1846.

In 1905 the astronomer Percival Lowell predicted that there is a planet beyond Neptune.



| A refracting telescope



| A reflecting telescope

After many years of searching by astronomers for another unknown planet in our solar system, the dwarf planet Pluto was discovered by the American astronomer, Clyde Tombaugh, in 1930. Thus, the two outermost planets in our solar system—Uranus, Neptune, as well as the dwarf planet Pluto—were discovered through the use of optical telescopes.

During the early 1900s, a German-born scientist, Albert Einstein, revolutionized our concepts about mass, energy, space, and time through his *special theory of relativity* (1905) and his *general theory of relativity* (1915). Einstein's work was very important to help astronomers understand certain aspects of the universe, such as the way stars get their energy and produce light through the transformation of mass into energy.

In 1929 the American astronomer Edwin Hubble demonstrated through observations and mathematical calculations that the universe is expanding. He showed that the more distant a galaxy is, the faster that it is moving away from the earth. This was important to our understanding of the structure and nature of the universe.

| Radio telescope in Jodrell Bank, England

The last event that we will include in our discussion of the history of modern astronomy was the 1931 discovery of radio waves coming from beyond our solar system by the American engineer, Karl Jansky. What Jansky actually detected was radio waves coming from the center of the Milky Way Galaxy. Using information from Jansky's discovery, an American amateur astronomer, Grote Weber, designed a radio telescope and began using it in the late 1930s to detect radio waves from outer space. This began a new branch of astronomy called *radio astronomy* using *radio telescopes*. Newer and larger radio telescopes were built around the world after World War II. For example, in 1955, a radio telescope was built in Jodrell Bank, England that has a dish 250 feet across. The study of radio waves coming from outer space greatly expanded the knowledge of the structure, size, and history of the universe.

Match the following names with the correct statements.

1.9 _____ Ptolemy

1.10 _____ Nicolaus Copernicus

1.11 _____ Tycho Brahe

1.12 _____ Galileo Galilei

1.13 _____ Isaac Newton

1.14 _____ William Herschel

1.15 _____ Johann Galle

1.16 _____ Clyde Tombaugh

1.17 _____ Albert Einstein

1.18 _____ Edwin Hubble

1.19 _____ Karl Jansky

1.20 _____ Grote Weber

a. discovered the planet Neptune

b. discovered the planet Uranus

c. discovered the dwarf planet Pluto

d. made first charts of stars in the sky

e. discovered radio waves from center of Milky Way

f. made predictions of springtime based on stars' positions

g. amateur astronomer who built the first radio telescope

h. demonstrated that the universe is expanding

i. said sun revolved around earth

j. said earth revolved around sun

k. invented reflecting telescope

l. first used refracting telescope for astronomy

m. analyzed motions of planets

n. developed special and general theories of relativity

Write a report on an astronomer.

1.21 Using the Internet, library, or other resources, find out more about one of the following astronomers. Write a 300-500 word report on the astronomer's life, especially mentioning his work that is important to the science of astronomy.

Nicolaus Copernicus	Tycho Brahe	Johannes Kepler
Galileo Galilei	Isaac Newton	William Herschel

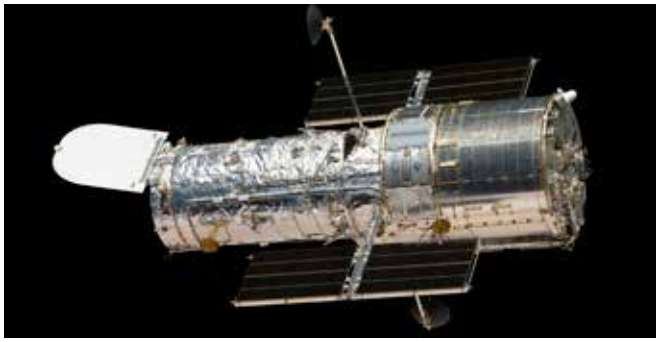
TEACHER CHECK _____ initials _____ date

ASTRONOMY TODAY

With the launch of the first artificial satellite into space on October 4, 1957, human beings entered a new era in the exploration of space. Since then, many different types of satellites and human missions have been launched into space. These developments have had significant impact on the science of astronomy. Our examination of astronomy today will highlight some of these developments.

Space travel has made it possible to observe the stars, planets, and other heavenly objects above the earth's atmosphere. Since the earth's atmosphere limits certain types of radiation and can distort optical images, the ability to send telescopes above earth is very helpful to astronomers. The earliest unmanned observatories were sent into space during the 1960s. Much information was gained about the moon and some of the other planets. In 1973 and 1974, American astronauts made some important observations using telescopes aboard the Skylab space station. Many other types of observatories were launched by American, Russian, and European space agencies in the 1970s and 1980s to study various types of radiation from outer space, including x-rays, infrared, and ultraviolet radiation.

In 1990 the United States National Aeronautics and Space Administration (NASA) launched one of the most important telescopes of all time: the *Hubble Space Telescope* (HST), named for astronomer Edwin Hubble who was discussed earlier in this Section. The HST was a reflecting telescope with a 94-inch (240-centimeter) main mirror for studies of visible and ultraviolet light. Although initially flawed, the mirror was repaired and corrected by astronauts in 1993 aboard the U.S. space shuttle. Since then, the Hubble Space Telescope has produced amazing images of many different objects in the universe. It can observe objects 50 times fainter than the most powerful telescopes on earth



| The Hubble Space Telescope

and can provide details on objects about 10 times smaller than those visible from earth.

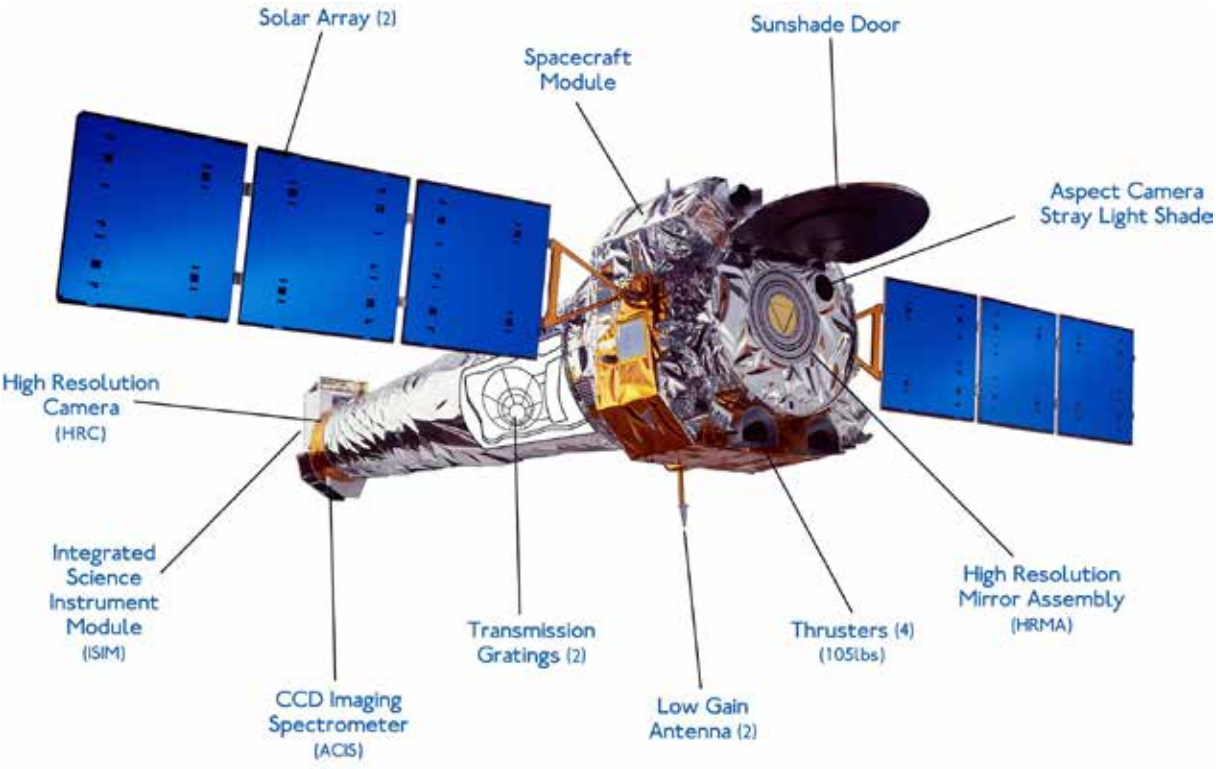
In 1999 The Chandra X-ray Observatory was launched aboard another U.S. space shuttle flight. It is the world's most powerful x-ray telescope and gives even more detail of objects in the universe than the Hubble Space Telescope. It is used to explore the universe in detailed ways not possible by any other methods before it.

New telescopes on earth have also been constructed in recent times. They include two identical optical telescopes on the island of Hawaii. The two telescopes are named Keck I (completed in 1992) and Keck II (completed in 1996). These optical telescopes consist of 36 mirrors mounted closely together and adjusted by computers to form a reflecting surface 33 feet across! In 1980, near Socorro, New Mexico, a network of 27 radio telescopes, each 82 feet (25 meters) in diameter, began operation. It is known as the Very Large Array (VLA). Another network of radio telescopes was completed in 1993. It is known as the Very Long Baseline Array (VLBA). It consists of 10 radio telescopes that are scattered across the United States.

One thing to note about the science of astronomy is the growing number and importance of amateur astronomers during the last 50 years. Amateur astronomers are very important to the growth of knowledge about our universe. Many important discoveries have been made

by amateur astronomers, such as the discovery of new comets, the classification of double-stars and variable star systems, and the previously mentioned invention of the radio telescope by Grote Weber, the American amateur astronomer.

The science of astronomy continues to expand the frontiers of the universe. Our knowledge of the stars and the universe continues to grow rapidly through the work of astronomers today.



| The Chandra X-ray Observatory

Complete the following statements.

1.22 The science of astronomy was advanced greatly by _____ , allowing observations above the earth's atmosphere.

1.23 The _____ is a large reflecting telescope in space that was launched in 1990.

1.24 The _____ is an x-ray telescope in space that was launched in 1999.

1.25 The _____ is a network of 27 radio telescopes located near Socorro, New Mexico.

1.26 Many important discoveries in astronomy, such as the radio telescope, were made by _____ .

Make a timeline.

1.27 Using the information in this Section of the LIFEPAC on the "History of Astronomy" and "Astronomy Today," make a *timeline* on a long sheet or roll of paper. Show the important dates, people and events relating to astronomy on your *timeline*. You may decorate your *timeline* with appropriate drawings and pictures that show the people, equipment, or events.

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

Match the following items (each answer, 3 points).

1.01 _____ Grote Weber

1.02 _____ astronomy

1.03 _____ Chinese

1.04 _____ Ptolemy

1.05 _____ Copernicus

1.06 _____ Newton

1.07 _____ Galileo

1.08 _____ Hubble

1.09 _____ 1931

1.010 _____ 1957

a. discovered Uranus

b. discovered Neptune

c. demonstrated the universe is expanding

d. invented refracting telescope for astronomy

e. designed the radio telescope

f. the study of stars and other objects in the universe

g. discovery of radio waves from space

h. made charts of star positions

i. first artificial satellite into space

j. discovered law of gravitation

k. said earth revolved around sun

l. said sun revolved around earth

Answer true or false (each answer, 2 points).

1.011 _____ Amateur astronomers have made important discoveries in astronomy.

1.012 _____ Astrology is helpful to understand events on earth.

1.013 _____ There are many stars and other objects in the universe.

1.014 _____ Astronomy is one of the oldest sciences.

1.015 _____ The invention of the telescope was not important to astronomy.

1.016 _____ For Christians, the discoveries of astronomy must be compatible with our faith in God as the Creator and Sustainer of the universe.

1.017 _____ The sun orbits around the earth.

1.018 _____ The Hubble Space Telescope can detect objects 50 times fainter than those which can be seen from the surface of the earth.

1.019 _____ Tycho Brahe analyzed the motions of the planets and predicted their motions.

1.020 _____ Albert Einstein developed the first radio telescope.

List the following items in the order they happened (oldest is 1, next is 2, etc. Each answer, 3 points).

1.021 _____ Hubble Space Telescope

1.022 _____ Radio Telescope in Jodrell Bank, England

1.023 _____ Chandra X-ray Observatory

1.024 _____ First refracting telescope

1.025 _____ Very Large Array near Socorro, New Mexico

Complete the following statements (each answer, 3 points).

1.026 Isaac Newton invented the _____ telescope.

1.027 Karl Jansky, an American engineer, discovered _____

_____

_____ .

1.028 Two identical telescopes, Keck I and Keck II, are located in _____ .

1.029 The ancient _____ made predictions of springtime by observing certain stars in the sky.

1.030 An American astronomer, Clyde Tombaugh, discovered the dwarf planet _____ .

Complete the following activities (each answer, 5 points).

1.031 Explain the difference between astronomy and astrology. _____

_____

_____

_____

1.032 Can "everything" taught about the stars and planets be believed and commonly accepted? Explain. _____

_____

_____

1.033 What are two important contributions that Isaac Newton made to the field of astronomy?

a. _____

_____

b. _____

_____

1.034 How is Albert Einstein important to astronomy? _____

_____

_____

_____

_____

80/100 **SCORE** _____ **TEACHER** _____ _____
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