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Space: That Vast Frontier

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Philosophy

Astronomy is said to excite the imagination in ways that no other area in science can. Often students imagine and talk about floating in space and intergalactic travel. People in many geographic locations have reported sightings of UFO's. There have been reports of alien infiltration and encounters from outer space phenomena. It is these reports and anxiety that caused my students to be concerned about the vast frontier of space.

Some of the major concerns of my students are as follows: 1) Is there any form of life in outer space? It is speculative that life exists beyond Earth. There is no scientific evidence to support such speculations otherwise. The chance of finding microorganisms on other planets however, can not be ruled out. 2) Travel through space. What the students are likely to discover is that the Earth is not the only planet in the Solar System. The major body in the Solar System is the Sun. The Solar System is made up of nine planets and their satellites, comets and countless minor bodies of meteorites and meteors. 3) Stellar detectors. Various telescopes and instruments are used to study the Sun and other stars. The telescope makes it possible to study many star groups. The telescope is most useful to show detail and take photographs of the night sky. 4) Life cycle of stars. Modern theory portrays that a star begins inside a nebula and contracts. Later it joins the main sequence. Eventually it will collapse into a condense white dwarf, a neutron star or a black hole, according to its mass.

This unit will be used as a tool to enhance the eighth grade Earth Science unit on astronomy. This unit will be spread out and dissected to fit what ever aspect in the astronomy unit requiring illuminating from data that I have gathered. In two of my classes this unit will be taught in its entirety. The time frame for teaching this unit is two weeks. Included in this unit are: vocabulary list, lesson plans, resource, field trip, student reading list, teacher reading list, and bibliography.

The students are looking for answers to their many questions and I am looking forward to answering them. The interchange will stimulate and enhance their knowledge of space.

I concur that space is a vast frontier which is far from being tamed. There is something new on the horizon to be explored. Technology has permitted man to get a quick glimpse into outer space but there is much more.

LIFE IN SPACE

Life beyond space is a topic that has undergone much discussion. According to current knowledge, we must admit to ourselves that most planets in the Solar System have proven hostile. Prior to the Space Age, Venus was thought to have at least oceans, which contained some sort of primitive life. We now know that the surface temperature of Venus is more than nine hundred degrees fahrenheit. The atmosphere is chiefly made up of carbon dioxide and clouds which contain sulfuric acid. Mercury is devoid of atmosphere and Mars, the least unfriendly planet lacks a useful atmosphere.

It is all speculative that alien life exists on Jupiter. There is no scientific evidence to support such speculations. Although the chance of finding microorganisms on Mars cannot be ruled out, the results of the Viking missions have proven totally negative in that regard. Scientifically speaking, it appears that there is no life in the Solar system except on Earth.

It is believed that solar systems are common in the Universe, and what happened to the Sun can also happen with other stars. Therefore, it is logical to assume that other planets that have a sun similar to ours are inhabited. In our Solar System, Earth is the only planet that is able to support advanced life forms. Earth lies at the center of the Sun's ecosphere, the area around the Sun that is neither too hot nor too cold for life to exist. Mars is located on the outer edge of the ecosphere and Venus is on the inner edge.

There are countless stars similar to the Sun in our Galaxy. For example Ceti, the twentieth closest star to Earth. It has the same type of spectrum, temperature, and other properties as our sun. It is because of this data that there is search for life elsewhere in the Universe.

TRAVEL THROUGH SPACE

MILKY WAY

The Milky Way appears as a white band of star light in the sky. It is made up of hundreds of billions of stars that form a great star system, a galaxy. Our Sun and nine planets are a part of the Milky Way Galaxy. It is of the gravitational pull of the stars that holds the system together. If you were above looking down on the Milky Way Galaxy, it would have the appearance of a pinwheel 100,000 light years across. The curving arm of the pinwheel are stars that together circle the center for the galaxy. Our Sun travels at a speed of 155 miles per second and takes more than 220 million years to travel once around the middle of the Milky Way.

Astronomers believe that there is a black hole in the center of our galaxy. A black hole can be defined as very dense remains of a massive star that has collapsed to pinpoint size. The black hole's gravitational pull is so strong that light and matter entering the hole cannot escape.

Astronomers believe that about 15 billion years ago, an explosion called the Big Bang created space, time, energy, and matter, and signified the beginning of the Universe.

FORMATION OF THE SOLAR SYSTEM

The Earth is estimated to be about 4700 million years old. The Sun is obviously as old as the Earth. There are

many theories attempting however to explain the formation of the Solar System. Modern theory says that the Earth and other planets were built up by accretion from a solar nebula. If this is the case, the process was a gradual one and the planets are expected to be approximately the same age. It is known that the Moon and the Earth are about the same age.

SOLAR SYSTEM

What do you really see when you look up into the sky on a dark clear night? Well, there is a lighted band that we call the Milky Way. Our galaxy appears to be flattened. Detailed studies indicate that it has a spiral shape. The Sun and its planets is situated near the main plane.

The Milky Way Galaxy contains about 100,000 million stars of which our Sun is not a particularly distinguished number. In size and luminosity, the Sun is an average star. It as important to us because the Earth moves around it.

The Sun is 30,000 light years form the center of the Galaxy. A light year is defined as the distance a ray of light travels in one year equivalent to 5.886 million million miles. The entire Galaxy is constantly in a state of rotation and it takes the Sun 225 million years to complete one journey around the center.

The Sun is a great distance from its nearest stellar neighbor. The closest star is a red dwarf, Proxima Centauri. Sirius is also one of our neighbors. The closest star that has some similarity to our Sun is Epsilon Eridani and Tau Ceti. These stars are eleven light years from earth.

The major body of the Solar System is the Sun. The Solar System is made up of nine planets and their satellites, comets, and countless minor bodies of meteors and meteorites.

PLANETS

The Sun is an ordinary star in the Galaxy. The Sun is not the largest star nor is it the smallest. The Sun is the center of our Solar System. Nine planets orbit around the Sun in their individual path. Mercury, Venus Earth, and Mars are the terrestrial planets. These rocky planets are small in comparison to the four giant jovian planets. The four jovian planets Jupiter, Saturn, Uranus, and Neptune are made mostly of gases. The outermost and smallest planet is Pluto. Seven of the nine planets have satellites (moons) circling around them.

MERCURY

Mercury is the closest planet to the Sun. Although Mercury revolves quickly around the Sun it rotates slowly on its axis. Consequently a day on Mercury is equivalent to a year.

Mercury is the second smallest planet. It is smaller than Saturn’s and Jupiter’s largest moon. Mercury has no moons.

Mercury gets its name from the Roman god, fleet messenger. It is hard to spot Mercury because it is only visible during the twilight hours on some days, and it is always close to the Sun’s bright glare. Some telescopic observations of Mercury reveal that it appears to change its shape from day to day much like our Moon.

The surface of Mercury is heavily cratered due to the bombardment of countless meteorites and asteroids.

Mercury is almost airless because of the closeness of the Sun. The temperature can rise above 750 degrees

fahrenheit during the day, which is hot enough to melt lead. During the long nights the temperature drops to -300 degrees fahrenheit, which is colder than the South pole.

VENUS

Next to our Moon Venus is the brightest object in the night sky. Venus is named after the Roman goddess of love and beauty. Although Venus is not a star, it is sometimes called the Morning or the Evening Star. Venus is the second planet from the Sun and rotates from East to West, the opposite of most planets and Moons. Venus has no moons. It is always shrouded in clouds.

Venus is also referred to as Earth's sister planet although it is very different from Earth. Venus is covered by thick clouds of sulfuric acid. Below the cloud the atmosphere is carbon dioxide.

Venus is a scorching desert with temperatures of 900 degrees fahrenheit. It is the hottest planet in the Solar System. The atmosphere is credited mostly for this intense temperature. It traps the heat and does not allow it to escape, in a process that is known as the greenhouse effect.

EARTH

Earth is the third planet from the Sun. It is the only planet with large amounts of liquid water on its surface and in the atmosphere. The Earth is filled with living things.

From space Earth looks like a perfect ball. It is 27 miles wider at the equator than at the poles. Planet Earth is larger than Mercury, Venus, Mars, and Pluto.

Earth spins like a giant top. One complete spin is called a day. It tilts on one side as it travels around the Sun. Part of the year the northern half experience summer because it tilts toward the Sun while the southern half tilting away from the sun experiences winter. As the Earth continues to orbit the southern half will tilt toward the Sun and experience summer while the northern half experiences winter.

Encircling the Earth is a protective blanket of atmosphere. The atmosphere is made up of nitrogen, oxygen, carbon dioxide, and trace gases. Most of the Earth's weather occurs in the layer of atmosphere closest to it, the troposphere.

Earth has one natural satellite, the Moon. We can only see that part of the Moon lit by the sunlight. The Moon is barren with no water, air, clouds, and no living things.

The Moon is covered with thousands of craters caused by bombardments of meteorites and asteroids. There are also mountains, hills, valleys, and flatlands. The gravity is 1/6 of that of the Earth.

MARS

Mars is the fourth planet from the Sun. Due to the closeness to us it appears bright in the sky. Mars has a red color. The Romans named it after their god of war because the red reminds them of blood and war.

Mars has craters, mountains, and valleys. The valleys are deep and longer than the Grand Canyon. The surface on Mars is made up of an orange dusty soil. The orange color is due to the presence of iron oxide in the soil. It is windy and cold there. The atmosphere is also thin.

Astronomers believe that when Mars was a young planet some water flowed there. Because of the properties

of its atmosphere, water cannot exist there in a liquid form. In some unexplored area there may still be some frozen water and possibly life. However, from samples gathered by the Viking missions there is no evidence that life exist on Mars.

JUPITER

Jupiter is the giant planet in the Solar System. The “rings” in Jupiter is speculative and it probably does not exist most times. Only Saturn has prominent rings. The gases that make up Jupiter are primarily hydrogen and helium.

An outstanding featured on Jupiter is the giant wind storm called the Great Red Spot. It was sighted 300 years ago and has not changed position.

Jupiter has at least sixteen moons. The outer moons are small. The four larger moons are Io, which has exploding volcanoes that spur out liquid sulfur, it also undergoes metamorphism with each explosion. Europa is covered by a smooth ocean of gas. Ganymede is the largest and is larger than Mercury. Callisto is primarily ice with some rock on top of a deep frozen ocean.

SATURN

Saturn is the second largest planet and it too is a gas planet composed mostly of hydrogen and helium. It is the sixth planet from the Sun and was named after the Roman god of farming.

Saturn’s rings are flat and are made of thousands small rings within rings. The rings are made of ice. The size of objects in the rings vary from the size of a house to that of a fingernail. The rings contain bits of rock and dust. The rings are less than three miles thick but extend to a distance of 170 miles across. No one knows for certain just how the rings were formed. It is speculative that they contain material left over from the formation of the planet.

Saturn has more than twenty moons, more than any in the Solar System. Titan is the largest moon. Titan is larger than Mercury and Pluto together. Saturn has six medium size moons and fourteen smaller moons.

Titan is the only moon in the Solar System known to have atmosphere. The atmosphere is mostly nitrogen gas that covers the moon surface with a thick haze.

URANUS

Uranus is planet number seven from the Sun. It is named after the Greek god of heaven and ruler of the world. If Uranus were hollow, about fifty planets Earth could fit inside. It is covered with pale blue-green clouds. The eleven rings around Uranus are made of chunks of an unknown black material.

Unlike other planets, Uranus lies on its side. Alternating poles when pointing toward the sun will have 42 years of dark.

Uranus has at least fifteen moons, five large and at least ten small. Uranus’s moon Miranda is quite unique in that it has huge canyons, deep grooves, ridges, and rope like markings on the surface.

NEPTUNE

You cannot see Neptune from Earth without the use of a telescope. Neptune is named after the Roman god of

the sea. It is the eighth planet from the Sun.

The rings here are not visible except from a close probe. It has dark storms, giant hurricanes, and streaky white clouds of methane-ice. Frigid winds blow at a speed of 700 miles an hour. Atmospheric methane absorbs red light which is why the planet has a blue color. Haze high above the clouds causes a red rim.

As Voyager 11 went past Neptune it discovered the two bright outer rings. There are eight moons of which Triton is the largest. Triton is said to be colder than any object in the Solar System. Once a hot volcanic place, now Triton is a frozen imprint of that earlier life. The planet has the appearance of a rind of an orange.

PLUTO

Pluto is usually the most distant planet from the sun. Its odd tilted orbit pulls it on occasions closer to the sun than Neptune. It is named after the Roman god of the underworld.

Pluto is the coldest and smallest planet in the Solar System. It appears to be an ice ball of methane gas and water mixed with rock. It is surrounded with methane gas.

COMET

Comets appear to be shining patches of light in the night sky . Most are too faint to be seen without a telescope. They are named, after their discoverer.

A comet is a dirty snowball. It has an icy core of water and gas mixed with bits of rock and metal, and covered with black dust.

When a comet approaches the Sun its surface material begins to evaporate. This exchange enables the gas to carry away some of the gas and dust particles that spread out around the nucleus in a large cloud called a coma. The sunlight causes the coma to glow. An average comet can create a coma 60 thousand miles across with a small amount of material spread very thin.

As the comet approaches the Sun, the pressure of the Sun and solar winds causes the gases of the coma to be swept away from the direction of the Sun. it is possible for the glow of a straight tail to extend millions of miles. Sometimes a second tail appears, this dust tail is usually slightly curved and shorter then the gas tail.

Most comets have an oval shaped orbit. Short period comets take less than 200 years to travel around the sun. Halley’s Comet is an example of a short period comet. Many short period comets have orbits that extends as far as Pluto. The comet with the shortest known period is Encke’s comet, which returns every 3.3 years.

There are two types of comet tails. The gaseous tail is usually straight and the dust tail is curved.

The mass of a comet is small compared to planets or satellites.

The tail of comets are mainly tenuous gases of hydrogen compounds, ammonia, methane and cyanogen. Many comets can be seen with the naked eye. They appear as a blurred patch of light and not all of them have tails.

A comet’s brightness is dependent upon its distance from the sun. The closer they are to the sun the brighter they appear. Some may fade away when they get close to the sun because their nucleus break apart.

In the past 200 years the comet IRA Araki-Alcock, has come closer to the Earth (2.9 million miles) than any other known comet.

There is a cloud of 100 billion comets that surrounds the Solar System.

ASTEROID

Asteroids are chunks of rock that circle the Sun. Sometimes they are referred to as minor planets. The diameters of asteroids are only a few miles across. They are far smaller than planets.

METEORS/ METEORITES/ ASTEROIDS

Meteoroids are members of the Solar Systems that are so small that they cannot be seen beyond Earth's atmosphere. They are the most common bodies in the sky.

Due to the high velocity of a streaking meteoroid, sometimes they plunge into Earth's atmosphere. The friction caused by the streaking causes them to glow red. Once a meteor enters the upper atmosphere, friction causes it to become heated and break up, leaving a luminous streak called a meteor or a shooting star. In reality they are not stars at all. Stars are Suns much beyond our Solar System.

Meteors originated as meteoroids, which are bits of rock and metal. There are two types of meteoroids, showers and sporadic. Meteor showers occur when Earth passes through an old comet's orbit and collides with some of the particles remaining from the comet's nucleus. The 1966 meteor storm was the greatest recorded in history.

The meteors that do fall to the Earth are called meteorites. Meteorites have the appearance of a rock or a hunk of metal.

Unless someone sees them fall they are difficult to find. The stony meteorites are mostly chondrites. Chondrites contain small glassy globs. The meteorite that was found in Antarctica is very much like that brought back from the moon by the Apollo astronaut. Meteoroids that are mostly iron and nickel do not look like ordinary rock and are attracted to magnets. A third group of meteoroids, stony iron, are about half stone and half nickel iron.

Large space rocks are asteroids. Most of these rocks are in the asteroid belt circling the sun between the orbits of Mars and Jupiter. There are about three thousand known asteroids. Ceres, about 600 miles in diameter is the largest known asteroid. Pallas and Vesta are next in size.

PROBES and DETECTORS

LUNAR

Prior to the landing of Apollo, the Soviet Union and the United States sent probes to the Moon. During some of the attempts to land some probes crashed while others made a soft landing. Luna 11, a Soviet probe sent back the first close-up pictures of the Moon. The space ship soft landed on the Moon and ejected an instrument capsule. Inside the capsule was a camera and transmitting antennas. Lunar 16, with its long arm a drill attached extracted soil sample that were placed in a container and blasted off back to Earth.

The Soviets used a remote control machine, Lunokhod, to fly over the moon and take pictures to send back to Earth.

Probes are very useful in orbiting or landing on planets and their moons. They have flown to most planets and some are on their way out of the Solar System and into interstellar space. They radio back to Earth informative data and excellent pictures.

PLANETARY PROBES

In 1989 NASA sent up the Galileo space probe. The purpose of this mission was to orbit and study Jupiter starting in 1995.

The mission of the Viking probes were to study Mars and search for signs of life. In 1976 probes entered the thin Martian atmosphere, soft landed and began to send back photographs and weather information for several years. The soil samples on Mars failed to indicate any signs of life.

The two Voyager space probes launched in 1977 were missioned to study distant planets. The results sent back included great photographs of planets and their moons. The planets visited were Jupiter in 1979, Saturn in 1981, Uranus in 1986, and Neptune in 1989. The Voyager spacecraft used the gravity of one planet which would fling the spacecraft in the fashion of a slingshot toward another planet.

Aboard the Voyagers were cameras, six computers, fuel tank to feed gas to small jets for stabilization, nuclear generator for the power supply, aerials to pick up natural radio waves from planets, boom carriers which are instruments to measure magnetic fields and large radio antennas to communicate with Earth.

TELESCOPE

An astronomer is a scientist that studies stellar bodies. Astronomers study the heavenly bodies with huge telescopes housed in domed observatories or on spaceships. At night the dome is opened and the telescope rotates at the same speed as the Earth to make it possible for objects to be photographed over a longer period of time. Most observatories are constructed on mountains where the air is clear.

The reflecting telescope and the refractor telescope are used to observe light rays from stars. The largest telescope in the world are the Keck Twin telescopes in Hawaii.

The Hubble Space Telescope, (HST) is an observatory placed in Earths orbit in 1 990. Churning and blurring in the atmosphere causes distortion in ground based observation. Distant objects appear fuzzy from Earth. The HST, outside the atmosphere sees the object much sharper. The HST can reach seven times farther into space than any ground observatory. It also provides ten times more detail. With the use of the HST, astronomers have made exciting new discoveries.

The infrared telescope is also used by astronomers to pick up infrared radiation given off by stars and planets. Several infrared telescope are perched high on a mountain in Hawaii, and on board satellites.

LIFE CYCLE OF STARS

The life cycle of a star begins as a spinning cloud of gas and dust called a nebula. Gravity then pulls billions of particles to gather into a huge ball. The inward pressure heats up these particles until the central region gets hot enough to start a nuclear reaction that transforms hydrogen into helium and a star is born.

The Harvard classification system divides stars into ten main types, O, B,A, F, G, K, M, R, N, and S. Each type is further divided into subdivisions. O, R, N, and S are considered comparatively rare. Most stars are included in the B to M sequence.

In 1908 E. J. Hertzsprung drew up a diagram where he plotted the luminosity of stars against their spectral types while simultaneously Russell in the United States was conducting similar research. The outcome is both men were credited and the research is known as the Hertzsprung-Russell Diagram or H-R diagrams. On this diagram most stars lie on the Main Sequence. At the left top the very luminous white stars are shown while to the bottom right the feeble red stars are shown.

In the universe the most abundant element is hydrogen, Normal stars contain primarily hydrogen. Inside a star is a tremendous amount of pressure with extremely high temperatures. The hydrogen nuclei combine to form nuclei of helium which yields energy. It is energy that keeps stars radiating.

Modern theory suggests that a star begins inside a nebula and contracts. The star will eventually join the main sequence at a point determined by its initial mass. If a star has a large mass, it joins the stars near the top left on the main sequence. Most of a stars brilliant career remains on the main sequence. When the hydrogen runs out, the core undergoes further contraction while the outside expands. This produces helium and the star becomes a giant. Eventually stars end up as white dwarfs, neutron stars or a black holes. Stars are said to be like people, they are born, they mature, they grow old, and they die.

One day our star will swell into a red giant, swallow up Mercury, and kill all life on Earth. The Sun will eventually shrink into a dim white dwarf about the size of Earth. It will cool down in time, and turn into a dense burned out amber.

CONCLUSION

Life in space is speculative. Although it is likely to exist there is no evidence to confirm this speculation.

While traveling through the Solar System, you will discover nine planets. Four small terrestrial rocky planets and four large gaseous jovian planets. The outer most planet is the smallest. Other bodies in the night sky are comets, asteroids, meteoroids and meteors, plus of course, stars and galaxies.

Without the aid of the telescope and probes astronomers would be at a loss as to the marvelous phenomena that takes place in our universe.

A star begins as a collapsing cloud of gas in interstellar space, nuclear fusion starts up in the interior which causes a fusion process transforming hydrogen into helium and a star is born..

Stars can be compared with humans in the sense that they are born, they mature, they grow old, and they die.

VOCABULARY

1. Nebulae
2. Supernova
3. Satellite
4. Probe
5. Milky Way
6. Solar system
7. Universe
8. Comet
9. HR Diagram
10. Meteor
11. Meteorite
12. Telescope
13. Astronomy
14. Luminosity
15. Neutron star
16. Density
17. Red dwarf
18. Helium
19 Cosmic year
20. Asteroid
21. Ecosphere
22. Metamorphism
23. Astronaut
24. Reflecting telescope
25. Refracting telescope

LESSON PLAN I

"Life in Space"

Objectives Upon completing this topic the students will be able to:

1. List all nine planets
2. Give two points of information about each planet
3. Identify the inner and outer planets
4. Discuss the other bodies in the solar system
   (comets, meteors, meteorites, asteroids, and satellites)

I. Terrestrial planets

II. Jovian planets

III. Stellar bodies

IV. Quiz
Home work: Make model of the Solar System

(use your creativity, due in two weeks)

Activity STAR DATE LOG . . . Amos (A-mouse) Takes A trip Rules

1. Amos must be launched in spaceship Viking, from Cape Canaveral, Florida
2. you must track his voyage in a log via Houston, Texas
3. tell all of her (his) encounters
   (use fantasy, comedy, be creative but stick close to the facts)
4. You must visit all the planets and tell what you find
5. Amos must survive the trip
6. The set down is to be in the California desert
7. Arrange an interview for Amos
8. An oral individual presentation must be given to the class

Quiz

1. List the four inner planets in the Solar System
2. List the four gas planets
3. Describe a comet
4. Which planet has a red spot? What causes it?

Field Trip Arrange a field trip to the planetarium at Southern Connecticut State University (the class is to write an essay on what they saw)

LESSON PLAN II

Life Cycle of Stars

OBJECTIVE After completing this topic the students will be able to explain the life cycle of a star

Vocabulary

1. Nebulae
2. Supernova
3. Density
4. Helium
5. Main sequence
6. Dwarf
7. Hydrogen
8. Neutron star
9. Luminosity
10. HR diagram

CLASS DISCUSSION

I. Birth of a star

II. Young star

III. Middle age star

IV. HR diagram

Pre test/ Post test
match column A with column B

A	B
——nebulae	a. young star, middle age star, old star
——luminosity	b. gas in a star
——phases in life of a star	c. a very compact star
——supernova	d. a vast cloud of gas and dust
——neutron star	e. a plot of temperature or luminosity of stars
——hydrogen	f. brightness of stars
——HR diagram	g. a giant exploding star

Homework Spelling test (vocabulary words)

Activity MEDIA CENTER:
The class must view the CD Rom, “Outer Space”, and write a critique.

Questions

1. How did you perceive space prior to watching the CD Rom?
2. How do feel about space now that you have seen the CD Rom?
3. What did you already know about space?
4. What did you learn from the CD Rom, be specific?
5. Do you feel that you may one day want to become an astronaut and travel in space? Elaborate.

LESSON PLAN III

Probes and Detectors

OBJECTIVE After completing this topic the students will be able to:

1. name the three types of telescopes used to study stars
2. explain the importance of each telescope
3. Explain the importance of the two types of probes

Vocabulary

1. Lunar
2. Probe
3. Planetary probe
4. Infrared probe
5. Reflecting telescope
6. Refracting telescope

I. Infrared telescope

II. Refracting telescope

III. Reflecting telescope

IV. Probes (lunar, planetary)

V. Define the vocabulary words in sentences

Homework Write a report on one of the three types of telescopes. Star gazing . . . .Use a sky map and find five constellations and draw them . . . .

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