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Dreams Toward the Stars: A View of the Solar System from Earth

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Introduction

Until I was in the 9 th grade I had spent most of my life on a farm 17 miles from the nearest town. Growing up in the country was at times uneventful, but never boring. My brothers, Don and Larry, older sister, Norma, and I were free to explore and discover the richness our farm and the surrounding area had to offer. We found arrowheads every time my step father would disc or plow a small hay field, we discovered a cool spring that ran the year around, located a wonderful sycamore tree just perfect for camping under and never had to leave farm. My brothers and I spent almost every day of the summer fishing and paddling a flat bottom boat up and down the Illinois River. We were allowed to explore, wander, and have fun if we obeyed mom's number one rule: we were to take care of each other and we were to be home before dark. Never once did we stay out after dark and Don made sure we took care of each other. Getting home before sunset was always a given.

Sunset was my favorite time of day. Even on the hottest days I knew as soon as the Sun began to set a cool breeze would come up from the river or down the holler from the hills in front of our house. The frogs would start calling to each other, Whippoorwills would repeat their melodic songs over and over again, and crickets would begin their nightly orchestrations. The songs of the frogs and Whippoorwills were beautiful, but the crickets were just annoying. Anticipation of the nightly show would grow as the sky got darker.

As soon as supper was finished and my chores completed I would be out the door, scanning the eastern sky, whispering "Star light, star bright, first star I see tonight. I wish I may, I wish I might, have the wish I wish tonight." Upon sighting the first star I would squeeze my eyes shut, repeat my wish inside my head and flop down on my back on the grass. The Sun warmed soil beneath the soft cool layers of clover and Bermuda grass were my nightly blanket. It seemed that time passed slowly as I scoured the sky, looking for more stars. First one, two, and then suddenly, in uncountable numbers, stars began appearing in the darkening sky. I would try to count the stars, but eventually gave up and just enjoyed the spectacular view. My brothers and younger sister, Carolyn, would eventually join me. We would section the sky off and Don and Larry would help me count. Fireflies emerged from the tall grass, mingling with the stars as though trying to signal long lost friends overhead. Their twinkling lights intermingled with the stars for our attention and usually got it. We would jump up and catch as many as we could, only to let them go after a few minutes. When mom would call us in for bed we would beg to sleep on the back porch. Grabbing a heavy quilt I would make my bed as close to the railing as possible, hoping to see a shooting star before I was lulled to sleep by the melodic music of the night creatures. Images of space ships and faraway planets, not unlike those I had seen in movies and read about in comics, would fill my dream world.

Today I am still in awe of the uncountable stars in the Universe, the vastness of space, and I still dream about the other worlds that might be hiding among the stars. As far as counting the stars, well I learned long ago that it is impossible. If each star in the Universe were a grain of sand it would take a large wheelbarrow just to carry the stars in the Milky Way and there isn't enough sand on all the beaches on Earth to represent the stars in the entire Universe. (Dickenson, 2001)

People living in Houston or other large metropolitan areas do not have the opportunity to see the stars the way I did when I was young. The first thing they notice is the glare of the lights from parking lots, street lights, security lights, and other sources of light pollution. The evening star is usually visible in the eastern sky but is very difficult to see all but the brightest stars. Most nights only the moon, the brightest stars, and a few planets are visible. If anyone wants to see the spectacular beauty of the stars they have to leave the city and go to an area that is basically free of external lights. With urban sprawl on the rise one has to go further and further out of Houston to do any stargazing. Once outside the ring of light pollution however, the vastness of space becomes apparent. Introducing my "city slicker" students to this never-ending view, the mesmerizing beauty overhead, is my goal.

School Demographics

I teach second grade on an elementary school campus on the north side of Houston. The majority of my students have never been able to go out of the city to see the stars. And I venture to say that most of my students have never given it a second thought either. Durkee Elementary is a Title I school with an enrollment of over one thousand students in grades Pre-K to fifth. We are in the process of being downsized and this coming year our enrollment should be between 650 and 750 students in K to 5th grade. Approximately 90% of the students receive free or reduced lunch. The majority of our students come from homes where Spanish is their home language and some are introduced to English for the first time when they enter school. They are escorted to and from school by a relative, usually their mother, and have been cared for only by a member of their immediate family. Very few get to experience the world outside their family unit except for the time they are at school. Vacations are spent at home with family or with family in Mexico. Some of my students seem to think that Mexico is a part of Texas, and vice versa. Although they know that the teachers at school speak English they are surprised when told that the majority of people in the United States speak English. When asked where they are born most of my students answer "Houston". I also get the answer "Houston" when I ask, "What is the name of our state?" and "What is the name of our country?" Our students come to school with very limited prior knowledge of our community, our state, our United States and almost non-existent knowledge of our Solar System.

The goals of this unit are to give students the understanding of the vastness of our Universe, the complexity of our Galaxy, and the wonderment of exploring our Solar System. It is my goal that they start asking themselves: Do you think I could travel into space? Do you think I could discover a new galaxy or planet? Do you think if I become an astronomer or an astronaut could I explore a new world in our Solar System? My goal is to instill the desire to want to learn more and perhaps one day they will be able to fulfill their dream to be an astronomer, astronaut, or an aeronautical engineer.

Lesson plans will revolve about the central theme, Our Universe. Lesson one covers the history of astronomy, important astronomers and their contributions. Lesson two draws on the prior knowledge of our Solar System and includes learning about the planets and their place in space. One activity for this lesson includes using astronomical unit equivalents to make a model of our Solar System along the perimeter of the school grounds by placing markers at specified increments along the fence to represent each planet. Lesson three includes an activity to track the movement of the Sun across our sky for one day and includes enrichment to extend the activity for the entire school year. Lesson four includes an activity to show why the planets take different lengths of time to orbit the Sun. Lesson five is an activity whereby students use the information they have learned about the planets to make their own game. Lesson six is a lesson on celestial navigation and how it was used by early explorers. Included in this lesson are directions for finding the Big Dipper, the Southern Cross, compass directions, and how they were used by participants of the Underground Railroad and the Lewis and Clark expedition. Lesson seven will be centered on information from NASA. My students will use facts pertaining to the economics of space travel, the importance of space travel, and jobs related to the space industry, such as astronomers, engineers, and astronauts. This lesson will also include writing a story about an imaginary trip to the planet of their choice.

Lessons will be taught cross-curriculum with specific emphasis on writing. To bring this unit close to home a field trip to NASA and/or the Houston Museum of Natural History's planetarium, as well as a visit from an astronomer, an astronaut, or an engineer from NASA, will be included. Parents will be encouraged to extend the enrichment by taking their family to the George Observatory, which is outside the city, to observe the night sky.

Background

The Universe

As an amateur astronomer, very amateur one at best, I have learned that astronomers estimate that the Universe is made up of hundreds of billions of galaxies, each with up to a few 100 billion stars. That is a total of well over 10,000 million million million stars. (Couper, 1992) This number, if written out would stretch almost across a page. It is very difficult to imagine a million stars and 100 billion times 100 billion is incomprehensible. Since we can't see the entire Universe some scientists estimate that there may be 20 trillion galaxies in the Universe. That would be 20 trillion galaxies with how many stars each? Now we are really getting to some serious numbers.

Galaxies, giant groups of millions or even trillions of stars, are not spread out randomly, but organized into clusters of galaxies with as many as tens of thousands of galaxies in each cluster. Now we are really getting into some numbers that are really incomprehensible. But there is more, they do not fill the entire Universe. There are vast amounts of space between them. Some of these huge voids are 150 to 200 million light-years across. Although there may be billions, perhaps even trillions, of galaxies, the void is greater than the space occupied by matter in the Universe. To put it bluntly, space is full of holes.

The Milky Way Galaxy

We will begin by studying a small part of the Universe. Within the Universe and in its vastness is the Milky Way Galaxy, our galaxy. Imagine living in a city with 200 billion inhabitants, so vast that it would take a jumbo jet 100 billion years to cross it. (Couper, 1992) We live within that "city" and we call it the Milky Way Galaxy. The Milky Way Galaxy, a huge spiral-shaped glowing collection of some 200 billion stars, is approximately 150,000 light-years across and one thousand light-years thick. At the sped of light it would take 28,000 years to get from the local neighborhood to the center of the galaxy. (Levy, 2002) The center bulges out and is about 20,000 light-years across and three thousand light-years thick. The center consists of very old stars, but little dust or gas. There may even be a huge black hole, filled with black matter, in the very middle of the Milky Way. The entire Galaxy whirls rapidly, spinning our Sun and all its other stars around at 100 million km/h (62 million miles per hour). (Farndon, 2001) Astronomers now know that there are in excess of 100s of billions stars in the Milky Way Galaxy alone (Freedman 2002) and our Sun, a local star, is just a minor member of this star city. On a dark night, if you are outside in an area that is very dark, you can trace the path of the Milky Way because the galaxy is flattened and the stars are concentrated into a hazy band. Just look up for an area that has so many stars that looks like the stars have gathered together and you will see what I mean about the hazy band. The stars appear to be so concentrated that the Milky Way is visible as one wide band across the sky. I have spent many nights looking up at the Milky Way trying to imagine what our universe looks like from other planets and wondering if there are some living beings looking up into their night sky wondering if there are other planets with someone looking back at them.

Our Galaxy is just one in a group of about 30 galaxies that cluster together around the Milky Way and Andromeda Galaxy. These galaxies range from 170,000 light-years to 4 million light-years from the Milky Way. The majority of these galaxies are relatively small, containing only a few million stars each. These small dwarf elliptical galaxies are thought to be them most common galaxies in the Universe. The Larger Magellanic Cloud Galaxy is 170,000 light-years away. Andromeda Galaxy is thought to contain about 400 billion stars and one of the biggest spirals known. It is the largest object visible without the aid of a telescope and although it is not exactly next door in the vastness of space it is not considered to be that far away either. Andromeda, the second closest galaxy, is only 2,200,000 light-years away. That makes it 21 quintillion km or 9 quintillion miles away. Written out it becomes 21,000,000,000,000,000,000, a number so large that it becomes meaningless. One light year is about 10 trillion km. Astronomers use Parsecs when discussing distance. One Parsec is equal to about 3.3 light years or 206,000 AU, as a unit of distance. No matter how you measure it, in light-years, Parsecs, kilometers, or miles, it is still too far for me to comprehend the distance.

The Solar System

As we explore the Universe and get closer to home we locate our Solar System. Located within the Milky Way Galaxy, it consists of one local star, our Sun, 9 known planets, about 70 moons, millions of comets, and countless asteroids. Scientists believe that the most distant edges of our Solar System may be 17.6 billion km (11 billion miles) from the Sun. (Hirschmann, 2002) If you could observe the solar system from a point several astronomical units (AU) above the Earth's North Pole, you would see that all the planets obit the Sun in the same counterclockwise direction. (Freedman 2002) Pluto is an exception. Its plane of orbit is tilted at about 17 degrees to the ecliptic. The four inner planets, Mercury, Venus, Earth, and Mars, are called *terrestrial planets* because resemble the Earth. Like Earth they all have hard, rocky surfaces with mountains, craters, valleys, and volcanoes. You could stand on the surface; but you would need to wear protective spacesuits if you were on Mercury, Venus or Mars. The outer planets are called *Jovian planets* because they resemble Jupiter. The composition of these planets is mostly gaseous or liquid and landing a spacecraft on the surface the Jovian planets would be futile. The visual surfaces are actually cloud formations in the planet's atmosphere. During our classroom exploration of our Solar System we will be examining each planet.

The Sun

Our Sun is located two-thirds of the way out in the galactic suburbs. It is not only the center of our Solar System, it also provides the light and heat energy for our Solar System. The enormous gravitational pull of the Sun keeps the planets in elliptical, or oval, orbits. It is 1.4 million km in diameter, one hundred times the diameter of the Earth, and has a mass 330,000 times heavier than the Earth. Just try to imagine the size of a dry green pea as compared to a dark green Black Diamond watermelon and you just might be able to understand the difference between the Sun and the Earth.

The Sun is located approximately 149.6 million km from Earth and 9.45 million million km from the nearest star. Every second, the Sun converts 4 million tons of itself into energy. One would think that the Sun has a limitless source of power in the nuclear fusion of Hydrogen that take place at the core. For us, it has a limitless source of power as it should last about another 5 billion years. At the time it begins to run out of fuel, it will have swollen until it is twice as bright and fifty percent larger than the current Sun. This stage will take about another five billion years. When it runs out of fuel its core will start to shrink. As the core shrinks, the rest of the Sun will swell up and our Sun will become a red giant star. At this point it will have engulfed Mercury, Venus, Earth, and Mars. It will eventually evolve into a white dwarf star about the size of Earth and with perhaps one/tenth of its luminosity. (Freedman, 2002) With the passage of eons our Sun will be just another dark cinder in the vast expanse of space. We don't have to panic, and we are not at the brink of extinction, this process will take billions of years. Who know where mankind will be capable of traveling by then.

Presently our Sun, like most stars, is an immense globe of glowing hydrogen gas. The hydrogen at the center or heart of the globe is so hot and compressed that hydrogen atoms fuse to make helium. (Couper, 1992) The core temperature is an estimated 15 million degrees Celsius (27 million degrees F.). As the nuclear reactions take place the energy floods outward by radiation up to about 70% of the solar radius. Once this energy reaches the outermost 30% of the radius (the so-called convection zone) it continues its upward motion and is carried by the Sun's gases, which rise and fall in huge bubbles. The energy emerges at the surface, the photosphere, as heat and light and is a mere 5,700 degrees Celsius (over 10,000 degrees F.). Even if it seems to be cooler it is hot enough to vaporize every substance known to man. Above the photosphere is the Sun's atmosphere which is divided into the chromosphere and the corona. The corona feeds fast-moving gas into the "solar winds" that rush away from the Sun at speeds of up to 3 million km/hr. These charged particles (mostly protons and electrons) generate magnetic fields and electric currents and all the planets orbit inside this magnetic environment, the heliosphere. The heliosphere acts as a protective bubble, cocooning the Sun's family of planets from the cosmic radiation that exists between the stars. (Couper, 1992) What makes our Sun so spectacular is that it has a luminosity of 390 billion billion megawatts. Each inch burns with the brightness of 650,000 candles.(Farndon, 2001) The Sun's influence extends to the very edge of the Solar System.

Space observatories like SOHO (Solar and Heliospheric Observatory) are enabling astronomers to learn a great deal about the Sun. The SOHO satellite circles the sun sending back information not available through the use of Earth bound telescopes. The scientific data being sent to NASA is priceless.

It is amazing that up until about 500 years ago people generally believed the Earth was the center of the Universe. Nicolaus Copernicus, a Polish astronomer, noticed that the planets did not always seem to travel in the same direction. He claimed that the Sun was at the center and all the planets traveled around it. It is called the heliocentric view. He described his ideas in a book called *De revolutionibus orbium coelestrium* ("On the revolutions of the heavenly spheres"). The Roman Catholic Church banned his book for almost 300 years, but it did not stop others from debating the authenticity of his ideas. In 1609, an Italian astronomer, Galileo

Galilei used a telescope to study the sky. Galileo discovered moons near Jupiter and saw that they were revolving around the huge planet. He had proof that Copernicus was correct but it took a couple more centuries before people generally agreed with Copernicus and Galileo. On the other hand, we now know that even the Sun is not at the center of the Universe, but it is, instead, one of hundreds of billion stars in one of hundreds of billion galaxies in the Universe. Makes one feel rather small and insignificant just thinking about the vastness of space and how little we actually know about it.

Mercury

After studying the Sun and its role in our Solar System we will then begin studying the planets as they line up from the Sun to the outer limits. Mercury, with an orbit between 45.9 and 69.7 million km (28.5 and 433 million mi), is the closest to the Sun. With daytime temperatures over 430 degrees C (806 degrees F), hot enough to melt lead, and night temperatures dropping to a -180 degrees C (-292 degrees F) I don't imagine anything being able to survive. Cap it off with a thin atmosphere of sodium vapor and the extreme temperatures are definite clues that life as we know it cannot exist on Mercury.

Venus

The second planet from the Sun is Venus. Its orbit around the Sun is from 107.4 million km (66 million mi) at its nearest and 109 million km (67.7 million mi) at it farthest. Venus is the hottest planet in our Solar System with temperatures reaching over 470 degrees C (878 degrees F). This is hot enough to melt lead. This extreme temperature was caused by the greenhouse effect. Venus began slightly hotter than Earth and the rocks on Venus could not absorb the carbon dioxide gas that was released into its atmosphere by its volcanoes. Today Venus is covered with thick clouds of carbon dioxide gas and sulfuric acid. It is remarkable that Earth, which is almost the same size as Venus, has a breathable atmosphere. Rocks on Earth absorbed the excess carbon dioxide gas. Had Earth been as hot in the beginning as Venus it is most likely that Earth and Venus would have the same type of atmosphere.

Not much is know of Venus' surface since it is covered with dense clouds. In the 1980's the Magellan orbiter sent back a photo, created on computer from radar data, of the Maat Mons volcano showing that is 6 km (3.7 mi) high. Without the use of the radar data the surface of Venus would be a total mystery.

Earth

The "third rock from the Sun" is the Earth. On January 3 rd we are 86 million mi from the Sun. This is called the perihelion. On July 4 th we are at its farthest position from the Sun, the aphelion. Earth is 146.8 million km, (91.2 million mi) away from the Sun during the aphelion. Earth, the fifth largest planet, is the only planet in our Solar System that has liquid water, which covers over 70 % of it's surface, and has an atmosphere that its over 700 km (435 mi) deep, mainly of harmless Nitrogen and life-giving Oxygen. The Earth is just the right distance from the Sun for the temperatures to stay an average 15 degrees C (59 degrees F). However, without the greenhouse effect caused by the Earths atmosphere, the temperature would be below the freezing point of water, and the Earth would be frozen over. We will be using the attributes of Earth to establish the possibility of "life as we know it" on other planets.

Earth is the only planet of the inner planets to have a moon. When I was about six my granddad told me our Moon was made of green cheese and that there was a man in the Moon. He loved to tease us. I didn't really believe him but after all he was my granddad and I couldn't say I didn't. Since then astronauts have landed on the Moon, walked on the Moon, and brought back samples of the lunar surface. I remember watching the first lunar landing, July 20,1969. I don't think I said a word the entire time. Watching Neil Armstrong climb out of Apollo 11 and stand on the Moon was the most exciting event I had ever seen. I was completely mesmerized by the accomplishments of our space program.

"Houston, the Eagle has landed." Those were the first words spoken from the surface of the Moon. When Neil Armstrong stepped on the Moon I was listening as he uttered his now famous words: "That's one small step for a man; one giant leap for mankind." I still get chills just thinking of that history making mission. Between 1969 and 1972 twelve men landed on the Moon. They brought back 380kg (838 lb) of Moon rock. There is one on display at Space Center Houston that everyone is allowed to touch. It is not the same as going there, but after all it is a Moon rock all the same. They left a mirror to reflect a laser beam which measured the Moon's distance from the Earth, a United States flag, the Lunar Rover, and their footprints.

Mars

There has been a lot of news about Mars lately with the Mars Rover sending back the pictures of the surface. Students may have the misconception that Mars would be a good place to establish a U.S. colony. The facts provided may help them decide if they would like to journey to Mars or not. One thing they will have to learn is if Mars has an atmosphere that can sustain "life as we know it". Mars, the fourth planet from the Sun, is called the red planet because of the rusty red color that comes from oxidized iron in its soil. It orbits at an average distance of 227.9 million km (141.6 million mi) from the Sun, and takes 687 days to complete its orbit. Mar's surface is cracked by a valley called the Vallis Marineris, so big that it makes the Grand Canyon look tiny. (Farndon, 2001) There is evidence of past volcanoes, a Polar ice cap, craters, but no liquid water. In fact, liquid water could not exist on Mars today, since for its present atmosphere, the boiling and melting point of water are equal to each other, so that upon melting, any water or ice would become vapor.

Mars has been the subject of numerous missions. In the 1970's the U.S. Vikings, 1 and 2 and the Soviet Mars 3 and 5 probes reached mars. Mars 3 send back data for 20 seconds and the fell silent. The aim of the Viking missions was to find signs of life, they found none. They send back plenty of information about the geology and the atmosphere. Then in 1997, on July 4 th , the U.S. Mars Pathfinder probe arrived on Mars. Live TV pictures were beamed back. Sojourner, a wheeled robot vehicle, sent back pictures of a rocky area. Together the Pathfinder and Sojourner took more than 16,000 pictures and operated for 83 days. This would be a great time to visit NASA's web site for all the statistics you will ever need on all its missions. Can Mars sustain "life as we know it"? This question is rhetorical and has been answered by NASA after every probe and mission.

Asteroid Belt

Once you venture past Mars you come to the Asteroid Belt. This area of space is littered by lumps of rock that orbit the Sun. They range in size from miniscule to over 100 km (60mi) across and it is estimated that there are more then a half a million in orbit between Mars and Jupiter. If you fit them altogether they would not make a world as large as our moon. (Simon, 1992) The first and largest asteroid, measuring 940km (540mi), was discovered in 1801 by Giuseppi Piazzi. He was actually looking for a missing planet when he found Ceres. Since then astronomers have been discovering more and more of these mini-planets. In 1991 and 1993 the Galileo space probe took close-up pictures of the asteroids Ida and Gaspra.

Jupiter

Jupiter, 778.3 million km from the Sun, is the largest planet in our Solar System. With an atmosphere of gaseous Hydrogen and Helium there is no surface for a spacecraft to land. It takes less than ten hours for the giant to spin around whereas it takes the Earth almost 24 hours. That means it is moving at nearly 50,000km/h (31,000mph) and that is really fast for such a large planet. One feature about Jupiter is that it has a Great Red Spot which is a huge swirl or red clouds measuring 40,000 km (25,000mi) across. This was first noticed by Robert Hooke in 1644. Galileo was the first to spot Jupiter's four moons, Io, Europa, Callisto, and Ganymede. Each of these four moons has distinct color and patterns. Ganymede is the largest and it looks like it would be very solid but under the outer shell of ice is 900 km of slushy, half melted ice and water. Callisto is scarred with craters. One of the craters, Valhalla, is so big that it looks like a giant eyeball. Io's surface is a mass of volcanoes, possibly the only moon with active hot volcanoes. Europa's surface is covered with ice and resembles a billiard ball with countless cracks. There are 24 smaller named moons and 12 more have discovered recently. They may have names now, we will just have to check with NASA to see.

Saturn

Saturn, the second largest planet, is my favorite planet. I think it is because of the rings and the mystery surrounding them. These rings consist of thousands of narrow, closely spaced ringlets. It had long been speculated by astronomers that they are made of ice and ice coated rock. The hunch was confirmed in the 1970's, when the American astronomers, Girard P. Kuiper and Carl Pilcher identified absorption features of frozen water in the rings' near-infrared spectrum. (Freedman, 2002) Voyager 1 and Voyager 2 flew past Saturn in 1980 and 1981. Using even more detailed infrared measurements they indicate that the temperature of the rings ranges from -180 degrees C in the sunshine to less than -200 degrees C in Saturn's shadow. Yes indeed, it is cold on those rings.

Saturn is made almost entirely of gas, mostly Hydrogen and Helium, but it has a very powerful magnetic field and sends out strong radio signals. It takes just 11.5 hours to rotate once, making it the second fastest, just behind Jupiter. It turns around at over 10,000km/h (6,125mph). It is also a very windy planet with winds ten times stronger than any hurricane on Earth, and the winds never let up. Remember I said the mystery of the rings made it my favorite, not that I would like to live on or even visit Saturn.

Since NASA has been sending probes more has been learned about those mysterious rings. One thing that is not a mystery is the fact that Saturn has at least 30 moons. One of NASA's missions sent back information about some of these moons. The largest is Titan at 5,140 km (3,190 mi) and it is the only known satellite in our Solar System with an appreciable atmosphere. The most current facts about our Solar System are being updated almost daily thanks to NASA and Earth bound astronomers alike.

Uranus

When I was growing up we were taught that only Saturn had rings. Thanks to the space program we now know that Uranus has a very faint set of rings that are made of the darkest material in the Solar System. (Farndon, 2001) Uranus, located 1.8 billion km (1.1 billion mi) from the Sun, tilts so far on its side that it seems to rotate in the opposite direction of all other planets. The angle of its tilt is 98 degrees which puts it equator running from top to bottom. This radical tilt means its north and south poles point toward and away from the Sun during its summer and winter. These seasons on Uranus are approximately 21 Earth years. Spring and fall, by contrast, are extremely short. Speculation has it that another planet or perhaps a meteor collided with Uranus, thus causing the excessive tilt. As a result of the angle of its tilt the Sun sets backward during Uranus spring.

Thanks to Voyager 2 and other NASA missions we have been able to learn more about our outer planets. Uranus has 21 confirmed satellites ranging in diameter from twenty-six km to 1520 km. One of these satellites, Miranda, has a landscape unlike that of any other world in our Solar System. Of course it is heavily cratered, as one would expect, but there are regions that look as those something has taken a rather large "bite". These areas have enormous cliffs that jut upward to an elevation of 20 km, twice as high as Mount Everest. (Freedman, 2002)

Uranus, with an icy atmosphere made of Hydrogen and Helium, is very, very cold mainly because of its distance from the Sun. It would not be a good place to live as the surface is an ice-cold ocean of liquid methane gas thousands of miles deep. A space ship could not land on Uranus. The liquid methane gives it a beautiful color but even a fraction of a second in that ocean and you would freeze so hard you would shatter like glass. Even with those beautiful rings I would never get to enjoy them in this atmosphere.

Neptune

If you keep going away from the Sun until you reach between 4.6-4.54 billion km (2.77-2.82 billion mi) you will reach Neptune. Neptune's surface is composed of icy cold liquid methane and it has an atmosphere of Hydrogen and Helium. Neptune has a thin layer of rings too. It has a Great Dark Spot on its beautiful blue surface. Like Jupiter's, it is where storms whip and swirl the clouds. There are eight moons, all named after characters from Ancient Greek myths, around Neptune. Triton, the largest, actually orbits Neptune oppositely to the direction in which the planet rotates. It looks like a green melon with pink icing at each pole. Triton's surface does not have large craters. This is an indicator that it either has a young surface, or ancient impacts have been erased by tectonic activity.

Voyager 2 observed plumes of dark material being ejected from the surface to a height of 8 km. These plumes are similar to geysers on the Earth. (Freedman, 2002) However, when they erupt they spew out fountains of ice. When you are that far from the Sun you shouldn't expect hot molten lava.

Pluto

Pluto was the last planet to be discovered. Perhaps that is because it is not only the farthest from the Sun it is also the smallest. Earth's diameter is five times bigger than the diameter of Pluto, and 500 times as heavy, like comparing the size of a basketball to a ping pong ball. Pluto is made from rock, but it is covered in water ice, and a thin layer of frozen methane. Only imaginary pictures of Pluto exist. Not even the Hubble space telescope could get an image to show any details. American astronomer James Christy was studying a photo of Pluto and noticed a bump. Now most of us would just think it was a flaw in the print, but it turned out to be a large moon, about half the size of Pluto. They orbit one another with the moon, Charon, always in the same place in Pluto's sky.

More to the Universe than Planets

There is more to the Universe than just planets and asteroids. There are so many stars that one cannot count them. One of my students could not think of a mathematical term for more than a trillion so he just said Kazillion. To him it simply meant a number too large to count, or write, or even comprehend. Of course he was talking about how old I was and at the time I believe he was kidding.

Long ago, before telescopes and before any known navigational tools, people navigated by using locations of stars and star patterns. They learned that certain stars were in a specific area of the sky at any given time during the year. In the northern hemisphere one star in the Big Dipper, Ursa Major, was used to locate north. Once north was located it was just a matter of deduction to locate south, east and west. People actually traveled long distances with the stars to lead the way. Early sailors relied totally on the Sun and stars for navigation. The Sun was used to navigate during the day. Today although most people don't think of using the Sun or stars as navigation tools the process is still the same. The Sun still rises in the east and sets in the west and the north star, second from the end of the handle of the Big Dipper, is still in the northern sky at night in the northern hemisphere.

A fellow teacher went to New Zealand to teach for a year and completely forgot that the stars they see are not the same ones we see here in the northern hemisphere. Their constant in the southern hemisphere is the Southern Cross, Crux. It is used to locate south and is used by the indigenous people of the southern hemisphere for navigation. Due to the curvature of the Earth there is a different set of stars for the northern and southern hemispheres. Only if you are on, or close to, the equator would you see the stars of both hemispheres. That would be a wonderful field trip for any age student, star gazing from the equator. Of course they would need a chaperone. And that is what I would call the perks of the trade.

We have two stories in our reading basal that tells about people that used the stars for navigation. *Harriet Tubman and the Underground Railroad* relates the story of how run- away slaves were taught to follow the North Star to freedom. They called the Big Dipper the Drinking Gourd. They slept hidden during the day and followed the North Star by night. Once the Big Dipper is located it is easy to find the North Star, just find the handle and Alcor and Mizar, the North Star is the second one from the end of the handle. The other story is about the Cliff Dwellers in Colorado. This story tells of how they traveled from pueblo to pueblo using the Sun and stars as navigation tools. At Chaco Canyon in New Mexico scientist have been studying how the Anasizi were able to place windows in their Kivas so that on the summer solstice the Suns rays would shine through that one window into the Kiva. This is the only day the Sun enters the building directly and it enters at precisely the center of the building. Another amazing fact in these cities is that all the major buildings had walls that faced true north, south, east, and west. Just as astonishing are the roads that lead from pueblo to pueblo. They did not meander, they headed directly from one to other. These ancient people had to have studied the stars and the Sun to be able to use them as navigational as well as building aids.

We also study about the Lewis and Clark expeditions. At the time they began their journey they had compasses to use. However, if necessary they could travel without a compass. People learn how to navigate by using the Sun and the stars. By day they could follow the Sun as it rose in the east and set in the west. By night they used the North Star in the Big Dipper. Although the angle of the Sun changed during the winter months the direction it rose and set did not. I don't remember them getting lost and if they did it was not due to not knowing the direction they were to go.

Explanations for the Seasons

Have you ever tried to explain why we have seasons? Try asking your students and see what they say before you go into the details. Of course we know it is because the northern hemisphere of the Earth tilts away from the Sun in the winter time and toward the Sun in the summer. As the Earth tilts away from the Sun the northern hemisphere gets less direct Sun rays. The northern hemisphere has fewer hours of light during a 24 hour time period and it gets colder, gradually of course, in the winter. It is just the opposite during the summer. The Sun skims the horizon most of the day; setting only momentarily during the middle of what is the night in the lower half of the northern hemisphere. In March and again in September the northern and southern hemispheres receive equal amounts of sunlight. As the northern hemisphere has summer the southern hemisphere has winter and vice versa. I can't imagine it being cold in July and August and my cousin in Melbourne can't imagine not having a possibility of snow during those months.

Extraterrestrials (ET)

Is there really life other than on Earth? Man has been trying to find the answer to that for generations. Some scientists say that ET life could develop elsewhere in the Universe. Other scientists believe that if there is ET life anywhere in the Universe it must be based on the chemistry of Carbon and that it would be as life on Earth. It is also believed if there is life on any other planet in our Solar System it would be very primitive. Is there life elsewhere in the Universe?, in another solar system?, that is another guess altogether. My students will use what they learn about our Solar System and their imaginations when writing their fictional story about space travel. Once they have all the facts I can give them they can use those facts to make their story as real as possible.

Is there really life on other planets? The problem is that the time it would take to travel to and from another solar system would require a much more technologically advanced society than we have. Is it possible to invent a method of transporting living beings across the Solar System and back? No one on Earth has been able to do it yet. We don't have the advanced technology at this time and so far there has been no real proof of any other world that has that capability either. We will just have to let our imagination do the dreaming for us.

Conclusion

Where do we go from here? Do we keep trying to explore the planets in our Solar System or do we start taking care of our Earth? I will let my students decide after we complete the unit. They will be looking for planets that can sustain "life as we know it" and they will use their research to make a logical decision. Most of us already know the answer but it will be enlightening to see what our students decide. Will they want to go to Mars or the moon? Will they think it is possible to find life on another planet? Or will they want to do their exploring here on Earth and become protectors of our glorious planet?

It is said that a little knowledge can be dangerous.

Knowing that you need to know more, and seeking that knowledge is empowering.

I want my students to be empowered.

"*... I have seen that in any great undertaking it is not enough*

for a man to depend simply upon himself."

Lone Man (Ina-la-wica) Teton Souix

Lesson Plans

Lesson 1: Important Astronomers: from the Ancient to the Modern

Objective

Students learn about astronomers, from the most ancient to present. They will learn what the astronomers discovered before and after the invention of the telescope and how the most recent adaptations are being used today.

Materials

Suggested list of names of astronomers, and those whose discoveries changed the face of our Solar System: Aristotle, Democritus, Erastothenes, Hipparchus, Abd Al-Rahman al Sufi, Tycho Brahe, Copernicus, Galileo Galilei, Johannes Kepler, Giovanni Cassini, Edmond Halley, Sir William Herschel, Christian Huygnes, Sir Issac Newton, Albert Einstein, Willamina Fleming, Edwin Powell Hubble, Stephen Hawking, and Clyde Tombaugh.

Vocabulary

Observations, nature, reasoning, models, telescope, planets, asteroids, stars, ancient, renaissance, age of enlightenment, modern. Add vocabulary as the students do their research and bring questions to the class.

Teacher Preparation

Gather resource material for students to research the lives of astronomers. Use internet and resources from the library.

Web sites :

- www.chldrensmuseum.org/cosmicquest/fieldguide/astronomers/html
- http://imagine.gsfc.nasa.gov/ask_an_astornomer.html
- (underscore after ask and an)
- www.csd.uch.gr/~vsiris/ancient_greeks.htm.
- http://es.rice.edu/ES/hunsoc/Galileo/People/tycho_brahe.html

Procedure

This lesson is designed for 2 or 3 days for research, three days for the writing, editing, and publishing, and one day for presentations.

Students will be divided into their study groups and given the list of ancient astronomers. Each group can have the same list but must report on a different astronomer or have each draw the name of astronomer out of a "hat". Distribute a list of expectations and discuss the information that needs to be included in the reports. The reports need to include pertinent discoveries for each, time they lived, where they were from, and how their discoveries revolutionized astronomy.

Each student will document the results of their group's results in their own personal science journal as soon as their group is ready for the group presentation.

The group will choose one person to present the report to the class. If charts, graphs, or pictures are used more than one person can implement the presentation.

Student Evaluation

Each student will take part in the writing of the presentation and the group will get a group grade. Each student will be given a grade for their science journal entry.

Enrichment

Independent research: Students can choose one invention that the ancient astronomers would find important to their research. Another topic that they can use is how modern travelers can use the findings of the ancient astronomers to find their way today without modern inventions. The student can choose to demonstrate how the invention was made, if possible, and how it is still being used. Enrichment can be an assignment that is completed during class after other work is completed or as a project completed at home.

Lesson 2: The Planets and Their Place in Space

Objective

The students will learn what planets are in our Solar System, their distance from the Sun, and how their diameter compares to the diameter of Earth.

Materials

Library books, map of the Solar System, NASA materials, measuring tape, meter stick, various art supplies: paper, markers, pie tins, baggie ties or strips of wire.

Vocabulary

Sun, Solar System, Universe, Milky Way Galaxy, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Moon, comets, asteroids, rotate, revolve, orbit, axis

Teacher Preparation

Arrange library books in display for students. Gather materials for lesson

Procedure

This lesson is designed for five to six days, including presentations.

During this lesson students will use an assortment of resources to construct maps, graphs, dioramas, mobiles of our Solar System. They may use any available materials from the art supplies or bring materials from home.

When they complete their individual project, the class will use the astronomical unit, which is the average distance from Earth to the Sun. (Freedman, 2002) as measurements for distance from the Sun to each planet. These measurements will be used to mark the placements of the planets along the school perimeter. Pie tins will be decorated and used to represent the planets and they will be fixed to the fence at the pre-measured points.

Student Evaluation

Students will display their completed projects in a prearranged area in the room and in the library. The class project will be available for any other class to use during their study of the Solar System.

Once their independent project and the class projects are completed the results of their research will be documented in their science journal.

Lesson 3: Follow the Sun

Objectives

Students will make a record of the Sun's motion during one day to show how the Sun moves across the sky.

Materials

White material, a piece of plastic from a shower curtain or laminated paper, approximately 36 inches long and 18 inches wide, permanent marker, perpendicular stick (a round dowel or a yardstick or scrap piece of 1x1) at least 3 feet long, black yarn, compass.

Vocabulary

Rotate, revolve, perpendicular, movement, axis, orbit, am, pm, noon, east, west, north, south, tilt, Sun dial

Teacher Preparation

This experiment has to take place on a sunny day. Before school, secure the water proof material onto an area that will remain in the sunlight all day. Align the paper to point east-west. This is where use of the compass comes in if you don't already know the directions and even if you do let the students check the directions. Tape the paper so it will not blow away. Place the stick perpendicular to the ground on the south edge, halfway across the paper. Mark the end of the shadow with the marker and date the mark.

Procedure

This lesson is designed for 3 days, one day to track the movement and two days for class discussion about seasonal changes and journal writing.

Explain that the activity will be hands-on and review the behavior that is expected.

Review the vocabulary and explain that they are going to track the movement of the Sun's motion, using a shadow of a stick as astronomers did thousands of years ago. As the activity begins, one student will mark the tip of the shadow and write the time next to the new dot. Another student will measure the distance from the first dot to the second dot and everyone will record this information in their journals.

Every hour two students will be chosen to mark the dot, write the time, and measure the distance from the dot from the previous hour. They will return to class and report the information to the class and it will be recorded in their journals. When the last mark has been recorded the students will go to their study groups and discuss the results. They will then come to a group conclusion as to what happened.

The class recorder will then gather all the group results and the class will then discuss the data and come to a class conclusion as to why the length of the shadow changed.

Wrap up

At this time introduce the term "Sun Dial" and explain how the movement of the Earth can be used to tell time. Explain that some people can tell time by the position of the Sun in the sky and do not have to depend on the clock or a watch.

The teacher needs to explain that it is impossible to feel the Earth move. We are actually rotating at about 1,000 miles per hour at the equator and slower as you move north or south from the equator. As the Earth spins from west to east it makes the sky appear to moving us east to west. Demonstrate this by having the students stand in one spot and pretend they are rotating slowly in a counterclockwise motion. Have the students watch one object to see what direction the object appears to be moving. During this demonstration they will see it move in the opposite direction. If needed use further demonstrations to show how later astronomers proved that the Sun was in the center of the Solar System.

Enrichment

Make a record of the Sun's motion on approximately the same date each month for the entire school year. Use a piece of 8 ½"x11" waterproof paper mounted on a cardboard. Place a T pin through one edge of the cardboard and tape it in a perpendicular position. Place the paper over the pin and tape it at the corners. Label the paper with the compass directions and the date. Again mark and record the shadow of the pin with a dot every hour. Make sure to put it in the same place each month. We have a table in our outdoor classroom that can be used for this project. Once the data has been collected, post the results in the classroom for the students to analyze. As they compare the pattern of shadows each month they can record their findings in their journals.

Lead a discussion near the end of the year to help the students understand why the shadows appear longer and shorter at different times of the year.

Students can use this to integrate seasonal changes, weather patterns, migration, seasonal planting and harvesting. For further enrichment bring in an Old Farmer's Almanac to use as reference.

Lesson 4: How Long is a Year?

Objective

Learn how the length of the orbit determines how long a year is on a planet.

Remind students this is not a race that they are determining who takes the most steps.

Once the procedure is over the questions will be asked: Why did it take more steps on each ring? How would that transfer to time to complete an orbit? The process of being able to translate the number of steps into the time it takes is then translated into why a year on Mercury is 88 days, Venus 225 days, Earth 365 days, Mars 687 days, and Jupiter twelve Earth years (12 X 365 +3 leap year days) will be more difficult for the younger students but can be explained in terms of how long it takes for them to travel from Houston to downtown compared to traveling to Austin as the same speed. Explain the difference in distances and they will understand the difference in travel time.

You will not have to bring in the speed of travel for the planets at this time, but do explain that the length of year varies for two reasons: 1. Orbit is larger as you go away from the Sun. 2. The velocity decreases as you go out from the Sun. There is a formula to find out how long a year is on each planet as well as charts that tell you the answer. For lower elementary the charts will be sufficient. Upper grades may want to teach the mathematical formulas and give the students a challenge as to how the answers are found for the charts.

Materials

Cone markers, pieces of paper and rocks, or wooden stakes to mark the orbital paths.

The paint stirring sticks at Home Depot (or similar paint store) would work very well if the ground is soft enough for students to push them into the ground, if not just lay them on the ground at designated points. Five of the markers need to be marked for beginning

points for the orbits. I would estimate that the first ring will need at 6 markers, the second 8, the third 12, the fourth 16, and the fifth 24 (total of 50). The marking of the rings will take a big part of the lesson time so if time is limited you may have to make the rings smaller or use fewer markers.

Vocabulary

Orbit, rotate, revolve

Teacher Preparation

The teacher and students can mark off the orbits the planets will take or the teacher can do it before class. Personally, I believe the students can help with the preparation.

Procedure

This lesson is designed for two to three days depending on the number of questions that students need answered and their understanding of the subject.

1. Divide the class into five groups. Each group chooses a name for their new planet and then chooses one from their group to act as the planet. One student will monitor each planet, and will be considered as a "moon" for that planet. They will help keep count of the number of steps the planet takes.
2. Begin with the first group and mark off an oval ring at least one meter from the center circle, which should be at least two meters in diameter. Using the material chosen to mark the rings, each group marks off their orbit in the same fashion, one meter from the outer ring, until five rings have been marked. We have a large area to use and should have plenty of room. I just have to make sure that we have plenty of markers.
3. The "planet" from each group goes to the start marker and their "moon" tags along to help the planet stay in their ring and to keep count of the steps.
4. All the rest of the class enters the center ring, facing out. They will be the Sun and will do the counting of steps.
5. As the Sun counts the planets step off their orbit. Remind students that this is not a race. Once the first planet reaches its start marker everyone stops to see how far they have traveled. Once a planet reaches its beginning marker another student from their group rotates with that student. Continue counting until the second, third, fourth, and finally the fifth planet have reached the starting marker. Each "moon" needs to keep track of how many times its planet has passed the beginning marker. Knowing how many different students have been planets on each ring will help keep track for the times the planets go around the Sun.
6. Once the demonstration is completed have the students answer these questions: Why did the planet in ring one go around more times? How did the distance planet 1 traveled compare to the distance planet 2 traveled? Why did planet 5 seem to be going the slowest? Why did planet 1 seem to be going the

fastest? Was any planet traveling any faster than the other ones? If you lived on planet 1 would you be older than those living on planet 5?

Lesson 5: Solar System, Solar System. What is in our Solar System?

Objective

Develop a game the students make themselves. Write complete sentence clues to identify different planets, stars, constellations, asteroids, moons or comets. Write answers on a separate sheet of paper.

Materials

5x8 cards or half sheets of writing paper, pencils, books or other source materials from previous lessons

Vocabulary

Use prior vocabulary that has been added to the science journal

Teacher preparation

Students will need 5x8 cards or half sheets of writing paper. Have enough so that every student can use as many as they want.

Procedure

Each student is to write one fact about any planet, or any thing in our Galaxy, on each 5x8 card or half sheet of paper. This fact is to be written as a statement followed by the question: Who am I? or What am I? Do not write the answer on the card of paper.

Examples:

- I have liquid water. Who am I? (Earth)
- I have the most moons. Who am I? (Jupiter)
- I have an icy tail. What am I? (a comet)
- I may have caused the dinosaurs to disappear. What am I? (a comet or meteor)

Students may use their science journal or other reference material they have available. This does not include using the computer at this point. Once the facts have been written and gathered, one student chooses one fact sheet and reads it to the class. The answers may be written or given orally by the other students or by the one reading the fact sheet.

Points can be given for each correct answer.

I plan on using this lesson as an enrichment activity. Students will have to retrieve the facts from materials already studied and from their science journal notes as they write their questions and answers. Once they complete the lesson their questions and answers can be printed on 5x8 index cards and used as study guides later in the semester. We can also use this game in a class discovery center.

Lesson 6: Twinkle, Twinkle, Every Star

Objectives

This is a three part lesson that goes along with stories in Reading and Social Studies

Identify specific constellations

Explain how specific stars and the Sun are used for navigation

Vocabulary

Constellation, Big Dipper, Underground Railroad, navigation, north, south, east, west, compass rose, sextant

Materials

Black paper, straight pins, chalk, Styrofoam blocks, shoe boxes with lids, toothpicks, chopsticks or wooden sticks, glue, stars of different colors and sizes, flashlights

Procedure

The first part of this lesson is to read the story about Harriet Tubman and discuss the story. Once the students understand that the people traveling North had to travel at night begin questioning why and how they knew which direction to go. Explain that the constellation is easy to see if you look toward the North once it gets dark.

The second story to read is the true story about Lewis and Clark. A story about Christopher Columbus and The Mayflower can be read at this time too. The discussions at this time will include navigation by using stars and the Sun.

Activity

Using black paper and a straight pin make tiny holes that match the shape of the Big Dipper. This can be drawn on the back side with white crayon or chalk. The placement of the stars can be marked with an X. Continue the lesson having each student make the constellation on black paper, pushing the pins through the paper to make the holes. Cut the end out of a shoe box. Glue the black paper with the holes to the open end. Cut a tiny hole in the other end of the box and look through this hole as someone shines a flashlight on the black paper (from the outside of the box). The constellation will appear on the black paper. If your students are adept enough to glue the black paper three inches from the end of the shoe box a hole can be cut in the bottom of the box. They can shine the flashlight up through the hole in the bottom and see the light through the holes they have punched in the black paper. They can get the same effect by attaching the black paper to the end of a paper tube and looking through the tube toward a light.

Lesson 7: NASA and The Space Industry

Objectives

Since we live just north of NASA I feel that it is very important that our students learn as much as possible about the space industry and specifically about NASA. Students will learn the history of NASA, deal with the economics of space travel, the importance of space flight, and jobs related to the space industry. During this lesson a trip to NASA as well as visits from an astronomer, engineer, or astronaut will be planned.

Materials

Classroom library, computers, writing paper, pencils, drawing materials for illustrations

Procedure

This lesson is designed to take four to five days for the research and another three days for the writing, editing and publishing of their story.

Using the computer and class library, students will begin their research on the space industry and the history of rockets and space flight. Each group will be given a specific area, person, or time frame to use during their research. Topics will include beginning rocketry, flight to the moon, Sputnik, astronauts, space food, space ships, and space suits.

After their research project has been completed they will then use the information gathered to write a fictional story about a trip to another planet. This writing will include why they are going, how long they must travel (in light years), what they have to take, and what they might see. Remember, it is fiction and I expect their imaginations to soar.

Annotated Bibliography

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Books, Buffalo, New York, 2001. Page 6.

A standard reference guide for stargazers throughout North America.

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Contains short, sharp facts that are compact and easy to use. A complete reference

resource for teachers and students alike. Students will be fascinated by all the "facts"

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Freedman, Roger and William J Kaufmann III. Universe. W.H. Freeman and Company, New York, 2002.

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Hirschmann, Kris. *The Magic School Bus Fact Finder Space and the Planets*. Scholastic,Inc., New York, 2002. Page 3.

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Levy, David H. *A Guide to Skywatching*. Fog City Press, San Francisco, 2002.

Designed to increase awareness and enjoyment of the sky above.

Simon, Seymour. *Our Solar System*. Scholastic, Inc., New York, 1992. Page 59.

A fascinating tour of the nine planets, dozens of moons, and thousands of asteroids, meteoroids, and comets that travel around our Sun. Full color photographs and easy-to-read text. This is a good book for the classroom library.

Teacher Resources

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Surveys space exploration, focusing on the flights of rockets, satellites, and probes, and the possibility of living in space cities.

Berger, Melvin and Gilda. *Can You Hear a Shout in Space? Questions and Answers* About Space Exploration. Scholastic, Inc., New York, 2000.

Provides answers to commonly asked questions about space exploration, including "Which was the first living being in space?" and "Do you grow taller or shorter in space?" Read straight through and become an expert.

Branley, Franklyn M. *The Planets in Our Solar System*. Harper Collins Publishers, New York, 1981.

Describes the nine planets and other bodies of the solar system; includes directions for making models showing the size of the planets and their distance from the Sun.

Ciupik, Larry. *The Universe*. Raintree Publishers, Austin, Texas, 1988.

Discusses the various planets, moons, constellations, solar systems, and galaxies

that makes up the universe and some of the instruments used to explore it.

Ferris, Timothy. *Life Beyond Earth*. Simon & Schuster, New York, 2000.

The search for life beyond Earth takes the human mind and spirit back down long

corridors of cosmic history, probing the ancient questions of who we are and where

we came from. This is the story of this exploration.

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Usborne Discovery Internet-Linked: book contains descriptions of websites

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Story of a young boy and his dad as they search for a place to count the stars in the

sky. Excellent for introducing astronomy.

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from space probes.

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Company, Racine, Wisconsin, 1992.

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a wealth of amazing facts.

Ronan, Colin A. and Storm Dunlop. The Skywatcher's Handbook. Crown Publishers,

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An illustrated reference book that provides information one needs to interpret the skies of the Northern Hemisphere by day and by night.

Scagell, Robin. C*hildren's Night Sky Atlas*. Dorling Kindersley Limited, London, 2004.

Spectacular space photography, see-through pages, and state-of-the-art maps and

charts combine to take you on an unforgettable tour of the night sky.

Train, Priscilla and Frederick Engle. *Looking At Earth*. Turner Publishing, Inc., Atlanta,

1993.

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guide to locating the stars, constellations, planets, and other features of the heavens.

Student Resources

Alston, Edith. *Let's Visit A Space Camp*. Troll Associates, U.S.A., 1990.

Tours the Space and Rocket Center in Huntsville, Alabama, describing exhibits,

spacecraft and activities at the space camp where children can experience what space

travel feels like and participates in a simulated space shuttle mission.

Becklake, Sue. *Traveling in Space.* Troll Associates, U.S.A., 1991.

Surveys space exploration, focusing on the flights of rockets, satellites, and probes,

and the possibility of living in space cities.

Berger, Melvin and Gilda. *Can You Hear a Shout in Space? Questions and Answers*

About Space Exploration. Scholastic, Inc., New York, 2000.

Provides answers to commonly asked questions about space exploration, including

"Which was the first living being in space?" and "Do you grow taller or shorter in

space?" Read straight through and become an expert.

Branley, Franklyn M. *The Planets in Our Solar System*. Harper Collins Publishers, New

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Describes the nine planets and other bodies of our Solar System; includes directions

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1997. Satellite images from outer space show an astronaut's view of the world below.

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Scholastic, Inc., New York, 2002.

The kids in Ms. Frizzle's class learned a lot during their unit on space and the planets.

Now they're going to share everything they know.

Hort, Lenny. *How Many Stars in the Sky?* Scholastic, Inc., New York, 1991.

A story of a young boy and his dad and their search for a place to count the stars in the

sky.

Malloy, Christine Corning. *The Solar System*. Chronicle Books, New York.

Pull-out book that showcases the celestial magnificence of the solar system.

When the panels "clack-clack-clack" into place it creates a frieze of the solar

system. The back of the panels have fascinating facts about the asteroids, comets, planets, the Sun and the Moon. Purchased at Houston Museum of Natural Science this is one of my student's favorite books.

Moche, Dinah. *If You Were An Astronaut*. Western Publishing Co., Inc., Racine, Wisconsin, 1985.

Photographs and artists conceptions provided by NASA and Rockwell International Space Operations give readers a look into how astronauts train, live and work in space.

Moore, Eve. *The Magic School Bus Chapter Book Space Explorers*. Scholastic, Inc., New York, 2000.

Ms. Frizzle's class goes on a far-out adventure ñ all the way to outer space.

Murray, Peter. *The Planets*. Encyclopedia Britannica Corp. Chicago, Ill., 1993.

Discuss the location, size, movement, and other aspects of the Solar System.

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Internet Sources

________ .NASA's Destination Tomorrow. National Aeronautical and Space Administration, Langley Research Center.

http://destination.larc.nasa.gov > .

This site has a series of 30-minute educational programs that focus on NASA researchpast, present, and future. It also contains satellite coordinates and more.

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_________. NASA's Education Program.

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There are links on this site to retrieve information on the planets, missions, news and events as well as science and technology. I found it very useful.

_________. Planetary Fact Sheet Summary. The-solar-system.net.2005. 27 June 2005.

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Complete fact sheet on the planets of our Solar System. It will be used to compare the aspects of the different planets.

Weitz, Catherine. *Explosive Volcanic Eruptions on the Moon*. NASA's Solar System Exploration: Science & Technology: Explosive Volcanic Eruptions. 27 June 2005.

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This site contains information the volcanic activities on the Moon and the craters they left as evidence of this volcanic activity.