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# Shoot for the Moon

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## Introduction

It is essential that students recognize, observe and understand that the world around them is one of constant motion and change. In accordance with the National Science Education Standards as well as those dictated by the state of Connecticut, students are expected to achieve scientific literacy through hypothesizing, collecting and evaluating data and applying this knowledge to alternate situations. Through this process they will also need to differentiate the factual from the mythical. In doing this students are inheriting strategies to make logical decisions based on factual information which is then applied throughout multiple curricular and "real world" experiences.

I teach second grade at Vincent E. Mauro Magnet school in New Haven, Connecticut. Vincent Mauro is an interdistrict elementary school with a Science, Mathematics and Technology focus. My second grade classroom is in an urban district and is composed of a diverse, multicultural community of learners that encompass a wide spectrum of achievements, interests, learning and social needs. Students come not only from New Haven but from surrounding suburban communities as well. Since this classroom is a part of a science, mathematics and technology magnet school the students are provided with the means to explore their multiple intelligences and interests and utilize different learning styles to strive to reach their goals. Students are given opportunities to choose how they respond and how they are assessed on various integrated curricular tasks throughout the year. Assessment is done via a project driven rubric and students are not limited as to how much they can achieve.

In this 6-week unit, students will study the structure and characteristics of our Earth and Moon and examine their connections. They will compare and contrast the mythological tales about what the Moon is like with the scientific data obtained by astronomers of yesterday and today. Through various activities and experiments students will explore our Moon, specifically what it is, how it was formed, and what it is made of. Students will also, learn about the Moon's connection with the Earth. This will be done in terms of what we can see from Earth as well as what was seen and explored historically by the Apollo missions. Through this study, students will then gain the perspective that the Moon is the only celestial body other than the Earth that man has set foot on and the requirements to achieve such an accomplishment. Students will learn what past astronomers and astronauts have contributed to space exploration and the effects these have had on our own lives. Once

this is achieved, students will delve into how an astronaut trains and investigate the possibility of another trip to the Moon or even Mars.

Prior to the start of this unit students will be required to begin to observe the Moon and its phases beginning with a full Moon so that students can visually comprehend its greatness. During this time, students will be required to complete a moon calendar documenting the changes of the Moon which will later be kept in their journal. This moon calendar will have pre drawn circles at each date. The student will observe the moon each night and shade in the circle to show what part of the Moon is lit. Below the circle on the moon calendar will be 4-5 lines where the students will be required to write their ideas about what they may notice about the Moon and what they think causes the changes. During this time, students will familiarize themselves with the appropriate names of each phase and the times at which the phases occur so that the students can later connect the times of Moon rise and Moonset with its phases and notice the correlating pattern.

## 6 Week Unit Overview

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Throughout history, many have noticed different shapes and even faces of people on the Moon's surface. The first week will introduce the students to various pieces of literature that depicts how the Moon came to be, as well as its phases. Students will write their own fables that describe the origins of the Moon. A brief scientific introduction to the Earth's Moon will then be given, such as the Moon is Earth's satellite and a satellite is an object that travels around a larger object because of gravity, in this case the object is the Earth. Brief facts in regards to the Moon's size (roughly one fourth the size of the Earth), and its inability to sustain life because of its lack of air and water will be discussed. Vocabulary that will be introduced and integrated throughout this unit include *atmosphere, axis, eclipse, gravitational pull, orbit, revolution, satellite and tide.*

The second week students will explore whether there is any scientific reasoning behind the mythological explanation. In order to develop a deep understanding of lunar material and geology, students will evaluate images and other information retrieved via astronauts' explorations. This will then be compared with what ancient people observed when they looked at the Moon. Students will also investigate the physical features of the Moon, specifically: hills, mountains, plains, craters and the "maria" that are seas of dust. The Moon has no weather since it does not have an atmosphere. Students will discuss the weak gravitational pull on the Moon and experiment with gravity in a dramatization with an orange, dime and a sheet of paper (see lesson plan for details).

By the third week, students are familiar with the names of the phases of the Moon and can differentiate between what the Moon looks like at various times during the month. Students will be asked to defend the explanation that the Moon does not change physically, but only that the amount of light that falls upon the Moon causes it to appear that way. Students will display their understanding through the creation of a 'paper plate Moon phase chart', 'flip book' or 'mobile'. Students will examine how the Moon always keeps the same side facing the Earth and recall that it takes about 27 days to revolve around the Earth.

After having investigated some ancient cultures and beliefs with regards to lunar eclipses, students will need to apply their prior knowledge about how the Moon's phases occur to demonstrate how and when a lunar eclipse can occur in week four. Students will differentiate between a lunar eclipse and a solar eclipse. Additionally, students will apply their prior knowledge of the Moon's gravitational pull and explain with

supportive detail how the Moon affects the tides on the Earth.

During week 5, students will explore NASA's first glimpses of the Moon and how the space race began. The objective will be to understand mankind's knowledge of the Moon dating from the early astronomers to the astronomers in the twenty -first century. Students will categorize and analyze the Apollo Missions by creating a time line of what discoveries were made and their effects on NASA today.

Although fascinating, children generally want to know, "what's next?" Based on their cumulative study, students can sketch and predict what will come next based on their application of prior knowledge from this unit. Students will question the possibility of another trip to the Moon and possibly to Mars. During the sixth week, students will review what is needed to become an astronomer today, evaluate the training needed and the tools that astronomers use.

## Background Knowledge

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Overview of the Solar System

The Solar System contains all that revolves around the Sun which lies at the center of the system. It consists of comets, meteors, asteroids and the eight known planets - Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, the dwarf planets Pluto, Ceres and Eris, the satellites of the planets and dust.

A planet is simply a body that revolves around a star, is roughly spherical and does not share its orbit with other objects. Planets themselves reflect the light of the star but do not generate light itself. The Sun's gravity keeps the planets in orbit. According to the International Astronomical Union (IAU), a "dwarf planet" is defined as a celestial body within the Solar System that is in orbit around the Sun, has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a near-spherical shape, has not cleared the neighborhood around its orbit and is not a satellite. [1]

A satellite is something that goes around an even larger something such as the Earth or another planet. Some satellites are natural, like the Moon, while other satellites are made by scientists and technologists to go around the Earth and complete tasks for example, taking accurate photographs of the Earth's surface and sending images to scientists to report any changes that occur around the world as well as about water, crops and various other resources. Such satellites are designed in such a way that they can send and receive television signals and send and receive telephone, fax, and computer communications. This helps to make communication by telephone, fax, internet, or computer with anyone in the world possible. There are still other satellites designed to observe the world's weather that sends signals through a computer to help scientists know what the weather will be. Furthermore, the weather forecaster will acquire its information about the weather from these scientists. [2]

A comet is made up of dust, gas and ice. They are said to have come from the outer area of the solar system and consist mostly of leftover matter from the formation of the solar system. Meteors can be found almost anywhere in the solar system and are various sizes of celestial debris. They are just bits of dust or rocks from space that get pulled into the Earth's gravitational pull when they come to close to it. When meteors burn up, we can sometimes see a brief flash of light which is what we call "shooting stars." Sometimes, a meteor is big

enough to weather its descent and land on Earth. It is then called a "meteorite." Asteroids are known as "minor planets" because they are made up of most of the same stuff as planets, but are much smaller. Although some asteroids can have sizes that compare to some Moons in our solar system, they are not Moons because they only orbit the Sun. Planetoids is another name for the largest asteroids. [3]

## Gravity

But what keeps these celestial bodies from falling from the sky? Well, gravity of course! Anything that has mass also has gravity. Because gravity is proportional to mass, if the mass were to increase, so would its gravity. For this reason the gravity that a person generates is much weaker than the gravity generated by a planet. Gravity is only felt if something is working against it from the outside. For example, when you stand on Earth, the Earth's gravity pulls you down. The ground however pushes you back up with a force that is equally strong. When you stand however you feel as though your head and body is pushed into your feet. This is your weight! Therefore your weight is actually how much force is exerted as the ground pushes you up. Your mass is what is contained in your entire body. This is why in space astronauts may be weightless, but he/ she will still have the same amount of mass.

People do not fall from the Earth because of the force of gravity between the people and the Earth. Anything that has a mass attracts each other with a force of gravity that increases as its mass increases and decreases when the centers of the masses are further away from each other. No matter where you stand on Earth, gravity always pulls you to the center. You may not feel it when you float in space even though the gravity from Earth still pulls at you because there is not anything such as the ground to work against gravity. For example, when you jump up you feel weightless for a moment because the reaction of the Earth is not pushing you back up. [4]

## The Earth, Our Home

The Earth is the third planet from the Sun and is the only planet in the solar system that we know of that sustains life. Our planet Earth is located about 93 million miles from the Sun and receives enough sunshine to support life. The Earth spins like a top as it orbits the Sun. One complete spin on its axis takes one day or about 24 hours while one complete orbit around the Sun takes about one year or 365 days. Since the Earth is tilted to one side as it travels around the Sun, for part of the year the northern half has summer and gets more direct rays of Sunlight while the southern half has winter. The southern half is then tilted toward the Sun as Earth continues its orbit which allows the southern half to have summer and the northern half to have winter. More than 70 percent of the surface area of the Earth is covered by water. It weighs about 6,600 million trillion tons. Its mass is what creates a force of gravity which pulls everything to the planet's center. The Earth was formed about 4.5 billion years ago and over those years it has changed. At first its air was poisonous and there was no life. It is thought that from a gas mixture of methane, ammonia and carbon dioxide and water vapor in the atmosphere the first organic molecules began the first building blocks of life on

Earth when sparked by lightening and the radiation from the Sun. The first one-celled plants and animals were said to have formed about three billion years ago. [5]

Just as then, the Earth continues to change. The Earth's surface is constantly affected by water and wind, while its interior is altered below the surface from volcanoes and earthquakes. The Earth is covered by a solid 22 mile layer of rock known as the crust. It is made up of granite and basalt. This is where the continents and oceans lie. This crust is cracked into huge pieces we call plates that meet, among other places, along the rim of the Pacific Ocean. Where the plates meet is where volcanoes and earthquakes are prominent. The crust is in constant change by pressures from within the Earth. The mantle lies beneath the crust and is a 1,800 mile thick layer of thick, hot, dense rock. It will bend under steady force but can also break if hit hard. The core is about 2,170 miles in radius and is made up of iron and nickel. The Earth's protective blanket of air is called the atmosphere which consists of many layers. Although you can not feel it, the Earth's atmosphere is very heavy. It weighs about 5,000 trillion tons. The atmosphere extends upward for several hundred miles and as you go higher the air becomes less dense. When you fly in an airplane or even in a space craft you must bring the air you need to breathe. The atmosphere surrounds the entire planet and is made up of mostly nitrogen and oxygen along with a small amount of carbon dioxide, dust particles and water. The atmosphere is what protects us from getting to much Sun during the day yet keeps in enough heat during the night so we do not freeze. We live in the layer of air known as the troposphere which is the lowest layer of the atmosphere where we have oxygen and most weather phenomena take place. [6]

## The Earth's Moon

Outside of our planet Earth, the Moon is the only other world in space that humans have set foot upon. The Moon is the Earth's closest neighbor, measuring about one quarter of a million miles away. Although close in space, the Earth and Moon are very different. The Moon is a barren place with no water, no air, no clouds and no living things. The Moon has no atmosphere. The Moon is about one fourth the size of the Earth itself, measuring at 2170 miles in diameter. Since the size of the Moon is much smaller than the Earth, its gravity is only about one sixth of the Earth's gravity. If you have ever looked at the Moon through a telescope you would notice that the surface of the Moon is uneven and rough. It is made up of hills, mountains, plains and craters. Prominently, what you see are the craters which formed more than 3 billion years ago when asteroids and meteoroids collided with the Moons surface. In looking at the Moon, you can see that there are light regions and dark regions. The darker regions on the Moon are known as the *maria* which means 'seas' in Latin. This region is smooth with few craters and low-lying plains. The maria consists mainly of basalt rock. The dark regions are what form the features of "The Man in the Moon." The lighter regions are heavily cratered highlands and composed mostly of a light colored rock known as anorthosite. [7]

The Moon is Earth's only natural satellite. A satellite is an object that orbits another 'parent' object. It takes the Moon about 27 days at 2,300 mph to orbit the Earth. There are many theories that tell how Earth got its satellite. Most scientists believe that that an asteroid or an object about the size of Mars, collided into Earth which then ejected massive amounts of debris from it. This is known to scientists as the 'collision ejection theory.' Simulations of this theory shows that energy as produced from such a collision can produce vaporized rock from the impact. The Moon then formed from the cooled material. Much is explained from this theory about the known properties of the Moon, its orbit and its composition. This collision would have caused ejected

material to coalesce in an ecliptic plane which then caused the Moon to be put in an orbit much like its own. Another theory about how the Moon was formed states that the Moon came out of the Earth's crust. This can give evidence to its location but does not support the evidence that the Moon is made of different material including volatile gases. Still another theory explains, that the Moon may have also been 'captured' by the Earth. This theory may prove true for other planets' Moons but not for the Earth's Moon due to its shape and orbital direction. [7]

**Phases**

Just as the Earth, the Moon acquires all of its light from the Sun. Even though we can see the Moon easily at night, it does not produce any light of its own. In actuality moonlight is simply reflected sunlight. The direction of the sunlight that falls on the Moon changes which then creates images on the sunlit parts over the course of a month which is referred to as the phases of the Moon. The Moon's position in the sky changes as the Moon orbits the Earth and because of this we do not always see the whole side that is lit. When we do see an entire lit side of the Moon it is called a full Moon. When we see half of the lit side of the Moon it is called quarter Moon, while we call a silver of a lit side a crescent Moon. Each cycle of phases begins with the new Moon which is when no Moon is visible at all. We do not see a Moon at this time because the lit side of the Moon is facing entirely away from the Earth. As the Moon continues to move around the Earth in orbit, more of the lit side becomes visible to us. As viewed from Earth the waxing crescent (sliver of light) follows the new Moon and moves into first quarter (half Moon), waxing gibbous (three quarter Moon) and finally into a full Moon. Following a full Moon we see the waning gibbous (three quarter Moon), last quarter (half Moon) and the waning crescent (sliver of light) to complete the cycle. [8]

Waxing Crescent

(image available in print form)

The visible Moon is partly but less than one-half illuminated by direct Sunlight while the illuminated part is increasing

First Quarter

(image available in print form)

One-half of the Moon appears illuminated by direct Sunlight while the illuminated part is increasing

**Waxing Gibbous**

(image available in print form)

The Moon is less than fully illuminated but greater than half illuminatedby direct Sunlight while the illuminated part is increasing

**Waning Gibbous**

(image available in print form)

The Moon is less than fully illuminated but greater than half illuminated by direct Sunlight while the illuminated part is decreasing

**Last Quarter**

(image available in print form)

One-half of the Moon appears illuminated by direct Sunlight while the illuminated part is decreasing

**Waning Crescent**

(image available in print form)

The visible Moon is partly but less than one-half illuminated by direct Sunlight while the illuminated part is decreasing.

**New Moon**

(image available in print form)

The visible Moon is not fully illuminated by direct Sunlight.

Figure 1: Courtesy NASA [9]

**Eclipses**

Eclipses occur when the shadow of one celestial body falls on another celestial body. The Moon travels directly between the Earth and the Sun during a solar eclipse. During this time we see the Sun disappear and a shadow is cast from the Moon which then passes over the Earth. A lunar eclipse however, occurs when the Earth is between the Moon and the Sun. At this time, when the full Moon enters into the Earth's shadow the Moon will turn a deep red color. A lunar eclipse occurs only during a full Moon while the solar eclipse occurs only during a new Moon. Both solar and lunar eclipses follow a predictable cycle and occur approximately no more than once each year when the two paths that the Moon and Sun follow cross exactly during a new or full Moon. The eclipses of the Sun and Moon are directly tied to the lunar phase cycle. [8]

(image available in print form) Figure 2: Courtesy NASA [10]

**Tides**

The daily ocean tides on Earth are caused by the pull of the Moon's gravity. As the Earth rotates on its axis different parts of the world face the Moon. When the Moon passes overhead, the waters in that area are attracted to the Moon because of its gravitational pull. The Moon's gravity pulls up the water below it which causes a high tide (higher water level). At the same time, the oceans on the opposite side of the Earth also experience a high tide. Low tides occur (lower water level) on the other two sides of the Earth where water is said to be chasing after the Moon. Additionally, the Moon's gravity causes land tides. The surface of the Earth actually rises and falls as much as one to two inches when the Moon is overhead. Although the Moon's gravity can create tides by itself, it does not. The Sun also exerts tidal forces on the Earth, but these are only about half as great as the Moon's force. When the Sun, Moon and Earth become aligned at a new Moon or full Moon, the tidal effects will reinforce each other and create a large shift in the water level known as spring tides. Neap tides, on the other hand, occur during a first quarter and last quarter Moon when the Sun and Moon form a right angle with the Earth. This causes the tidal effects of the Sun and Moon to cancel each other out, creating a much smaller shift in the tides. [11] An animation that shows the tidal effects of the Moon can be

found at (http://science.nasa.gov/headlines/images/missingtides/dissipation.gif)

**Mythology about the Moon**

In myths around the world, the Moon often represents immortality or change. The Moon's ability to change forms was thought to be remarkable, and because of it many people used the Moon as guidance to know when to plant and when to reap. There are many lunar myths used to explain why the Moon waxed and waned and even why it appeared to die and resurrect. In some parts of the world, the Moon was male, such as in Australia and Mexico. Other parts of the world depicted a sibling relationship such as in Scandinavia or India. Other myths, however, made the Moon a beautiful goddess. Some placed the Moon on a chariot and married her to the Sun. All over the world, people would gaze at the Moon to see the beautiful goddess that lived there. Some even recognized her face in patterns on the surface of the Moon while still others saw images of animals. To some, spots on the Moon looked like toads, while to others they looked like rabbits. Some people thought that the patterns looked like fields of trees or even imagined that a boy, girl or the man in the Moon lived there. The various myths associated with the Moon were written by many different cultures, but all were an attempt to explain the pictures seen upon the Moon's surface. Heng O and Her Palace on the Moon is a myth from China. Heng O is the illustrious Moon goddess who brings light, life and harvest. One autumn night, Heng O swallowed a magic pill that made her immortal and float up to the Moon. Her husband, Shen I, built her a lovely palace where she lived with her rabbit. Once a month Shen I would leave Heng O and visit the palace of the Sun. It was at this time that day by day Heng O would grow sadder and sadder causing her light to grow dimmer and dimmer and by the time Shen I reached the solar palace Heng O disappeared in the darkness. This made Shen I very upset to see his wife so sad but when it was time to leave the Sun and return to Heng O, the closer he came to her, the brighter Heng O would become. When Shen I and Heng O would reunite she would dance and shine in love and happiness for all to see. [12]

This marriage of the Moon goddess to the Sun god appeared in other cultural myths around the world too, such as in Egypt or Greece. The marriage was a reflection of the Moon's relationship to the Sun and also explains their interdependence. The concept of yin and yang, the idea that everything in the universe has an opposite power that keeps them balanced and moving in recurrent cycles is also based on this. This myth is both representative of the yin and yang and the Moons phases as shown when Heng O becomes illuminated as her husband comes to see her each month. Because the Moon is also thought to bring good luck and happiness due to its connection to the seasons and harvest, people in China still celebrate the harvest Moon. Other cultures traditionally have a Moon goddess as well who is believed to control the cycles of the seasons and the Earth's fertility. [13]

The people of India pay close attention to the Moon because it is the Lunar calendar that determines the dates for their festivals. Most of them celebrate religious occasions; however they also include street parades and family events like weddings or funerals.

If you were to ask the people of India what they see in their Moon they would say a mother, Astangi Mata's handprints. Astangi Mata was known as the mother of all living things on Earth, but the sky was empty. Because she loved her twin daughters so much, she decided she would grant them everlasting life as rulers of the heavens. Suraj, was coined Raja, (i.e. the king) of the Sky. He was ever hot and the nurturer of all growing things (Sun) while Chanda was cool and ever changing, new and beautiful (Moon). As the Chanda started her journey to the sky, she missed her mother's last embrace and Astangi's hand barely brushed Chanda's cheek. To this day, that is why the Moon bears a handprint. [14]

The people of Scandinavia however know a different story. When they look to the sky they see a boy and a girl with a pail. Hjuki and his sister Bil worked every day and night gathering water in a pail from a magic well. One night the Moon, on seeing the children had pity on them and decided to let them come live in his house. The children were happy living there because they only had to gather water once a month. When there is a full Moon you can see the children with the pail, but over the course of a few nights, Hjuki falls out of sight. Bil later disappears, leaving the Moon dark and empty. After a few days the Moon begins to fill again and the children can be seen, first Hjuki and then Bil. This tale is one version of a familiar tale "Jack and Jill went up a hill to fetch a pail of water." [13]

In The Truth About The Moon, a young African boy, Sumu, is curious about the changing Moon and so his father tells him the tale that the Sun and the Moon were happily married and would shine all day together. At night however blackness would take over and no one could leave their house for fear of getting lost. So Man asked the Sun and Moon to give some light by night so that Man would not be afraid to leave their house. So the Sun and Moon decided to split up the day and night. The Sun shone all day and the Moon shone all night. Because the Sun and Moon were equally bright and equally hot however, no one could tell were the day ended and night began. Man was not happy because it was always hot and the crops were drying up. The Sun and the Moon then got in an argument because the Sun wanted to go back to the old ways were they would shine together but the Moon liked her independence and wanted to shine alone. In order to let Man sleep the Sun or the Moon had to dim his/her light. Since neither wanted to, the sly Sun ordered a swimming race across the river and the winner would get to shine in the day. As Mrs. Moon jumped in the water, Mr. Sun stopped. Mrs. Moon was made of fire and since fire and water do not mix, she lost her heat and was unable to shine as brightly. After Moon got out of the water she picked up a stick and started chasing him across the sky and to this day the Sun and Moon can not be together. They simply chase after each other night after day after night. [15]

Moon worship, myths and legends are an important piece of history in many cultures. There are countless tales that have been written as well as have been passed down from generations via oral tradition. Many astronomers today have lost the magic in their scientific explanations of the images seen on the surface of the Moon as well as the mystery of its waxing and waning. Although early man could not have known its scientific explanation, the Moon still symbolizes change and transformation while the Sun stands for all things permanent. [13]

## The Study of the Moon from the Early Astronomers to Now.

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**Early Astronomers: their lives and discoveries.**

For centuries many have marveled at the greatness of the Moon and even based traditions around it. Although one may think the Moon is so close and big enough to touch, only twelve people have actually touched the Moon and walked on its surface. In ancient times, Chinese, Babylonians, Greeks and Egyptians recorded their observations of the night sky. In the late 1500's - early 1600's however, came much change. Nicolaus Copernicus was the one who put the Sun in its proper place, the center of the Solar System despite Ptolemy's idea that the Earth was the center and the Sun and Moon went around it. Johannes Kepler wrote the laws of planetary motion: All planets follow an elliptical orbit around the Sun. The planets move faster when they are

passing closer to the Sun. Each planet's orbit time is related mathematically to its distance from the Sun. Galileo Galilei however proved that Copernicus and Kepler were right. Through experiments and observations he was also able to disprove much of medieval science. Galileo is responsible for having built the first telescope. A device that was able to magnify objects to twenty times their size. Galileo discovered that the Moon wasn't smooth, because he was able to see the craters and mountains on the Moon's surface through his telescope. These discoveries proved that the planets and their Moons were actual worlds rather than the god like figures of light that many cultures dreamed them to be. Sir Isaac Newton is then credited for having discovered that gravity is simply the force of attraction among all matter. He noted that objects that are far apart have less gravitational attraction than objects that are close and that the more mass an object has, the greater its gravitational force. Additionally, Newton created a revolutionary reflecting telescope. From here, astronomers were able to use telescopes to get a closer look at what was out there, and used their observations to calculate the sizes of the planets, its' distance from the Sun, and rotation periods. Later new tools were introduced such as cameras to photograph telescopic viewing and the spectroscope that was used to magnify and split visible light into bands of color. It was not until 1956 however that the first liquid fueled rocket was launched which was followed closely by the first satellite, Sputnik 1 to orbit the Earth in 1957. One year later, in 1958, the National Aeronautics and Space Administration (NASA) was formed and the race for space began. [16]

*Reaching the Moon*

The United States was the first to take a shot at reaching the Moon. Pioneer 0 a space probe (a robotic space explorer) packed with a camera launched in August of 1958 but exploded about a minute after lift off. Pioneer 1, NASA's first spacecraft was the launched toward the Moon with Pioneer 2 and Pioneer 3 closely following without success. Meanwhile the Soviet Union tried and failed at their first three attempts to reach the Moon via a lunar probe. The Soviet Union's Luna 1 became the first lunar flyby probe coming within four thousand miles of the Moon and artificial object to orbit the Sun where it remains today. Meanwhile, the United States Pioneer 4 became America's first flyby probe to the Moon but was unable to get close enough for pictures. The USSR's Luna 2 became the first spacecraft to touch the Moon, closely followed by Luna 3 which snapped pictures of the Moon. The 1960's brought in with it a new era of exploring the Moon. This time, scientists explored the idea of having humans become space travelers. The USSR and the United States did not begin with humans. NASA started with monkeys and chimpanzees while the USSR drafted canines. After successfully putting these spacecrafts in orbital flight around the Earth, the United States chose the 'Mercury Seven'. The Mercury Seven were the first seven astronauts "sailors of the stars" to be chosen by NASA to be sent into space. The actual first human in space however was a USSR cosmonaut, i.e. "sailor of the universe" by the name of Yuri Gagarin in 1961. Approximately 23 days later, Alan B. Shepard became the first American in space. With this, NASA developed the Apollo program which was created to send a man to the Moon. NASA then sent seven Surveyors to the Moon between 1966 and 1968 to map the Moons surface as earlier seen through lunar pictures sent by Ranger 7. Finally NASA sent five lunar orbiters to the Moon to scout a landing site. By the time the Ranger, surveyor and Lunar Orbiter missions were complete, Apollo astronauts were not left with any guesswork about what they would find on the Moon and where they would land. The orbiters also checked the radiation levels and looked for meteoroids in order to design spacesuits to protect the astronauts. Despite all of this work, the first Apollo mission unfortunately ended before it left Earth when the capsule caught fire in 1967. After having been put on hold for some time, Apollo 4, Apollo 5, Apollo 6 were launched without a crew as test runs. Apollo 7 and Apollo 8 carried astronauts into space to orbit the Earth, demonstrate the command and service module and test communication systems. Apollo 9 and Apollo 10 followed carrying with it a crew to test the performance of the landing sites by passing over them, evaluate the performance in lunar orbit and the lunar environment. These rehearsals made way for Apollo 11 which

launched on July 16, 1969 from Kennedy Space Center in Florida to bring astronauts Neil Armstrong, Mike Collins and Buzz Aldrin to the Moon. Neil Armstrong and Buzz Aldrin walked the surface of the Moon with Armstrong creating the first footprints on the Moon. Mike Collins' job was to keep Command Service Module Columbia in orbit around the Moon while the landing module Eagle would land. [16]

A total of 12 humans were landed on the Moon because of the Apollo program. The technology, instruments and methods used during the missions were later used in robotic space probes. Thanks to Apollo, much of what we know about the Moon's geology is due to more than 841 pounds of lunar samples that were brought back, including Moon rocks, bags of dust and core samples. We learned that the Moon as its own history of volcanic activity, Moonquakes and meteorite impact. We have even been able to compare the ages of the Moon's youngest rocks with that of the Earth's oldest rocks. While the Moon does not have what is needed for an atmosphere or surface water to sustain life at least life can visit there! Following Apollo NASA wanted spacecrafts to go beyond the Moon in exploration of the planets, but because of the expense, the visits were canceled. The expense was not the only challenge presented. We have yet to know how to successfully shield astronauts from radiation during the missions. Additionally, the distance of the planets from Earth added its own obstacles. [16]

*From the Moon to Mars*

In an attempt to continually comprehend the awesomeness of the universe, the space race needed to go on, so space probes that were also an orbiter were designed to withstand the obstacles. NASA's space probe, Mariner 9 however became the first spacecraft to orbit another planet, Mars. Because Mariner 9 was an orbiter it was able to wait out the wind and dust storms often produced there. Mariner 9's success taught us that there are volcanoes and canyons on Mars. Its remains of dry river channels and landslides also gave us the idea that there may have been water that flowed there. This sparked NASA to send missions to explore the possibility of life there. The Viking Project was designed for this exploration. It was created to map the surface of Mars from space, while landers could look for life on the ground. Scientific instruments and experiments measured the weather and temperature. Evidence of lakes and rivers that had gone dry were noted. The polar ice cap on Mars was confirmed to have been made from water rather than carbon dioxide and the element nitrogen was found in Mars' atmosphere. [16]

The region visited by the Viking spacecraft proved Mars to be lifeless, but also gave birth to new questions for scientists. Our Earth and Mars seemed to have started from the same material, but overtime evolved into two very different worlds and scientists were left with questions as to why. Mars was seen as a cold desert with below freezing temperatures. Its atmosphere consists of mostly carbon dioxide. Because Mars is tilted it has seasons. It is a rocky planet with canyons, and plains and the soil on Mars is colored red from iron oxide. This red dust in the air makes the planet appear pink or reddish in the sky giving Mars, the nickname The Red Planet. It has two Moons. Since the Viking Project NASA has received images and data from Mars via the Mars Global Surveyor, Mars Pathfinder and Sojourner the Mars rover. The Mars Odyssey began to map the surface of Mars in 2001, while NASA's Mars Exploration Rovers, Spirit and Opportunity study the planets geology, giving evidence to ancient surface water. In 2006 Mars Reconnaissance Orbiter began scanning for water on Mars. [16]

From Galileo's telescopes to human spaceflight, space probes, rovers and orbiters we have learned allot about our solar system. More than 50 missions have visited and studied the planets. So what is next for NASA? Another trip to the Moon? Human spaceflight to Mars? In 2004, United States president, George W. Bush suggested in a State of the Union address, that NASA plan another trip to the Moon in order to pave the way to

a manned mission to Mars by 2030. A trip to Mars is a fifty million mile long journey which would take today's space craft up to nine months to even reach The Red Planet. This would be a very long journey for astronauts to sustain. Although floating in space appears to be fun, it is often hard on the human body. Astronauts suffer from backaches and stomachaches from their bones and organs moving within them. Living and working in a small cramped space for an approximately 2 year round trip mission would carry the weight of many physical and mental problems. In an attempt to make a trip to Mars a reality, exercise, medications and certain nutrients that astronauts would be given are being examined. Currently, the Mars Science Laboratory, a rover, is scheduled to land on Mars in 2010 and stay for at least one Martian year (687 Earth days). Its mission is to search for fossil or living signs of life. It is scheduled to return by 2014 with rock and soil samples getting NASA one step closer to human planetary exploration. The Mars Exploration Program is designed to determine if life had ever arisen on Mars, characterize its climate and geology and prepare for human exploration. In order to help make this dream a reality, NASA is in search of budding scientists and astronauts. [17]

## Astronauts Education &Training

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On a continuing basis, NASA selects qualified applicants to participate in a rigorous one year training program directed by the Johnson Space Center in Houston. Prerequisites for the space program include jet aircraft and engineering training as well as scientific education. NASA astronauts are required to have at least a bachelor's degree in engineering, science or mathematics. This means you would need to take a majority of classes in math or science, such as advanced physics and calculus classes. All applicants must be citizens of the United States. [18]

After completing the course, candidates become members of the astronaut corps and are generally eligible for a flight assignment the following year. While in training, candidates study subjects like aerodynamics and spacecraft tracking techniques. They learn about flight control systems as well as on board equipment. The actual flight training takes place in a jet aircraft where the trainees practice maneuvers at high altitudes. They are even trained to experience near weightlessness as the training airplane practices dives and the candidates float in padded cabins for half a minute. After an astronaut is assigned to a mission he or she will then spend more hours training in a simulator that replicates the conditions of actual space flight. While practicing in the full sized space craft astronauts can get used to doing everything that they will routinely need to do in space, such as preparing food and entering and leaving the spacecraft. Pilot astronauts are trained to control and command the space craft while mission specialists train to conduct experiments launch and recapture satellites and maintain the spacecraft and its equipment.

Pilot astronauts can serve as either a pilot or commander during the shuttle flight. A commander's key responsibility is to keep the vehicle and crew safe. They play a key role in the success of the mission. The pilot astronaut controls and operates the shuttle. During the flight pilots and commanders assist in the spacecraft deployment and retrieval operations. In order to be selected as a candidate a pilot astronaut applicant must have a bachelors degree in engineering, biological science, physical science or mathematics. A graduate degree is preferred but is not always essential. Applicants must also have at least one thousand jet aircraft flying hours. Additionally applicants are required to pass a physical examination as well as have a distance visual acuity no greater than 20 /50 uncorrected, a sitting blood pressure no greater than 140 over 90 and a height between 64 and 76 inches tall. The mission specialists work one on one with the commander and pilot

and are responsible for coordinating on board operations such as planning the crew activities and monitoring the fuel, water and food on board the shuttle. The mission specialists also perform on board space walks. Although the basic physical qualifications are the same as for the pilots their uncorrected visual acuity can be as high as 20/100 and their height range lies between 60 and 76 inches. Academically, however these applicants not only need the bachelor's degree in engineering, biological science, physical science or mathematics, they also require at least three years of related professional experience. [19]

Once selected, initial training consists of courses in aircraft safety which includes instruction in ejection in the event that the aircraft becomes disabled or they have to make an emergency landing. Pilot astronauts and mission specialists need to continually maintain their skills in flying as well as academically through lectures and classes that include courses in meteorology, navigation, astronomy, physics and computer science.

Advanced training follows initial training which combines curricula with system training (what to do in orbit, how to live and work) and phase training (shuttle simulations.) [19]

## A day in the Life of an Astronaut

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Even after having been selected and completed trainings an astronaut's day is not as easy as one may think. This career certainly has its drawbacks. The rigorous training is often time consuming and limits time that astronauts have to spend with their families. One could actually work 24 hour days, 7 days a week and still not have completed their work. It is very difficult to strike a balance between work and family life. The long unpredictable hours and extensive travel for months at a time are not commensurate with the compensation and can be difficult on the family. It is not unusual for astronauts to begin their day at 7:30 am and not leave until 11:30 pm. When not on a mission, astronauts perform research and conduct experiments for potential space missions. They participate in weightlessness simulations and undergo continuous security screening while continuing to update their jet-pilot qualifications and flight experience. [20]

While on a mission an astronaut's day may seem similar to your daily life: get up, brush teeth, wash your face, comb your hair, and eat breakfast, but being in space poses challenges because you are now at zero gravity. For example, washing your face is not as easy because the water will not stay in your hands to splash on your face. One would have to use a wash cloth that was carefully wet down from a water bag so that no water was to escape and float around the cabin. Washing your hair is equally difficult. Astronauts use no rinse shampoos and have to towel dry it out. The biggest change is that personal hygiene and daily tasks like preparing and eating your food are time consuming at zero gravity.

After a day of experimentation and research the crew gathers for exercise and their evening meal before getting ready for bed in sleeping bags that tied to a wall or the floor. Exercise is essential to the astronaut's routine because it helps to prevent the deconditioning effects of zero gravity. Even while on the treadmill, astronauts have to wear harnesses to hold them in place. [20]

## Lesson Plans

Space has always been a fascinating topic for students, specifically because of its wonder and unpredictability. Many have often imagined what exactly lies above us and what new discoveries are yet to be made. The Earth and the Moon remain one of the most intriguing aspects of scientific discovery. In motivating students to become aware of space exploration past and present we encourage students to appreciate the wonder of the sky and what lies ahead. It also motivates students to value the questions scientists have yet to answer and help them to conceptualize the various ways scientists seek answers to these questions. In applying critical thinking skills students can better understand what can be learned from space exploration and to one day become a scientist or astronaut themselves. In order for NASA's dream to one day send people to Mars to come true, today's students must become involved.

**Lesson Plans -Week 1 - Introduction of our Earth-Moon system (5-7) 45-60 minute classes**

*Day 1 (integrated with literacy)*

Since students have already begun to observe the Moon, noticed the changes in the Moon and have even begun to wonder about the images seen, the teacher will open the unit by discussing what the students have observed about the Moon and what they may already know about the Moon. The teacher will then chart any questions that the students may have in regards to their observations or otherwise. As the unit progresses, the teacher can add additional questions that the students may have to the list. After the students shared their observations and formulated their questions the teacher will recognize and encourage the student's thinking in saying "Just as many of you have noticed the Moon's changes and have even seen people or animals pictured on the Moon's surface, so have many other people from different parts of the world throughout history. Let's explore what other people may have said about what they saw and compare it to our own observations, as well as what we know about the Moon already from scientific discoveries." Next, the teacher will read aloud The Truth About The Moon, by Clayton Bess. Throughout the read aloud, the teacher will stop and ask students questions like "Did you see the face of a person on the Moon's surface when you were observing it?" or "Did you feel puzzled like Samu each night as you noticed the Moon looked different than the previous night?" or "Do you think that there could be more than one Moon?" or "Do you think Samu will ever be able to reach the Moon?" Following the read aloud, the teacher will discuss with the students what genre The Truth About The Moon belongs in. Once students have established that The Truth About The Moon is a myth, a traditional story told to explain the view of a culture, then students can compare and contrast their perspective of the Moon and note the differences between what is true and what is merely made up to explain what couldn't be explained at that time.

*Days 2- 5 ( integrated with literacy)*

The teacher will open each class by reading a myth from a different part of the world taken from Moontellers by Lynn Moroney, followed by a discussion about what makes a myth a myth and how it relates to their observations. One the second day the teacher will begin to outline how a myth is written and give students the chance to share their own ideas if they were to write a myth about how the Moon came to be, what would they say? On day three, students will begin to write their own myth about how the Moon came to be.

*Days 4-5 (integrated with Science)*

Later in the day during science class the teacher will facilitate a class discussion about the Moon in accordance with scientific discoveries. The teacher will introduce the lesson by reading The Moon Book, by Gail Gibbons. A discussion about the composition of the Moon, its size and its phases will follow. Students will create their own "Moon Book." to be completed by the end of the unit. The book should begin with a Table of Contents and end with a Glossary of terms learned throughout the unit. In it, the students should have at 4 sections, namely: Moon Milestones (timeline of early astronomers to the 21st century, Apollo missions, what's next for NASA, astronaut training and education) Moon Facts (size, composition, phases, tides eclipses etc.) Moon Myths (summaries of the myths read and their own myths) and Moon Journal (Today I . . ...This is what I learned by doing it. . ...here are some pictures that show what I did. . ..)

**Sample Lesson Plans for Weeks 2-6**

Now that students have been introduced to the mythological background that many cultures share about the Moon they are ready to explore a deeper scientific explanation as they experiment with reflected light, gravity, eclipses and explore the Moon's surface. Students will continue to add definitions to their Moon Book as develop the Moon facts section.

*The Source of the Moon's Light*

Objective: The students will investigate and demonstrate the source of the Moon's light

Materials: mirror, flashlight, Moon logbook to record and illustrate data and observations.

Instruction/ Activity: Ask students to think about what causes the Moon's light. After charting some of the students' answers the teacher can perform the following demonstration with student assistance. The mirror represents the Moon and the flashlight represents the Sun. First, shut the curtains and turn off the lights. Then, turn on the flashlight and point it toward a wall. Ask students to observe what happens to the light. Next point the flashlight at the mirror and ask the students what they observe is happening to the light. Discuss the students' observations by asking them to describe what they saw. (When the flashlight shone on the wall, we saw only the wall, but when the flashlight shone on the mirror we could see other things in the class room too!) Explain that this is called reflected light. The sun shines on the Moon just as the flashlight shone on the mirror. Sunlight is reflected away from the Moon, similarly to the light that reflected off the mirror. Although neither the Moon nor the mirror actually produces their own light they can both reflect light. Finally students will record and illustrate what they learned in their Moon Book. [21]

*Gravity Lesson*

Objective: The following experiment will help to explain why celestial bodies, like the Moon or planets don't fall out of the sky. Many astronomers, including Nicolaus Copernicus and Galileo often wondered; How does the force of gravity act on objects both on Earth and in space? Galileo thought that gravity exerted an equal force on objects despite their size and weight. This experiment will explain Galileo's idea. Be sure to provide background information about these two astronomers and their ideas first.

Materials: An orange, a dime and a piece of paper.

Instruction / Activity: Have the students stand in a wide circle. The teacher can stand in the middle with an orange in one hand and a dime in the other holding both arms straight out in front of her/him. Drop the orange

and the coin at the same time. Both the orange and the dime will hit the ground at the exact same time. The size and weight did not make a difference in the gravitational pull on the objects. Give students a chance to come into the middle of the circle to try the experiment themselves. Next, the teacher will try another experiment with an orange and a sheet of paper. After charting the students predictions about which will hit the ground first, the teacher will hold each hand straight out in front of him/her and drop the object at the same moment. Students will wonder why gravity acted differently with the sheet of paper versus the coin. The truth is that gravity did not act differently, only that the light weight and shape of the paper interfered with the gravity's ability to pull the paper to the ground thus allowing the paper to 'float" for a moment before touching the ground. Next crumple the paper into a ball and holding your arms straight out, one with the crumpled piece of paper and the other with the orange drop both at the same time. Notice that this time both objects hit the ground at the same time again! The paper acts for a moment lighter than the air and so it floats before hitting the ground. Because our Earth's atmosphere is composed of several gasses there are some objects that can seemingly defy the laws of gravity like a feather or a parachute by taking advantage of the properties that make up the air. If you were on a planet without an atmosphere the sheet of paper would hit the ground at the same time as the orange. Following the activity, students can add a page in their Moon Journal portion of the Moon book by describing what they did and what they learned while doing it. [22]

*Creating Lunar Soil*

Objective: During this week students will also experiment with making their own "lunar soil" and will explore the Moon's surface by examining how craters were formed.

Instruction: Begin with instruction with background information about the geology of the Moon. After having discussed meteors, asteroids and comets at length and adding them to the glossary section of the Moon Book, students will enjoy creating craters. Craters were caused by meteors, asteroids and comets that slammed into the Moon's surface. Many of these "impact craters" are deep and round in shape. Some may be smaller and shallower.

Materials: Newspaper, 9x 13 baking pan, 6 cups of salt, 6 cups of flour, Spatula.,2 tablespoons of paprika, cinnamon or cocoa powder,3 impactors such as a marble, a stone, a shell or a coin, Tongs [16]

Instruction / Activity (The teacher can model her/his own pre-made soil and review instructions as printed on the chart paper or overhead. Be sure to have parent volunteers or paraprofessionals come in to work with the children to help monitor stations. Then arrange the room into 4 monitored stations. Each station should have the instructional steps on chart paper and the materials needed.

First, cover the floor with newspaper and put the baking pan on top of it.

Then, fill the pan with the salt and flour. Mix together. This is your lunar soil. Use the spatula to smooth out the soil.

Next, sprinkle a thin layer of paprika, cinnamon or cocoa across the lunar soil. (the colors will allow the craters to show up better upon impact.

Finally hold one of the impactors about twelve inches above the "moonscape" and drop it into the lunar soil. Repeat this step with the two other impactors. While students take turns repeating this step discuss with the station monitors about how and why they think the craters are different.

After having finished creating craters, allow the students to view the other stations so that they can note the similarities among the moonscapes. Next, have the students sit together in a community circle to discuss how the three crates were different and why. Ask the students, "What created the deepest crater or the widest?" After charting the answers you may even want to create a bar graph or pictograph together to represent tour data

The station monitors can meanwhile remove the impactors from the lunar soil. After having met with the teacher for sharing time, the students can then guess what impactor fit the crater it created.

*Investigating Eclipses*

Objective: students will investigate the cause of lunar phases and eclipses

Materials: Overhead projector or a bright light source, Small tennis ball, Soccer ball, Photos that show the different phases of the Moon

Instruction/Activity: Darken the room and set the projector or other light source on one side of the room having it point toward the center of the room. Begin the lesson by asking the students what is an eclipse and explain the two different types of eclipses that we see on Earth: a solar eclipse and a lunar eclipse. After choosing two students to assist you, demonstrate a solar eclipse. Give one student the tennis ball (represents the Moon) and the other student the soccer ball (represents the Earth). The students should stand in the center of the room holding up the balls so that the light source (the Sun) is shining on them. Ask the students how much of the Earth is lit by the sun? (half) and How much of the Moon is lit by the Sun? (half) The class is then instructed to closely observe as the student who is holding the Moon crosses between the Erath and the Sun so that the tennis ball blocks some of the light that is hitting the soccer ball. Now ask the students; " What do you see on the Earth when the Moon crosses in front of it ( a shadow that covers only a part of the Erath).Now explain that during a solar eclipse the Moon casts a small shadow on the Earth, but from the Earth it looks like the Sun disappears behind the Moon. Ask students: "Can everyone on Earth see a solar eclipse when it happens?" (No, only the people who are in the path that the Moon's shadow passes over.) Next demonstrate a lunar eclipse. Begin by asking students what they think happens during a lunar eclipse. The same two students now have to switch places so that the Earth passes between the Sun and the Moon. The rest of the class observes carefully as the soccer ball blocks the light from hitting the tennis ball. Ask the class what is the main difference between a solar eclipse and a lunar eclipse. Explain that the Earth is so much ;larger than the Moon that it casts a larger shadow lunar eclipse therefore lasts longer than a solar eclipse and is visible to more people on Earth. [9]

## Implementing District Standards

In accordance with the Connecticut curriculum standards for Science in grades K - 4, after completing this unit, students will be able to identify objects in the sky, such as the Moon, identify and describe the patterns of movement of objects in the sky from day to day and season to season and explain the characteristics and patterns of movement of the Moon. Students will recognize that sometimes scientists have different explanations for the same set of observations, which usually leads to additional observations to resolve the

differences. Students will describe how the Moon looks a little different every day, but looks the same about every four weeks. Students will describe how the astronauts use spacecraft for travel and how some astronauts have even traveled to the Moon and back. Through this exercise students will recognize that information and photographs from orbiting spacecraft have added to our knowledge of the Earth and the universe.

## Notes

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1. Wikipedia. "Dwarf Planet" Wikipedia Foundation: May 2007. http://en.wikipedia.org/wiki/Dwarf_planet>This online reference is handy for teachers who need a quick answer to a question or an explanation in teachable terms to share with the class about almost anything.

2. Boeing Satellite Systems Development Center. "What is a Satellite?" http://www.boeing.com/defense-space/space/bss/sat101.html> This corporate homepage gives specific information about its industry and products it services.

3. Northwestern University. "What is in Space?" http://www.qrg.northwestern.edu/projects/vss/docs/space-environment/1-asteroid-planetiod-meteoroid.html> This collegiate webpage provides information on student's past projects. It provides very helpful background information for teachers when planning a unit.

4. Astronomical Institute. "Astronomy Answer Book: Gravity" April 2007. http://www.astro.uu.nl/~strous/AA/en/antwoorden/zwaartekracht.html#v32> This is a fantastic resource for teachers. It provides detailed information about all aspects covered by astronomy. You simply click on your question and it provides answers!

5. Simon, Seymour. Our Solar System. New York: Morrow Junior Books,1992. A comprehensive guide that upon first viewing looks like a science picture book, (which adds to its character as students chose to look through it and read it), but instead this non-fiction text is packed full of information for both teachers and students alike. This book gives a detailed look at our solar system including facts from its origin, the 9 planets (before Pluto was named a dwarf planet) and their moons, the Sun and even a look at the Apollo Space Program.

6. Campbell, Ann-Jeanette. Amazing Space. New York: New York Public Library and Stonesong Press,1997. This book is a handy reference to own when doing a unit on the universe because it is written in question/ answer form and the author writes as if she were talking to you. This easy to understand book begins with an introduction to astronomy but gives information about the universe and its galaxies, the stars and the Sun, the planets and their moons, as well as a timeline of space exploration.

7. Spudis, Paul D. "Moon." World Book Online Reference Center. 2004. World Book, Inc. http://www.worldbookonline.com/wb/Article?id=ar370060> This is an online encyclopedia that is very helpful when teachers are looking for background information about almost any topic when planning a unit.

8. Chang, Maria. Ed. Teaching Science, Yes You Can. New York: Scholastic. 2007. This sourcebook for teachers includes lesson plan ideas and background information for the teacher for all areas of science, including Earth and Space (i.e. crystals, soils and plate tectonics, weather, the seasons the Moon and its phase) ,Life Science ( i.e. plants, germination, animal adaptations and the human body), and Physical Science (i.e. energy, magnets, mirrors and changes in matter).

9. National Aeronautics and Space Administration. "Lunar Prospector" October 2001. http://lunar.arc.nasa.gov/science/phases.htm> NASA's website is an excellent resource for any student or teacher doing research about the universe. It provides detailed information including data tables, figures and animations.

10. National Aeronautics and Space Administration "Total Lunar Eclipse of March 2003" http://sunearth.gsfc.nasa.gov/eclipse/OH/OH2007.html#2007Mar03T> NASA's website is an excellent resource for any student or teacher doing research about the universe

11. Freedman, R.A. & Kaufmann W.J. The Universe. 6th Ed. New York: WH Freeman and Co.2002.This textbook is an excellent source for teachers who are teaching a unit about the universe. It provides answers to questions that both teachers and students alike may have during the study. This easy to understand extensive textbook organizes its information about the universe including, but not limited to The nature of light, optics and telescopes, the Solar System, the birth and death of the stars and the galaxies.

12. Russell, Randy. "Windows to the Universe - Our Moon." University Corporaation for Atmospheric Research. October 2005. http://www.windows.ucar.edu/tour/link=/mythology/planets/Earth/moon.html> This website gives many examples of celebrated myths about the Moon from around the world. It also includes student friendly work and projects to use as examples when modeling a lesson plan.

13. Brueton, Diana. Many Moons. New York: Prentice Hall Press. 1991. Many Moons gives information about the myth and magic that surrounds our Moon. It contains cross cultural myths and the stories behind it. The guide also includes a brief scientific look at the moon, its origin and exploration.

14. Moroney, Lynn. Moontellers. Northland Publishers: Arizona. 1995. Moontellers is a compilation of various myths told about the Moon and its origin from the viewpoints of people from different parts of the world, like Australia, China, Mexico, Bolivia and Scandinavia to name a few. It also gives readers background information about that culture to help the reader better understand how the myth came to be told.

15. Bess, Clayton. The Truth About the Moon. Boston: Houghton Mifflin. 1983. The Truth About The Moon is a fictional story about a young African boy named Samu who is curious about the changes he notices in the Moon. This tale is written as a quest to find answers beyond the legends told by his family.

16. Carson, Mary-Kay. Exploring the Solar System. Chicago: Review Press.2006. This nonfiction text is written in kid friendly terms but intended for teachers. It contains background information about our solar system including its' history from the ancient astronomers and their tools to the Apollo missions and the planets and their moons. It also gives teachers various classroom activities to compliment their lessons.

17. National Aeronautics and Space Administration. "NASA's Mars Exploration Program." March 2006. http://mars.jpl.nasa.gov/science/human/index.html One of NASA's goals is to one day prepare for a mission to Mars. This exploration program is designed to motivate and captivate student interest in astronomy.

18. National Aeronautics and Space Administration "Astronaut Selection." January 2007. http://www.nasajobs.nasa.gov/astronauts/default.htm> This webpage is for anyone who ever wanted to know how astronauts are selected. There are also links to view recent astronaut candidates and an astronaut fact book for background material or the curious

19. National Aeronautics and Space Administration . "Selection and Training of Astronauts" February 1995. http://liftoff.msfc.nasa.gov/academy/astronauts/training.html> This webpage is designed for teachers and older students alike to teach them how about the many different jobs an astronaut has and how he or she is trained to accomplish the task.

20. National Aeronautics and Space Administration. "So You Want to be an Astronaut." September 1995.

http://liftoff.msfc.nasa.gov/academy/astronauts/wannabe.html> This webpage references what you need to do in order to prepare for a future as an astronaut. It also gives data about what an astronaut's life is like including the benefits and drawbacks.

21. Moore, Jo Ellen. Exploring Space: Science Works for Kids. Monterey, CA: Evan -Moor Corp. 1998. This is a teacher resource book that gives great ideas for lesson plans across the science curriculum including but not limited to plants, the human body and space. It's great for planning inquiry based science lessons, labs and science fair projects!

22. Panchyk, Richard. Galileo for Kids, His Life and Ideas. Chicago: Chicago Review Press. 2007. This is a teacher resource book that concentrates on the life of Galileo and his work as a mathematician and astronomer. This nonfiction text includes classroom activities intended for students nine years and older.