Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
2005 Volume IV: The Sun and Its Effects on Earth

Our Place in Space

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What do scientists and children have in common? They both feel excitement when new discoveries are made. For children, this excitement can capture their imagination and introduce them to the fundamentals of math and science. My goal in this unit is to help this generation of students grow up feeling more at home in this vast, awesome, and exciting universe.

I teach third grade at Harry S. Conte West Hills Magnet School in New Haven, Connecticut. Conte is an interdistrict elementary school of choice. Students come from all thirteen New Haven neighborhoods as well as from the surrounding suburban communities. I find that at the beginning of third grade many of my students do not even know their addresses and telephone numbers. How can I help these students understand that they are not only part of their family, neighborhood, and city but also part of the Universe? My job as a teacher is to make them feel at home with the information. Most of my students come from African-American and Latino backgrounds. For this reason, a special emphasis has been given to encourage students from groups who have been historically underrepresented in the sciences such as women and ethnic minorities. The New Haven Public School Science Curriculum includes a unit on the Solar System for third grade students. The topic overview for this curriculum is the study of the characteristics of the members of the solar system and the exploration of the motions of the Earth and the Moon.

Many teachers would love to include astronomy in their classroom but they are often held back because their own background and training in the subject is weak or outdated. This unit is designed to build background knowledge of the Solar System as well as provide resources to obtain up to date information to teach this content area. It is also designed to instill in students a curiosity and concern for their natural world and create critical thinkers and problem-solvers. Students need to see connections among the various disciplines of science, mathematics, and the humanities, as well as between what they learn at school and the real world.

Overview

To begin at home, our Earth is a member of the family of planets and moons known as the solar system. Orbiting our star, the Sun, are the nine planets, and assorted satellites with their own special characteristics. Our solar system is also shared with assorted debris in the form of asteroids, and meteoroids.

The planets basically come in two different types. The Earth-like planets, or "terrestrial", planets: Mercury, Venus, Earth, and Mars. These are small, dense rocky worlds are known as the inner planets.

Unlike the terrestrial planets, Jupiter, Saturn, Uranus, and Neptune have no solid surface on which to stand. They are "gas-giants" with complicated wind patterns and storms centers. These large planets are circled by rings and are known as the outer planets.

Pluto, the tiniest planet, is the most distance from the Sun. It doesn't really fall into terrestrial or gas planet categories, it is believed to be icy.

At the center of all these planetary neighbors is our Sun. It is our nearest star and important to our life here on Earth. From ancient times people recognized that the Sun was related to the seasons. It is the basis for our twenty-four hour day, our year of 365-1/4 days, and the division of the year into four seasons.

Our planet's natural satellite is the Moon. The Moon offers the easiest opportunity to transform enjoyment of the sky into predictive science. The Moon is the only other thing in the sky other than the Sun that doesn't look like a point of light to the unaided eye. Its pattern of repeating phases is hard to miss.

Earth: There's No Place Like Home

Which planet is closest to us? We are standing on it...the Earth of course! To fully understand the Earth as a planet, students need to grasp both the Earth's shape and gravity concepts.

Our planet is the largest of the terrestrial group. It is the third planet from the sun and it has a diameter of 7,926 miles (12,756 km) at the equator and orbits the Sun at 1.0 Astronomical Units, or 93 million miles (150 million km). Earth is rich in nitrogen and oxygen and has an abundance of water in solid, liquid and vapor forms. Nearly three-quarters of the earth is covered with water (71%). The rest of the earth's surface varies from flat lands to dry desserts to towering mountain peaks. Earth is covered with life. There are over 175 million forms of life identified on earth. Because of Earth's geographical location in the Solar System, it is in a special place well suited for life and appears to be the only place in our Solar System where life exists. If the planet is too close to the Sun, it is too hot for life-giving molecules to form and if it is too far away, it will be too close for molecules to join and too cold for liquid water to exist.

Our daily experience is that of a fixed Earth at the center of the Universe. It's always a bit of a shock to remind students that we live on a ball of rock and water that spins once a day around the glow of a star (our Sun). Earth revolves around the Sun once every 365 days, which we call a year. Earth and all the other planets are held in orbit around the Sun by the Sun's gravity. Earth also rotates on its axis once every 24 hours. It is night on Earth when we are on the side of Earth in shadow, facing away from the Sun. When Earth's rotation brings us out of shadow and back into Sunlight again, it is daytime. In the course of a year, regular climate changes occur regularly on Earth. These changes are called seasons and they occur because Earth's rotation axis does not stand upright relative to our planet's orbit but tilts at the angle of 23.5 degrees. Earth revolves around the Sun. When the side we live on is tilted down toward the Sun, we have summer because we receive lots of the Sun's heat. Six months later our part of Earth is tilted up away from the Sun at it is winter because we then receive less of the Sun's heat.

Internally, Earth consists of three parts: core, mantle, and crust. The Earth has a partly molten core of nickel-iron that is about 4,400 miles (7,000km) in diameter. Earth's mantle contains high-density basaltic rocks, rich in iron and magnesium. It extends from the top of the core almost to the surface. The mantle's top layers lie beneath the crust (the part we live upon). The thickness of the crust varies, being 5 to 6 miles (10km) thick in the ocean basins, but reaching a depth of 50 to 60 miles (100 km) under the continents.

Other factors in creating "our world" are the atmosphere and water in all its forms. Wind and rain work slowly and steadily, removing material from the land and returning it to the sea. By attacking the softest rocks and soil first, erosion shapes our landscape here on Earth. The air and the seas also serve to moderate Earth's climate, carrying heat into the arctic regions and bringing cool currents to the tropics.

Moon: Earth's Natural Satellite

The Earth's Moon is the easiest thing to spot in the night sky. Unlike a planet that orbits around the Sun, a moon is an object that orbits around a planet. We call the moon that orbits around the Earth "the Moon," but many more moons exist in out solar system.

Scientists believe the Moon has accompanied Earth since the beginning. Earth had barely formed when a Mars-sized object struck it obliquely. The blow sent a spray of vaporized rock into space and formed into the Moon. The Moon is 238,860 miles (384,400 km) miles from Earth. The Moon is 2160 miles (3475km) in diameter and is an airless, dry surface covered with plains and craters.

The moon circles the Earth every 29.3 days, moving through a cycle of phases. This cycle formed the basis for most early calendars and led to the 12-month year that is used today. The gravity of the Moon raises tides on Earth, while Earth's gravity locks the Moon's rotation to keep the same side always turned towards Earth. Lunar tides raise the ocean twice a day. One bulge of water, on the side nearest the Moon, marks where its gravity is pulling the water away from Earth. The other bulge, on the opposite side of Earth, marks where the Moon is pulling Earth away from the water.

Asteroids bombarded the Moon and so it has a heavily cratered surface. Some craters measure 55 miles (90 km) from rim to rim. Because the moon lacks air it can be very hot and very cold. The lunar high-noon temperature reaches 134 degrees Celsius. On the Moon's night side the temperature drops to about –170 degrees Celsius.

About 3 billion years ago, the Moon heated up and melted. The surface rock later hardened, and then molten rock below welled up through cracks in the surface, flooding huge areas. Today we see these areas of solid lava as the Moon's "seas," or "maria" from the Latin word sea.

The Moon now appears to be geologically dead. Six manned missions to the moon brought back hundreds of pounds of rocks that have done much to unfold the moon's history. The moon is our best known, as well as nearest neighbor in space.

Phases of the Moon

The relation of the Moon in relation to the Sun affects how we see the Moon from Earth. The Moon has no light of its own. It reflects sunlight. The Moon is always round. It looks like it changes shape because as it orbits the Earth, we see different parts of the lighted side. This is known as the Phases of the Moon. The Moon travels around the earth about every 28 days. As it travels its bright side (side facing the Sun) faces the Earth and looks like a big bright ball of light in the sky. As it moves around the Earth and only part of the bright side faces us, we see a *crescent* and then a *quarter Moon* . The Moon continues to move and we see less and less of the lighted area. When we see no more of the lighted area and it looks like the Moon has disappeared, we call it a *new Moon* . The Moon continues to move around the Earth, and as it does, we begin to see more and more of the lighted area. At last we see that big bright ball again and call it a *full Moon* . There are eight phases: New Moon, Crescent, First Quarter, Gibbous, Full Moon, Gibbous, Last Quarter, Crescent.

Mercury: The Fastest Planet

Mercury, the planet closest to the Sun is a small rocky ball. Mercury has been known since ancient times because of its brightness, it shines by reflecting sunlight. Mercury is the planet the orbits closest to the Sun. Mercury is only 3,031 miles (4,878 km) in diameter. It is the smallest of the four terrestrial planets and smaller than Jupiter's moon Ganymede or Saturn's moon Titan. It is 36 million miles (57.9 million km) from the Sun or about .4 Astronomical Units. Mercury travels around the sun faster than any other object in the Solar System. It completes one orbit every 88 days. Mercury spins on its axis every 59 days (exactly two-thirds of its 88-day year. Every two Mercurian years the planet spins three times.

In the spring of 1974 a small spacecraft named Mariner 10 gave us our first close-up view of Mercury. Photos showed that the planet has many craters, mountains, and valleys, like those on the Moon. Because Mercury is so close to the Sun, the planet is very hard to study through telescopes. While Mercury generally resembles the Moon, it does not have "seas" of lava found on the lunar surface. Instead, its gently rolling lava plains feature many raised ridges, known as scarps, which tend to run north-south. Scientists think that as the planet slowly cooled over many millions of years, the planet may have shrunk a bit and wrinkled, forming the scarps.

Mercury can best be seen with the naked eye when it is as far from the Sun in the sky as it can be, at its greatest eastern and western elongation. For a few days at these times Mercury can be viewed in the eastern sky rising before the Sun and is known as the "morning star" and in the western sky, low over the horizon as the "evening star" for a short time after sunset.

Mercury has a rock crust made of the same kind of rock found on Earth. Beneath the crust is a thicker mantle layer of the same material. Mercury has an iron core about the size of the Moon.

Venus: The Hottest Planet

Venus the second planet from the Sun is Earth's near twin in size is the brightest planet in the night sky apart from the Sun and the Moon. It is located 0.7 Astronomical Units from the Sun. For centuries, astronomers lacked a view of Venus' surface and could only calculate its size and motion. Venus has a diameter of 7,521

miles (12,104 km), about 5 percent smaller than Earth's and orbits the Sun every 225 day.

In 1962 radar enabled scientists to measure Venus' 243-day spin, which surprisingly goes backward (retrograde) compared with most other planets. The sun rises in the west and sets in the east, opposite what we see on Earth. From one sunrise to the next on Venus takes 117 Earth days.

Venus is hidden beneath a blanket of deep yellowish clouds made up of sulfuric acid. The top layers are very cold but down near the surface they heat up. Most of Venus' air is carbon dioxide. Venus' air is a never-ending storm, with continuous thunder and lightning. Although Venus is farther from the Sun than Mercury it is much hotter. The Sun's rays go down through Venus' air and heat the surface rocks. The carbon dioxide acts as a blanket that traps the heat given off by Venus' surface. This produces a greenhouse effect because the Sun's heat is trapped.

Venus has many craters, but they have been worn down by weather. Venus' highest mountain is named Maxwell Montes. It stretches up 100,000 feet (30,300 meters) and appears to have a volcanic crater. Venus has one of the largest canyons in the Solar System. It is nearly four times larger than the Grand Canyon and twice as deep.

Like Mercury, Venus is sometimes called the "morning star" and "evening star". Because its orbit has it revolving relatively closer to the sun, Venus is easiest to spot right before the Sun goes down, or right before it rises.

Mars: The Red Planet

Mars is the fourth planet from the Sun is sometimes called "the Red Planet" because it shines with a reddish color. Mars is a little more than half Earth's size and takes nearly twice as long to orbit the Sun. It's diameter measures 4,217 miles (6,787 km). It is located 1.5 Astronomical Units from the Sun.

With clouds, storms, and seasons, Mars is the most Earth-like of the Sun's family. Its year last 687 Earth days and its day is 24 hours, 37 minutes long. It has a 25-degree tilt on its axis thus giving the planet four distinct seasons. Other Earth-like features include tall mountains, deep canyons dust storms, dried riverbeds, and its many volcanoes. One of the largest, Olympus Mons, is more than twice as high as Mount Everest. The planet's red color comes from its rusty, oxidized rocks and dust. Mars' ruddy color is detectable with the naked eye.

The climate on Mars is brutal. The atmosphere is 95 percent carbon dioxide, which locks in heat, and helps keep the planet warm. But the Martian atmosphere is thin and offers only a small barrier to escaping heat. The temperature at the planet's surface climbs to a high of about 25 degrees Celsius at the equator at noon. At the north and south poles, which are covered with ice, it plunges to a low of –123 degrees Celsius. The polar ice is mostly "dry ice" or frozen carbon dioxide, with just a little water ice mixed in.

Mars has two moons that were discovered in 1877. They resemble asteroids (they look like potatoes) and are named Phobos and Deimos. Deimos is about 9 miles (15 km) long and Phobos is neary twice that size.

Life on Mars?

Science fiction has led us to believe stories about little green men from Mars. H.G. Wells' novel The War of the World had many Americans believing Martians had invaded the United States. However, recent discoveries of what appear to be fossil bacteria in a meteorite from Mars has reopened the discussion. At present, Mars probably cannot support life. However, Mars is the most Earth-like planet in our Solar System. Life may have begun on Mars and disappeared as the planet cooled and gave up most of its water in space. Future robotic space missions are designed to provide an understanding of Mars as a whole. Did life begin on Mars? By exploring our neighbor we may be able to answer this question.

The Asteroid Belt: Minor Planets

Between Mars and Jupiter is an area of space called the Asteroid Belt. Thousand upon thousands of tumbling chunks of rock and metal called the asteroids are trapped in an orbit around the sun. In 1596 Johann Kepler thought he would discover a planet between Mars and Jupiter. Not until 1801 did Giuseppe Piazze discover the first minor planet named Ceres. Ceres is a small body, about 600 miles (1,000 km) in diameter and its appearance lent to the alternative name these bodies are still known by: "asteroid". At present more than 35,000 minor planets are known.

Billions of asteroids, varying in size from a bus to a mountain, orbit between Mars and Jupiter. Most astronomers think that the asteroids are bits and pieces of matter left over from the time the planets were formed out of the great Suncloud matter. Jupiter's powerful gravity most likely kept a planet from forming nearby and so the asteroids came to be.

Jupiter: The King of the Planets

Jupiter is the fifth planet from the Sun about 5.2 Astronomical Units. Jupiter is a gas-giant with a composite structure that is radically different from the four terrestrial planets. It has a diameter of 89,400 miles (143,800 km) and weighs more than all the other planets put together. Its immense gravity directs the fate of many comets and asteroids. Jupiter has 63 moons as of May 4, 2005. The four moons that were discovered by Galileo are the largest. They are Io, Europa, Ganymede, and Callisto. Together these are known as the Galilean moons, and each has its own geological character. Ganymede is the largest moon in our Solar System.

Jupiter's make-up is similar to the Sun's. Hydrogen accounts for 80 percent and helium 19 percent, the rest of the planet consists mainly of water vapor, methane, and ammonia. The surface of Jupiter consists of layers of cloud standing near the top of an immense atmosphere thousands of miles deep. The colors and striping result from chemical reactions in the ammonia and methane. Below the surface of the clouds the atmosphere remains gaseous to a depth of perhaps a few hundred miles. At its center lies a core of molten rock, perhaps several times Earth's mass. Sometimes called "a failed star," Jupiter would need about 100 times more mass to become even the smallest type of star.

Jupiter has very faint rings. These rings were discovered during the Voyager flybys in 1979. They are composed of particles of rock that reflect very little light. This makes it difficult to observe the rings from Earth.

Jupiter spins very rapidly on its axis. Its day is less than 10 hours long. This rapid rotation and powerful winds force that atmosphere and clouds in dark and light-colored stripe patterns. The turbulence in the clouds often causes storms. One such storm is known to us as "The Great Red Spot" and is nearly four times as large as the Earth and has raged for at least 150 years.

Saturn: The Ringed Planet

Saturn is the Sun's sixth planet. It is the second largest planet, large enough for 800 Earths to fit inside. Saturn has a diameter of 75,000 miles (120,660 km) and is located 9.6 Astronomical Units from the Sun. All gas giants have low densities compared with the terrestrial planets, and Saturn's is the lowest of all. The planet's density is actually less than that of water, and therefore it would float, if one were able to find a tub big enough to accommodate it.

Saturn is very much like the Sun and Jupiter. It is 88 percent hydrogen and 11 percent helium, and a small amount of methane, ethane, and ammonia. Saturn, too, spins on its axis very quickly. It takes Saturn 10 hours and 40 minutes to make one complete rotation. A year on Saturn is much longer. It takes Saturn approximately 29-1/2 years to make one complete revolution of the Sun.

Saturn's "rings" are actually bands of rock, dust, and ice trapped in orbit around the planet. Galileo first spied Saturn's rings in 1610 through one of his early telescopes. Many astronomers think that the ring pieces are matter that was left over after Saturn was formed.

At last count Saturn has 46 moons. The largest one is Titan, the second largest moon in the Solar System after Jupiter's Ganymede. Titan is the only moon known to have an atmosphere and clouds.

Uranus: The Tilted Planet

Uranus lies twice Saturn's distance from the Sun about 19 Astronomical Units, and is about half Saturn's size. Uranus is a gas-giant and it has a diameter of 31,765 miles (51,120 km), nearly four times the size of Earth. Like the other gas-giants it is like the Sun in composition: hydrogen and helium and traces of methane. The methane gives the planet its blue-green color.

In 1986, Voyager 2 flew by Uranus and frustrated scientists with its bland appearance. Scientist found that clouds do exist but are hidden below the bluish haze. The tilt of Uranus' axis is 98 degrees. This is a planet orbiting on its side. One pole faces the Sun for 42 Earth years, the other pole faces the night just as long. It takes Uranus 17 hours and 14 minutes to rotate once on its axis. To completely revolve around the sun it takes Uranus 84 years. At last count Uranus had 27 moons. The orbits of Uranus' moons are inclined almost at

right angles to Uranus' orbit Uranus has ten rings and are much narrower than Saturn's.

Neptune: The Last Giant

Neptune is so far away it is hard to see the planet in much detail. It appears as a dim bluish-green world through telescopes. It is located 30 Astronomical Units from the Sun. Neptune is nearly the same size as Uranus with a diameter of 30,760 miles (49,500 km) and is sometimes thought of as Uranus' twin. A Neptunian day is only 17 hours and 50 minutes long. Astronomers have calculated that it takes 164.8 Earth years to complete one revolution around the Sun.

Hydrogen and helium dominate Neptune's makeup as it does the other gas-giants. It is also made of methane, water, and other compounds. Methane gives it its blue color as it does to Uranus. Scientists believe Neptune's internal structure is also very much like Uranus.

When Voyager 2 flew by Neptune in 1989, it spotted rings like those encircling Saturn and Uranus. Neptune's rings seem to be made up mostly of dust-sized particles. Neptune is a very stormy planet with gale-force winds that have been measured at speeds up to 700 miles per hour. It has two dark storm spots. The larger is names the "Great Dark Spot" and is as big as the planet Earth. Neptune has faint rings and 13 moons, one of which is named Triton. Triton is nearly as big as Earth and is thought to be the coldest place in the Solar System.

We often think of Neptune as the eighth planet from the Sun followed by the planet Pluto. However, this is not always accurate. Pluto has a very strange elliptical orbit around the Sun. This odd orbit is responsible for bringing Pluto inside Neptune's orbit and closer to the Sun for 20 out of every 248 years. This will not happen again until the year 2247.

Pluto: The Tiny Planet

Pluto lies about 40 Astronomical Units and is the ninth planet from the Sun. It is the last planet in the Solar System. It is the smallest planet, smaller even than our Moon. Pluto has a diameter of about 1,466 miles (2,360 km). This strange, icy planet is much more like the rocky planets that are found near our Sun. Tiny Pluto takes 6 days and 9 hours to make one complete rotation on its axis and 248 years to orbit the Sun. Pluto is the smallest of all the planets and has its own moon named Charon. Charon is half the size of Pluto at 746 miles (1,200 km). The two bodies rotate, facing one another.

Pluto's density suggests a rock and ice core covered with layers of ices. Its surface probably resembles Neptune's moon Triton, with nitrogen and methane frosts. The temperature is about –220 degrees Celsius. Relative to the orbits of all the other planets, Pluto is more tilted and eccentric. At times, this brings the planet closer that Neptune to the Sun. Pluto is the only planet in the Solar System not yet visited by spacecraft.

Is Pluto Really a Planet?

Pluto fits the classical criteria for a planet: it orbits the Sun, it is large enough to become round, and it even has a moon. But planetary scientists are now starting to think of Pluto as an object from the Kuiper Belt. This is a region within the solar system that extends from the zone of the planets out to a thousand astronomical units further. In addition to Pluto's tilted and eccentric orbit, Pluto's orbit is strange in another way. It is tilted away from the evenly arranged orbits of the other planets and crosses the plane of another major planet, Neptune. Pluto is a trans-Neptunian object (TNOs) of which there are many (Pluto being the largest) that orbit the sun twice for every three times that Neptune does. These appear to be stable orbits over millions of years. The objects in this group are now called "plutinos".

In recent years, there has been much discussion as to whether Pluto is a planet or not. If discovered today, Pluto would not be considered a major planet but a minor planet like Ceres. Due to the politics and social pressures of things assumed to be one way and then shown to be another it takes time for the public to accept that even major concepts and ideas must be abandoned to further progress. Sometimes things need to be reclassified or discussed in different ways in the light of new knowledge.

Sun: The Star at the Center of Our Solar System

The Sun is our closest star. It has a diameter of 1,392,000 kilometers. It is thought to be 4.6 billion years old. The Sun is a medium size star in the Milky Way Galaxy. The temperature at its core is estimated to be over 15,000,000 degrees Celsius. In the Sun's core, hydrogen is being fused to form helium by a nuclear fusion process. The energy created from this process radiates out into space as heat and light. Because the Sun is so massive it exerts a powerful gravitational pull on everything in our Solar System. It is because of the Sun's gravitational pull that the Earth and the other planets orbit the Sun.

The Milky Way: Our Solar System's Galaxy

A galaxy is a cluster of stars, dust, and gas which is held together by gravity. Galaxies are scattered throughout the Universe and they vary greatly in size. Our Sun is a star in the Milky Way Galaxy. Our Galaxy is a spiral galaxy that formed approximately 12-13 billion years ago. Contained in the Milky Way are stars, clouds of dust and gas called nebulae, planets, and asteroids. All objects in our Galaxy revolve around the Galaxy's center. It takes 250 million years for our Sun to pull us through one revolution around the center of the Milky Way. The stars we see over our head every night are also members of the Milky Way family.

The Universe: Everything in Existence

The Universe is a vast expanse of space, which contains all matter and energy in existence. It contains all of the galaxies, stars, and planets. The exact size of the Universe is unknown. Scientists believe the Universe is still expanding.

New Haven Science Standards

Content Standard 4.0 Earth Science-Performance Standard 4.2

Students will demonstrate familiarity with fundamental concepts and principles that govern objects in the day and night sky.

a. Students will identify objects in the sky, such as the sun, moon, planets and stars; they will observe and describe their features and characteristics.
b. Students will recognize that the sun produces light and heat necessary to maintain temperatures we experience on earth.

Lesson 1

Solar System Introduction

Objective:

The students will elicit prior knowledge and ask questions about the Solar System using a KWL Chart.

Materials:

Chart paper

The Magic School Bus Lost in the Solar System by Joanna Cole

*Scientific discoveries continue faster than the pace of children's publications. *The Magic School Bus* is out of date on the discovery of moons. As of this writing Jupiter has 63 moons, Saturn has 46 moons, Uranus has 27 moons and Neptune has 13 moons.

K-W-L (What I Know, What I Want to Learn, What I Learned)

K-W-L involves three steps: accessing what I know, determining what I want to learn, and recalling what I did learn as a result is a teaching model designed to help student learn from nonfiction text. It consists of brainstorming, purpose-setting through questioning, and then examining answers to those questions. Using chart paper, divide the paper horizontally into three columns labeling the first column K, the middle column W, and the third column L.

Step K (What I Want to Know) involves two steps: brainstorming and generating categories for ideas. Prior to reading *The Magic School Bus Lost in the Solar System* the students are intended to brainstorm in response to what they know about the Solar System. As students offer ideas, jot down the ideas on a chart, and then use them as a basis for encouraging discussion.

The second part of Step K involves generating categories of information likely to be encountered in the read aloud. Do some of the suggestions fit together (i.e. planets, moons).

Step W (What Do I Want to Learn?) After discussion the students begin to develop interests and curiosities. Some of these interests may be associated with uncertainties; at other times the students may be driven to learn more about the Solar System. List these interests, curiosities and uncertainties on the chart. Try to elicit one question from each student.

Read Aloud- *The Magic School Bus Lost In the Solar System*

Step L-What I Learned. As the teacher completes the text, the students another discussion ensues as student discuss what they have learned and check what questions they still need answers.

Lesson 2

How Big Are the Planets?

Purpose:

In this activity, students will construct a scale model of the major components of the Solar System. By creating this model, students will avoid misconceptions concerning the relative sizes of the planets and Sun in the Solar System.

Objective:

The student will gain an understanding of the relative size of the objects in the Solar System.

Materials:

Model of the Sun (cloth model 11 ½ feet in diameter)

For each team of two or three students

1-4 sheets of construction paper

1 planet data sheet (copy)

1 ruler

1 scissors

1 roll masking tape

Procedure:

1. Begin by asking the following: *What is the Solar System? What kinds of objects make up the Solar System? What are its largest and most important components?* The student should reach the conclusion that the Solar System consists of a star and the objects that travel around it. Students should be lead to realize that the largest and most important components of the Solar System are the Sun and planets.

2. Tell the students that they will create a scale model that represents the relative sizes of the planets.

3. Divide the class into teams of two or three. Distribute materials.

4. Assign each team a Solar System object (planet). Ask each team to keep the identity of their object a secret (Secrecy allows the students to discover the relationship of the sizes of the planets after they make their own predictions.

5. Ask students to draw and cut out a representation of their planet on the paper. They should use the data sheet to determine the correct diameter for the circle that they make (Pluto will be too small to cut out easily and should jut be drawn to the correct size.

6. On the board, list numbers 1-9. Have one student from each team tape their planet next to one of the numbers. No particular order for the planets is needed, in fact a random order often helps the discovery process.

7. Ask the students as a class to determine which object represents which planet. Write the answers under each planet. Allow a free discussion and debate (referring students to their data sheet and providing assistance when needed) so that students will eventually arrive at the correct labels.

8. Ask the students: *What major part of the Solar System is still Missing? How does this last component compare to the planets in size?* Students should realize that the Sun is not yet a part of the model. Allow them to make predictions concerning the relative size of the Sun.

9. Take out the cloth model of the Sun. Open it up and have the students surround it. For effect, remove the planets from the board and tape them onto the Sun. Allow the students to discuss the enormous size of the Sun in comparison to the planets. Point out that the Sun makes up over 99% of the matter in the Solar System.

Planet Data Reference Sheet

(table available in print form)

These sizes are to a rough scale.

6500 miles = 1 inch

If you are teaching an upper grade and would like your students to do the math, the number of miles divided by 6500 will give diameter in inches.

Lesson 3

"Dress Up" as a Planet

Purpose:

In this activity, students will use props to "dress" like a planet. By creating these "dressed up planets, the students will remember the major characteristics of each planet.

Objective:

The student will gain an understanding of the characteristics of the planets in the Solar System.

Materials:

2 pairs sunglasses

1 large piece red construction paper

4 rocks

2 scarves

1 pair gloves

1 crown

small blanket

4 index cards labeled "GAS"

4 hoola hoops

1 potted plant

1 sign "HOME SWEET HOME"

masking tape

labeled planet picture cards (These can be purchased or made with pictures from magazines or from internet.

variety of planet books

Procedure:

1. Begin by asking the students: *How are the planets the same? How are they different? What is the order of the planets in the Solar System in relation to the Sun?* The students should be sharing some of the similarities and differences about the planets.
2. Divide the class into group of two or three. Tell the children that they will be using the props to dress a student as a planet. The child in each group with a birthdate closest to the date of this activity will be the "dressed up" planet.
3. Give each team a planet card. Lay out the props on a large table. Each team should write a short proposal as to why they need a certain prop. After teacher approval, each team is to dress the student as the planet and present the planet to the class.

Suggestions for Props:

Mercury: sunglasses to represent its position close to the sun, rock for rocky (terrestrial) planet

Venus: sunglasses to represent the position close the sun, blanket to represent the cloud cover, rock for rocky (terrestrial) planet

Earth: plant to represent life, HOME SWEET HOME sign to represent our home, rock for rocky (terrestrial) planet

Mars: red construction paper to represent the rust, rock for rocky (terrestrial planet)

Jupiter: hoola hoop to represent the ring, crown to represent the largest planet, index card labeled GAS for gas planet

Saturn: hoola hoop to represent the rings, index card labeled GAS for gas planet

Uranus: hoola hoop to represent the rings (placed between the legs represent the tilted planet; index card labeled GAS for gas planet

Neptune: hoola hoop to represent the rings, scarf to represent the cold and the distance from the Sun: index card labeled GAS for gas planet

Pluto: scarf and gloves to represent the cold and the distance from the Sun (the student should get down on his/her knees to represent the small size)

Follow-Up:

Have the students design travel brochures for each planet using a variety of planet books to describe major characteristics of the planet chosen.

Assessment

Objectives:

Students will use the inquiry skills of classifying, organizing and comparing to show specific similarities and differences among the planets by examining various features visible in photographs. Identify types of features found on planets by classifying the photographs into groups using a classification scheme of their choice.

Procedure:

Students may use Venn Diagrams, charts, graphs or narrative writing to compare the planetary characteristics and analyze their observations.

My Place in Space Test

How much do you know about your place in space?

1. The closest star to planet Earth is how far away?

a. 250 thousand miles
b. 93 million miles
c. 36 million miles
d. 3,660 million miles

2. On which of the following days of the year does planet Earth come closest to the Sun?

a. March 21st
b. June 21st
c. September 21st
d. December 21st

3. How many humans live on planet Earth?

a. 93 million
b. 600 million
c. 6 billion
d. 10 billion

4. What fraction of planet Earth is water?

a. Two-thirds
b. One-half
c. One-fourth
d. Three-fourths

5. What galaxy do you live in?

a. Andromeda Galaxy
b. Milky Way Galaxy
c. The Cartwheel Galaxy
d. The Antennae Galaxy

6. What is the name of planet Earth's nearest natural satellite?

a. Titan
b. Phobos
c. Moon
d. Ganymede

7. How far is it to your nearest natural satellite?

a. 245,000 miles
b. 93 million miles
c. 1,000 miles
d. 93,000 miles

8. The primary gas in planet Earth's atmosphere is

a. Oxygen
b. Carbon dioxide
c. Ozone
d. Nitrogen

9. Planet Earth's closest planetary neighbors are

a. Mercury and Venus
b. Venus and Jupiter
c. Mars and Neptune
d. Venus and Mars

10. The center of the Solar System in which you live is the

a. Sun
b. Asteroid Belt
c. Earth
d. Jupiter

My Place in Space Test: Answer Key

1. b 6. c

2. d 7. a

3. c 8. d

4. d 9. d

5. b 10. a

Write your Universal address:

Name _____

Street _____

City or Town _____

State/Zip Code _____

Country _____

Continent _____

Planet _____

Location from the Sun _____

Galaxy _____

Literature Connections

Books that explain the physical world through myths and legends are a perfect accompaniment to a unit on the Solar System. Children learn tales of the Earth and space from different cultures as well as get inspiration for their own imaginary stories. Information books both narrative and expository are excellent resources for children to do research and learn on their own. The following is a list of good children's books recommended for your classroom library.

Beasant, Pam. *1000 Fact About Space* , Kingfisher Books, New York. 1992

Berger, Barbara. *Grandfather Twilight* , Philomel Books/Putnam & Grosset, New York. 1984

Bess, Clayton. *The Truth about the Moon* , Houghton Mifflin Co., Boston. 1983

Blegvad, Erik. *Moon-Watch Summer* , Harcourt Brace Jovanovich, San Diego. 1972

Branley, Franklyn M. *Floating in Space* , Harper Collins, NewYork. 1998

Branley, Franklyn M. *Is There Life in Outer Space* , Harper Collins, New York. 1984

Branley, Franklyn M. *The Moon Seems to Change* , Harper Collins, New York. 1987

Branley, Franklyn M. *The Planets in Our Solar System* , Trumpet, New York. 1987

Branley, Franklyn M. *The Sun Our Nearest Star* , Harper Collins, New York. 1988

Brenner, Barbara. *Planetarium* , Bantam Books, New York. 1993

Cole, Joanna. *The Magic School Bus Lost in the Solar System* , Scholastic Inc., New York. 1990

Davis, Kenneth C. *Don't Know Much About Space* , Scholastic Inc., New York. 2002

Driscoll, Michael. *A Child's Introduction to the Night Sky* , Black Dog & Leventhal, New York. 2004

Gibbons, Gail. *The Moon Book* , Scholastic Inc., New York. 1997

Hamilton, Virginia. *In the Beginning: Creation Stories from Around the World* , Harcourt, Brace, Javonovich, San Diego. 1988

Hirst, Robin & Sally. *My Place in Space* , Orchard Books, New York. 1988.

Lauber, Patricia. *How We Learned the Earth is Round* , Harper Collins, New York. 1990

Leedy, Loreen. *Postcards from Pluto: A Tour of the Solar System* , Scholastic Inc., New York. 1993

McNulty, Faith. *How to Dig a Hole to the Other Side of the World* , Harper Collins, New York. 1990

Moche, Dinah L. *Amazing Space Facts* , Western Publishing, Racine, Wisconsin. 1992

Morgan, Jennifer. *Born with a Bang: The Universe Tells Our Cosmic Story* , Dawn Publications, Nevada City, Nevada. 2002

Moroney, Lynn. *Moontellers-Myths of the Moon from Around the World* , Northland Publishing, Flagstaff, AZ. 1995

Reid, Struan. *The Usborne Book of Space Facts* , Scholastic Inc., New York. 1987

Riley, Peter. *Straightforward Science: The Earth in Space* , Franklin Watts Publishing, Danbury, CT. 1999

Simon, Seymour. *Einstein Anderson Lights Up the Sky* , Viking Press, New York. 1982

Singer, Marilyn. *Nine O'Clock Lullaby* , Harper Collins, New York. 1991

Stott, Carole. *I Wonder Why Stars Twinkle and Other Questions About Space* , Kingfisher Books, New York. 1993

Sweeney, Joan. *Me and My Place In Space* , Scholastic Inc., New York. 1998

Thurber, James. *Many Moons* , Harcourt, Brace & World, New York. 1943

Vogt, Gregory. *Solar System Scholastic Science Reader Level 2* , Scholastic, New York. 2002

Teacher Resources

Carson, Mary Kay. *Space: Quick & Easy Internet Activities for the One-Computer Classroom* , Scholastic Inc., New York. 2001

Moore, J.E. & Evans J. *Sun, Moon and Stars* , Evan-Moor, Monterey, CA. 1986

Rogers, Kathy. *Stars & Planets: An Integrated Unit of Study* , ECS Learning Systems, San Antonio. 1993

Stone, Stacie. *Our Spectacular Solar System,* Copycat Press, Racine, Wisconsin. 1995

Suid, Annalisa. *Spectacular Space: Super Duper Science Reading, Writing and Speaking About Space* , Monday Morning Books, Palo Alto, CA. 1996

Weiner, Wendy. *Science: Hands-On Minds-On Science, Teacher Created Materials* , Inc., Huntington Beach, CA. 1994

Zike, Dinah. *Science Pocket: The Solar System* , Ideal School Supply Co., Oak lawn, IL. 1987

See Yale New Haven Institute for related units by Michelle Murzak, Marisa Ferrarese, Waltrina Kirkland-Mullins, and Roberta Mazzucco

Bibliography

Freedman, R. & Kaufmann, W. *Universe 6th Edition* , W.H. Freeman, New York. 2002

Internet Websites

These websites are good resources for teachers.

http://kids.msfc.nasa.gov/Teachers

www.abcteach.com

www.enchantedlearning.com

www.learningpage.com

www.exploratorium.com

These websites will give up to date information about the solar system.

http://seds.lpl.arizona.edu/nineplanets/nineplanets/nineplanets.html

http://neo.jpl.nasa.gov/neo/

http://cfa-www.harvard.edu/icq/ICQPluto.html

These are wonderful interactive websites for children.

http://starchild.gsfc.nasa.gov/docs/StarChild/StarChild.html

http://kids.msfc.nasa.gov