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Traveling the Solar System through Literature

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Introduction

Learning about the Solar System can be a very exciting thing for third grade students. However, some concepts and ideas are difficult for their young minds to understand. In preparing to organize this Unit of study, it was important for me to gain as much content knowledge as required to best facilitate the learning process to my students. I realize that there are going to be many challenges throughout this Unit, but they will be tackled accordingly as they arise.

I have decided to teach this Unit using literature. One of the ways I will do this is by introducing many theme related books to the students and having them work in groups or pairs to find information and report their findings to another group or the whole class. The students will each be responsible for reading the material, answering any questions that are associated with the material, and defining vocabulary within the literature. I will break down the Unit into sections and each one will have appropriate literature to help introduce, and support the topics being taught.

Unbelievably, the concept of the Solar System is difficult for third graders to understand for a variety of reasons. First, anytime a new word or idea is introduced, the students need time to process the information and break it down to a level that is easy for them to understand. Second, although learning new material can be fun, interesting and engaging, it can also be intimidating. Sometimes, large ideas, like the ones being introduced in this Unit, are too much for young minds to grasp. My students often ask "why" things happen in their lives. They want to know why events occur around them, why things are the way they are, and why order is an important part of life. These questions are relevant in all subjects, but there is one in particular that is more difficult for young minds to understand. Science and the Technology of Space is a topic that posses many questions of "why".

District Demographics

Appoquinimink School District is located in Middletown, Delaware. Reaching 8,000 students, Appoquinimink serves more than 135 neighborhood communities ranging in grades K-12. In 2004, Brick Mill Elementary School was added to the four other elementary schools in the district. Brick Mill students are in grades 1-5, in a building where the capacity is approximately 800. The student population is mixed, although predominantly white. I teach in a third grade classroom and have done so for the past four years. Average size for a class is anywhere between 22-27 students. Although we have a diverse population, my classroom is usually made up of more girls than boys. In the 2006-2007 school year, I had the Inclusion classroom. Inclusion models, while keeping the same ideals and beliefs, can look differently from school to school, and district to district. At Brick Mill, the Inclusion model is set up in a way that there are two full time teachers in the classroom, where one is a designated Regular Education teacher and one is a Special Education teacher. Being the Inclusion teacher for the 2007-2008 school year, I am very excited to teach this Unit to my students in the Fall.

Objectives

The students at the third grade level are being introduced to the concept of the Solar System. I have to remember that when these students were in second grade, they were not introduced to any of the ideas or concepts that are being taught now. This means that I have to be understanding, more so than ever, when students ask probing and clarification questions. The objectives that are going to be addressed during this Unit are many and cover a broad range of topics. A typical Curriculum Unit taught in the area of Science would take about three to four weeks. My plan for this Unit is to each it within those same confines. However, I realize that if my students need more time to grasp the concepts, I will extend the time length. My individual lessons will last anywhere from about 45 minutes to one hour per day. During that time block, each lesson will begin with a review of the past days objectives and end with a preview as to what will come the next day. I want my students to get excited about the information they are learning. In order to facilitate this, I will preview the next lesson either though visual stimulation or literature.

By the end of the Unit, I would like my students to be able to identify objects that are located in space and compare them with the objects that are within the Earth's atmosphere. This can include but not limited to the birds, planes, stars and the Moon as well as other planets in our Solar System. The students will be involved in investigating the enormous distances that separate the objects in space as well as observing that an object's size appears to change when its distance is altered. The closer an object is to a person's face, the larger it is going to look, whereas when an object is very far away from the face, it appears very small. It is important to note here, that this is true for an object that does not change in size or shape naturally itself. The Sun is a bright star in our Solar System that illuminates light 360 degrees around and it is Earth's principal light and heat source.

In order for the students to grasp the concept of time, they need to understand that the Earth rotates counter clockwise (as viewed from the Northern Hemisphere) and revolves around the Sun in the same direction. Rotation is what produces day and night every 24 hours, whereas the Earth's revolution around the Sun happens in a year's time. The Sun's position in the sky changes throughout the day. In order for the students to see this, they will create a sundial to track the positions of the shadows that are made because of the Sun's movement. Just as they will track the Sun's position, they will also observe the different phases of the Moon every night for approximately thirty days. Since the Moon has no light source of its own, the students will learn that the light comes from the reflection of the Sun on the Moon's surface. At the conclusion of the Unit, one option for student assessment will be for them to make a physical model duplicating the Moon, Sun and Earth's positions in relation to space. As an extension activity, the students will also identify the environmental differences between Earth and space, identify the needs for human exploration in space, and view equipment developed and manufactured by Delaware scientists and businesses for space exploration.

Rationale

The third grade science curriculum in the State of Delaware is basic with the key ideas being the Earth/Moon/Sun System and the Solar System. In particular, the students need to recognize the patterns of movement in the Earth's sky, along with making observations of what they see in the day and night sky. They also need to be aware that there is a distinction between stars and planets, as well as recognizing that objects close up appear to be larger than those that are far away. At this point in their educational studies, it is not important for the students to know discrete facts or information covering multiple topics in detail. Technology is introduced in the Science curriculum on a limited basis, with the students using binoculars and mini telescopes to see objects that are within the Earth's atmosphere, as well as basic objects that can be seen with more magnification.

There is no question that the topic of Space is a vast one, covering many ideas and concepts that can be built upon year after year. Science and space exploration is constantly being improved and updated so that people can get a better understanding of the areas, which are outside of Earth's realm. Just as space is huge, so is the number of concepts that need to be taught in order for students to gain even a basic understanding of the topic. Student's first need to know that Earth is a planet in which we live, and that it provides all the necessary resources for humans to survive. This concept in and of itself is difficult for students to grasp, only because the planet Earth is not easy to recognize as such. Therefore, for students to understand what a planet is, will take lots of modeling, time and explanation. Since the idea of the Solar System itself is too big of an idea for the students to understand, it is broken up into smaller pieces where the students learn about the Sun, Moon and Earth separately first, then make connections later.

The Delaware science curriculum for the third grade is provided by the FOSS Science Kits. These kits are fully inclusive with all the materials needed to teach each unit in its entirety, all in one box. There are three of these kits taught at this level: Human Body, Water, and Earth Materials. You will notice that the Solar System or the Earth/Moon/Sun System are not listed. The reasoning behind this is because up until now, funding and state standard shifts have been an issue in the development of the FOSS Kits. For now though, teachers need to get their own materials based on the goals and objectives of the state and local standards. The Unit, which I am currently developing, will not be in place of a science kit; however, it will serve as a stepping-stone towards creating one.

According to the Delaware State Science Coalition, there are two essential questions, which need to be addressed in order for the students to be able to build upon the grade four expectations. Those questions are: What predictable, observable patterns occur because of the interaction between the Earth, Moon and Sun?

and How has technology expanded our knowledge of the Earth, Moon and Sun system? Both of these questions will be answered and expanded upon in this Unit. However, the Unit will also cover other basics of astronomy that will help us give a better foundation for when the students advance on to the upper grades. Therefore, the purpose for this Unit will be for the students to learn about the relationships between the Earth, Moon and Sun.

Throughout the lessons in this Unit, there will be some materials used as constants to represent objects in the Solar System. A globe will be the Earth, a lamp with an exposed light bulb (light source) will be the Sun, and a softball will be the Moon. All three objects will be introduced separately at the beginning of the Unit so that while the lessons are being executed, the students will have the understanding necessary to make the appropriate connections.

Literature Connection

In the state of Delaware, along with the rest of the country, there is a great push for the integration of Language Arts in the Arts and Sciences areas. Due to this, it is extremely important for me to incorporate reading and writing lessons with all the lessons in this Curriculum Unit. At some point during each lesson, I will be incorporating the use of children's literature into the activities of my Unit. The books that I will use will directly relate to the subject area that I am teaching for that particular lesson. There are two main subjects that I will teach through the literature; they are the Moon and the Revolution/Rotation cycles. After whole group instruction on a topic area, individual students will be responsible for reading assigned literature and complete activities which will include vocabulary connections and comprehension questioning strategies. The students will also be responsible for creating a tangible model representing the factual knowledge that is presented in the literature they are reading. The students will be level grouped so that the literature assigned will be on their reading level. The three groups will each be assigned two to three books as well as a website to explore, in order to help them with their projects.

The reading books being used will be a combination of fiction and non-fiction. The reason for this is because it is not only important for the students to gain factual understanding of the information, but they need to see it in other formats as well. Reading fun filled stories that talk about this topic is exciting and of high interest to the students. Usually when the students are reading these types of books, they are more likely to remember the material being taught. The readings assigned will not only be completed during class, but will be brought home for further investigation.

It is important for me to incorporate literature into this Unit for various reasons. The first being that in the State of Delaware, the testing program that is used for state wide testing has a huge emphasis on the reading section. So much so, that if a student fails the reading portion of the test, he/she can possibly be retained the following year. Although given another chance in the Summer to take the test, in my experience if they have failed it in March, they will fail it again over the Summer. Knowing this, I want to make sure that language arts specifically reading will be fully inclusive in this Unit. The literature that I have chosen to teach this Unit is grade level specific, and it provides information that directly relates to the Unit topic of the Solar System. All of the books have been previewed and I have done extensive research on the Internet to gather other materials that may be useful with the literature to help teach the lessons.

I believe that it is also important to incorporate vocabulary development within lessons that is both explicitly and implicitly presented. I will teach the relationship of the words to build meaning within context. At the same time, I will teach the vocabulary to develop background knowledge for greater understanding of the contextual meaning within passages.

Strategies

In order for this Unit to be successful I believe that the best way to teach through literature is to use the model of Differentiated Instruction, more commonly known in my district as DI. This model requires teachers to learn about the students' academic needs and prepare lessons and activities that are individualized. In my school district, there is a big push for the use of DI in all classrooms at every grade level. Due to this, I want to make sure that this Unit follows the demand for multileveled teaching. I am lucky enough to have a teaching partner with me in the classroom full time. This means that the two of us can break the classroom up into small groups and deliver instruction in a way that is meaningful and on level. Because I am going to connect literature with the science in this Unit, DI will be a perfect fit for each individual lesson.

There are many individual strategies that I will use to teach this Unit, that when put together will allow it to be successful. Since DI will be the main teaching model used in the classroom, all of the lessons will center on the ideals and principles surrounding DI. These include but are not limited to; teaching with students personality in mind, structuring the classroom so students have multiple options for taking in information, making sense of ideas, and expressing what they learn, meeting kids where they are, as opposed to where we wish them to be, and utilize responsive teaching rather than one size fits all teaching. Using differentiation does not suggest that a teacher can be all things to all individuals all the time. It does, however, mandate that a teacher create a reasonable range of approaches to learning much of the time, so that most students find learning a fit much of the time.

I would like to implement cooperative learning in my teaching along with direct instruction. What I mean by this, is that after direct instruction, I will have the students engaged in cooperative learning activities, which support what was just learned in the lesson. This way, the students are building social interaction skills, learning how to get their ideas across, and discovering how to be tolerant of other people's opinions. Cooperative learning follows direct instruction most times because the teacher in front of the whole class would teach a lesson, and then eventually the students will break up into small groups and learn from each other. After teaching a lesson on the Moon, I would then ask the kids to use the Internet and get more information and pictures about what was just being discussed in the lesson. I would then have the students work in small groups specializing on the Moon phases, then becoming an expert on it so that they can teach the rest of the class all about their findings. This definitely is great to implement in a classroom because it promotes use of technology in the classroom, group work, and cooperative learning.

For any lesson in this Unit, my goal of teaching would be to define the relevant concepts fully, in a way that all students will understand. I will illustrate the abstract idea using specific examples taken from the material I am using to teach a lesson. If I am teaching about a specific topic in which I can use a book to directly relate the material, I will implement it in the lesson. During, as well as after the lesson, I will ask probing questions to the students to promote their active involvement in the classroom. These questions can just be thinking questions, for example, "What did you think about this particular situation? or" Why did you think that this situation happened?" This questioning also helps me to see which students have an understanding of the material, and which do not.

In order for me to be effective in teaching using DI, I must demonstrate effectiveness with the full range of student abilities in the classroom, use a variety of grouping strategies with differentiation to support student learning, and know and understand my students as individuals in terms of their abilities, achievement, learning styles, and needs. These combinations are crucial to a successful learning environment.

Beginning with a good curriculum, the planned lessons will demonstrate what a student should know, understand, and be able to do. Ongoing assessment is quintessential for determining the readiness, interest, and learning profiles of the students. I constantly monitor the student's interests, learning profiles, and readiness to adjust the design of the lesson to provide challenges for learning. All the students engage in respectful work that holds high expectations for all students; all students are to achieve at optimal levels through engaging activities. Learning should take place in a classroom environment that is welcoming, respectful of differences, safe, emphasizing academic growth, success-oriented, fair, and collaborative.

The Sun

With our commitments and busy schedules, it is not very often that people stop and think about how it is that life is being sustained on Earth. We eat, breathe, live and time goes on no matter what is happening around us. However, since the Sun has such a huge role in the development and support of life on Planet Earth, the Unit will begin by talking about the Sun and its role in the Solar System.

"The Sun is the closest star to Earth and is the center of our Solar System. A giant, spinning ball of very hot gas, the Sun is fueled by nuclear fusion reactions. The light from the Sun heats our world and makes life possible. The Sun is also an active star that displays sunspots, solar flares, erupting prominences, and coronal mass ejections." (http://www.windows.ucar.edu/tour/link=/Sun/Sun.html) Since the Sun is Earth's light source, it is important for students to recognize that the Sun gives us light and heat during the day. However since the Sun emits harmful radiation that is not blocked out in the space environment, humans who travel in space need special equipment and clothing to block this harmful radiation, maintain body temperature, provide oxygen to breathe, and provide contact to space vehicles.

The average distance from the Earth to the Sun is 93,000,000 miles. Since this number is too large for the students to understand, I will break it down into ways that are easier. If you think about driving to the Sun in a car traveling at about 60 miles an hour (96 km/hr), it would take about 176 years to get there! It takes light eight and a half minutes to travel from the Sun to the Earth. The diameter of the Sun is 870,000 miles, 109 times larger than the Earth's. Its volume is big enough to hold over 1 million Earths. The age of the Sun is about 4.5 billion years. A person that weighs 75 pounds on Earth would weigh about a ton on the Sun.

It is imperative to make the students aware that they should never look directly at the Sun with their eyes, even through darkened lenses, or binoculars. Doing so can cause permanent damage to their eyesight. The human eye is not made to look at an object that is as bright as the light emitted by the Sun. The light from the Sun is so bright that it can cause blindness in just a few seconds. If you have ever looked at a light bulb for a short period of time, you will know that when you look away there is a bright dot or areas that appear in your eyesight. The Sun is about a million times brighter than a light bulb and therefore looking at it will for sure injure your eyes. The damage that can be done if you look directly at the Sun is irreversible because the inside of your eyes can burn severely and there are chances that they can not be repaired. In order for scientists to study the Sun, they use special instruments that are made to keep the extreme brightness tolerable and safe to the eye.

Scientists are very interested in studying the Sun so that we can find out information that will keep us safe for a long period of time. As part of the research, we have found that the Sun emits harmful ultraviolet (UV) radiation. This radiation can cause permanent damage to your skin and eyes. Damaging your skin over time can cause scary things such as skin cancer. Whenever you are going to be out in the Sun for long period of time, you should always wear sunscreen of SPF 15 or higher. Even on days when you think that the Sun can not harm you, for example, when it is cloudy, sunscreen should still be worn due to the harmful UV light that still comes through the atmosphere. To help protect your eyes, sunglasses should also be worn. When looking for glasses that offer the best protection, purchase one that says 100% UV Protection. For those of us who do not protect our eyes, we are at risk for problems in the future such as cataracts and loss of sight.

The Sun is the center of our Solar System, with eight planets joining it. The inner planets are Mercury, Venus, Earth and Mars and are all made of rock. The outer planets are Jupiter, Saturn, Uranus, and Neptune which are all made of ice and gasses. An asteroid belt separates the inner and outer planets. Scientists think that most asteroids are the result of collisions between larger rocky space bodies. Asteroids are from a few feet to several hundred miles wide. We are not positive, but a good estimation would be that the belt contains about 40,000 asteroids.

Because the distance is so great between the planets, I needed to find a conversion that would help the students make sense of this. Note that the following are approximate distances from the Sun, but will give the students a general idea of how far away each of the planets are. If on a baseball field, with the Sun in the middle, Mercury would be 1 foot away, Venus 2 feet, Earth 3 feet, Mars 4 feet, Jupiter 15 feet, Saturn 24 feet, Uranus 51 feet, and Neptune 76 feet away. Since these numbers are manageable for the students to comprehend, they can represent each of the distances on the field as a miniaturized model of the Solar System.

The Moon

It is important for students to learn about the Moon because it is an object found in the night sky that is clearly visible. The Moon, Earth's only natural satellite, is an object that orbits around the Earth and is not man made. The distance between the Earth and the Moon is approximately 384,403kilometers or 238,857miles. The Moon has no atmosphere, so if we were to stand on its surface, there would be no apparent sky. A full view of space could be seen without any molecules refracting the light.

From Earth, we see the Moon most easily at night. Since it has no light source of its own, the only way that we can see the Moon is through reflected sunlight. Although the Moon is round, like planet Earth, we actually only can see the side that is illuminated. The light that we see from the Moon is the result of the angle of the Moon as it orbits the Earth, and it produces the lunar phases.

Moon Phases

The Moon's orbital motion causes the lunar phases. The Moon takes approximately four weeks to revolve around the Earth. While the four weeks are passing, our view of the Moon is a cyclical pattern, which repeats every four weeks. There are eight phases: New Moon, Waxing Crescent, First Quarter, Waxing Gibbous, Full Moon, Waning Gibbous, Last Quarter, and Waning Crescent. As the Moon revolves around the Earth, the phases are seen during different times of the month following the pattern listen above. During a full Moon, the Sun illuminates the entire face of the Moon that faces the Earth and it looks like a perfect circle in the sky. As the month progresses, the illuminated half of the Moon turns around, and a smaller amount of the illuminated side of the Moon faces the Earth. Consequently, less of the Moon can be seen on the surface of the Earth. Eventually we get to a new Moon where the Sun is no longer illuminating the portion of the surface of the Moon that faces the Earth, and therefore we do not see anything in the sky. During part of the month, the Moon is out in daylight, and it is difficult to see because of the brightness of the sky. However, near Full Moon, we are able to see the Moon near the horizon just before sunset.

One lunar day is the same as four weeks, or one month. There are two types of months: Sidereal and Synodic. A Sidereal Month is the time it takes the Moon to orbit around the Earth one time; this is approximately 27.32 days long. The Synodic Month is the time it takes the Moon to return to the same phase. This time is approximately 29.53 days long.

Two types of eclipses occur when the Sun, Moon, and Earth are aligned together in orbit. The Lunar Eclipse is when the Moon passes through the shadow of the Earth, and the Solar Eclipse is when the Earth passes through the shadow of the Moon.

The Moon does not have any atmosphere surrounding it. The surface of the Moon is in direct contact with the radiation from the Sun, and solar winds. Solar wind is a low density stream of charged particles that contains electrons and protons and travels outwards through space. When standing on the Moon's surface, when you look up at what would be the sky, there is no atmosphere blocking the view of space. Therefore, you are able to see clearly objects that would not be easily visible from Earth.

The Earth

Earth is the third planet from the Sun and is 93 million miles away. Earth is the only known planet that has water and can support life. A long time ago, people believed that Earth stood still while the Sun traveled around the Earth each day. They thought the "rising" and "setting" of the Sun caused day and night. Today we know that the Sun does not move around the Earth but the Earth moves around the Sun. The Earth rotates, or turns, on an axis, which is an imaginary line that runs through the center of the planet. The spin axis is not perpendicular to the orbital plane but it is slightly tilted. The North Pole is the north end of the axis and the South Pole is the south end of the axis. It takes approximately 24 hours for Earth to make one complete rotation; one rotation = 1 day. It is daylight where Earth faces the Sun and darkness where Earth is turned away from the Sun. When it is daytime on one side of the world, on the other side is nighttime. The rotation of the Earth produces a regular succession of night and day as it comes to face the Sun and then moves on into the region that is in darkness. As one side moves away from the Sun, the Sun seems to "sink" below the horizon; as the other side of the Earth moves toward the Sun, it seems to "rise" above the horizon. Viewing above the Northern Hemisphere, the Earth always turns towards the East (counterclockwise); therefore, the Sun appears to "rise" from the East and "set" in the West. As the Earth rotates on its tilted axis, it also revolves, or moves in a circular path, around the Sun. This path around the Sun is called an orbit. It takes 365 1/4 days for the Earth to complete one revolution around the Sun; one revolution = 1 year.

Earth has an atmosphere surrounding the planet. This atmosphere is made up of gasses that are held in place by the gravity of the Earth. The atmosphere protects life on Earth by absorbing most ultraviolet solar radiation as well as reducing the differences in temperature between day and night. The higher you go in the atmosphere, the thinner the layers become until eventually the layers dissipate and you are in the realms of space. There are six named layers of the atmosphere; troposphere, stratosphere, mesosphere, thermosphere, ionosphere, and exosphere. Each layer has its own unique properties.

Since Earth has an atmosphere, when we look outwards from the surface, we see the sky, which is a combination of molecules that scatter light. The sky has a blue tint to it because the molecules scatters more blue light that red light, therefore giving a bluish tint to the sky.

The atmosphere that surrounds the planet helps to protect life from the Sun and Space. "The atmosphere absorbs the energy from the Sun, recycles water and other chemicals, and works with the electrical and magnetic forces to provide a moderate climate. The atmosphere also protects us from high-energy radiation and the frigid vacuum of space." (http://liftoff.msfc.nasa.gov/academy/space/atmosphere.html) Without this great protection, life on planet Earth would not be able to exist as we know it today.

Although the students at this level are not introduced to the problems that we are having with Global Warming and the Greenhouse effect, it is important for them to understand that we need to preserve the existing atmosphere the best way we can for the future. One way that the students understand this concept is the ideas of recycling and preventing harmful chemicals or gasses from entering the atmosphere.

Have you ever wondered how astronauts in space need to be tethered to the Space Shuttle so they do not float away, but here on Earth's surface we do not need to do that? The force that keeps us planted firmly on the ground is called gravity. Gravity is a force of attraction. We can find it in all pieces of matter in the universe. There are many things that produce gravity, including galaxies, the Sun and the planets. Gravity is called a universal force due to the fact that it affects all matter. Try throwing something up in the air as high as you can, watching it come down would be gravity in full effect!

Seasons

In many parts of the world, the year is made up of four seasons: Winter, Spring, Summer and Fall. We have seasons because the tilt of the Earth's axis causes different parts of the Earth to be struck more directly by the Sun's rays at different times of the year. There is a common misconception that seasons are caused by how close the Earth is to the Sun during different times of the year. The belief is that the closer we are to the Sun, the warmer the temperature would be on Earth. This is not only false, but actually, the reverse is true. During the Winter months in the Northern hemisphere, the Earth is the closest to the Sun, and during the Summer months, the Earth is actually further away. As Earth revolves around the Sun, its axis is always tilted in the same direction, but as Earth travels around the Sun, the part of the Earth tilted towards the Sun changes.

Students know that the weather changes depending upon the time of year, but they lack the understanding of how and why that happens. This Unit will allow them to explore Earth revolving and rotating around the Sun to produce the seasons that they are familiar with.

For part of the year, the north end of the axis slants toward the Sun. During another part of the year, the North Pole slants away from the Sun. When the North Pole is tilted towards the Sun, the Sun's rays strike that part of the Earth more directly. This is when Summer occurs in the Northern hemisphere. The Sun crosses high in the sky during the day and it stays up for a long time. This gives us longer days and shorter nights. When the North Pole is tilted away from the Sun, the Sun's rays strike that part of the Earth less directly. This is when Winter occurs. The Sun remains low in the sky and gives us less warmth.

The solstices are days when the Sun reaches its farthest northern or southern heights in the sky. The Winter solstice occurs on December 21 st or 22 nd and marks the beginning of Winter (this is the shortest day of the year). The Summer solstice occurs on June 21 st and marks the beginning of Summer (this is the longest day of the year). Equinoxes are days in which day and night are of equal duration. The two yearly equinoxes occur when the Sun crosses the celestial equator. The vernal equinox occurs in late March (this is the beginning of Spring in the Northern Hemisphere and the beginning of Fall in the Southern Hemisphere); the autumnal equinox occurs in late September (this is the beginning of Fall in the Northern Hemisphere and the beginning of Spring in the Southern Hemisphere). (http://www.enchantedlearning.com/subjects/astronomy/planets/Earth/Seasons.shtml) During the Winter solstice, the Sun does not rise north of the Artic Circle, sits directly above the tropic of Capricorn and does not set south of the Antarctic Circle. During the Summer solstice, the Sun does not set north of the Artic Circle, sits directly above the Tropic of Cancer, and does not rise south of the Antarctic Circle.

From the surface of the Earth, it appears that the Sun rises and sets. Everyday the Sun rises in the East and sets in the West; however, during certain times of the year, the Sun may follow a slightly different pattern. In the Northern Hemisphere when it is Winter, the Sun rises in the Southeast and sets in the Southwest. In the Spring and Fall the Sun rises in the direct East and sets in the direct West. In the Summer, the Sun rises in the Northeast and sets in the Northwest.

What is most interesting about this topic is that the students associate schooling and activities around the seasons. For example, they know that school begins in the Fall and ends in the Summer, with the Summer being a vacation time. They also know that we have a Winter break and Spring break during the school year. I believe that the students use these terms frequently because it is what is comfortable for them. However, it is unclear whether they grasp the understanding of why and how the seasons occur.

Time

Time is something that is very difficult for third graders to understand. Since their attention span is shorter than that of adults, it is important to teach any information in short installments with time for discussion and clarification. To begin, students need to know that there are 60 seconds in one minute, 60 minutes in one hour, 24 hours in one day, 365.25 day's in one year and then every 4 years, we have what is called a Leap

Year, which adds one extra day to the calendar in February to make up for the ¼ day left over every year. Since a Leap Year happens only once every four years, the students often ask what happens when someone is born on the day that is left out all the other years, February 29 th . It is interesting to hear their ideas as to how that person would celebrate their birthday and on what day that would happen. Some wonder if because the birthday only comes once every four years, does this mean that one ages one year, every year, or just every four years? It is fun having the students brainstorm together and discuss their thoughts on the day that Falls every four years.

Measuring time is important for the students to understand. One lunar month is approximately 29.5 days. Within this month is a series of weeks, which are made up of seven days. In early times, the Babylonians and Hebrews said that the number seven came from the amount of days it took for the creation of the universe. This is just a speculation however, since there is no trace back to how the week came to be the seven days we know of it today. The day is broken up into two categories; one sidereal day is 23 hours and 56 minutes, whereas the solar day is 24 hours. A sidereal day is the time it takes the Earth to make one complete rotation with respect to the background stars, whereas the Solar day is how long the Earth takes to make a rotation with respect to the Sun.

There is a world standard for measuring time called the Universal Time (UT), or Greenwich Mean Time (GMT). Earth is divided into 24 time zones starting and ending at the Prime Meridian. If it were noon at the Prime Meridian, then anything West would be one hour earlier for every time zone and anything East would be one hour later.

The face of a clock is divided into twelve sections where each number represents five-minute intervals. In order for the students to understand concepts such as months and years, they first need to be able to tell how long a minute is as well as an hour. Keeping time is found in many forms and methods. It is important for students to be able to keep track of time in these ways. From looking at a Sundial, to seeing sand in an hourglass, from looking at a digital alarm clock to reading analog, students need to be aware of the resources around them. When thinking about this concept, it is very easy for students to be hung up on the fact that time is always moving, never stopping or delaying for any length of time. Even though, when given a time out from the classroom, they may think that time has stopped for that short period for them to wait out their punishment and then move on to a fun activity. I find it is cumbersome when many students ask what time it is during the day, or how long it is until something is going to happen. By the students learning time, they can take more responsibility for their actions.

Exploring Space

Many of the things that we have discovered about the Solar System were discovered as a result of improved technology. From telescopes to space probes and rockets, humans have developed many ways in which we can see what is happening within and outside of the Earth's atmosphere.

Space probes are used to land on or fly past other planets, and send pictures back to us on Earth. They are large machines that take a long time to build and cost a lot of money to produce. Space probes give us information about the surfaces of other planets, even the ones that are too dangerous for people to explore.

The Space Shuttle is more commonly known by students as a means of exploring space. While some other space crafts may only be used once to get information to us, the Shuttle can be used a few times. The Shuttle can bring people up into space to explore objects, launch satellites, and make repairs to the Space Station.

Astronomers use telescopes in order to find out information about space. Two types are optical and radio, where optical telescopes collect light from objects and radio telescopes collect radio waves that are sent out from objects in space. Pictures can be made from either type of telescopes. In 1990, the Hubble Telescope was launched into orbit. Even over 15 years later, this telescope is still in space producing pictures of the universe that are very clear and impressive. While telescopes do give us information, Earth bound telescopes are often hampered by factors that decrease or sp their usefulness, These factors include, but are not limited to: pollution, city lights and clouds in the sky. There are three sites around the globe that are the best places for telescopes to be placed due to these hindering conditions; the Canary Islands, Hawaii, and multiple parts of Chile. When viewing through a telescope in other locations, there is a chance that what is being seen is limited due to less than optimal conditions of the atmosphere. Everywhere on Earth there is a narrow window of transparency that lets stellar radiation through, but in addition there is turbulence in the atmosphere that prevent us from getting a clear view into space. This turbulence varies in degree from place to place, but to some degree it is always present. In order to get around this problem, we send telescopes past the Earth's atmosphere into space. These will produce clearer pictures and look further into space than what we can accomplish on the ground.

Classroom Activities

Investigation One

Lesson Description

In this activity, the students will discover that the rotation of the Earth produces day and night every 24 hours. They will also understand that the Sun is a bright star that illuminates light 360 degrees around.

Procedure

At this point, the students have already been observing the night sky. I will ask the students to share some objects that they have found in the night sky. When asking this question, the students always state that the Moon and stars are the two main objects in the night sky. Knowing this I will continue on to ask them if they are aware of what a star really is. I will record all responses on chart paper and read the story *Our Very Own Star, the Sun*. At the conclusion of the story, I will talk about how the Sun lights the day sky but then when we go to bed at night, what might happen to it.

I will then read a book titled *Watching the Night Sky*. This book closely relates to the above objective and will answer any questions or clarify any confusion that the students may have.

I will then show the students a globe with a sticker placed over the state of Delaware. The sticker will represent the people who live in Delaware. One student will hold the globe in front of the light source, facing the class with the sticker of DE facing the light source (Sun). I will point to the sticker and ask the students if it is day or night in Delaware. I will then have the student holding the globe turn it counter clockwise and ask the class what is moving and what is the Sun doing while the Earth is moving. I will ask the students what is happening to DE as the globe is turning and have them clarify at what points are day and night time. I will then explain to the students that it takes approx. 24 hours for the Earth to spin around one time. This corresponds with the 24 hours that we have in a day.

I will then read another story titled *Day and Night.* Class discussion will follow.

Summary

The students will be responsible for answering the following questions in their science journal:

How does the Earth move?

What does it spin around?

What is another name for spinning?

How long does the Earth take to spin one full time on its axis?

If it is nighttime in DE, where would it be daytime?

Assessment

The students will be given a handout after they are finished responding to the above questions. The hand out will be titled Day and Night. The question that the students will answer is the following: What causes day and night? In order for the students to receive full credit for their response, they need to write the following: Day and Night is caused when the Earth rotates. The Sun, which is located in the center of the Solar System, can only shine on one side of the Earth because it is shaped like a sphere. Light cannot reach all sides of a sphere at the same time. For the side of the Earth that is facing the Sun, it is daytime and the side not facing the Sun is nighttime.

Investigation Two

Lesson Description

In this activity, the students will understand that the size and shape of a shadow are a result of the Sun's position in the sky, because of the Earth's rotation, the Sun's position in the sky changes throughout the day and that the Earth is constantly moving and turning.

Procedure

We know that the Earth rotates around on its axis in a counter clockwise direction as seen from the northern hemisphere. This rotation of the Earth just makes it look like the Sun is moving across the sky. We can learn a lot about this by watching the shadows the Sun makes on Earth. I will ask the students if they have ever made a shadow and how the size and shape of the shadow changes.

With the light source back in the center of the room, one student will hold his/her hand in front if it casting a shadow of the hand on the board. Together we will discuss the shadows size, shape and position. I will then direct the student to alter the position of his/her hand but not change the shadow size and position. I will make sure that the students are aware that the light source is stationary.

For this experiment, the students will be studying how the shape and size of a shadow created by the Sun is a result of the Earth's rotation.

The students are going to be developing a Sun tracker that will be observed at multiple times throughout one school day. Students will draw a horizontal and vertical line across the middle of a large piece of white paper. They will write the cardinal directions on the paper. The students will then take modeling clay and stand a pencil straight up at the center of the paper where the two lines cross. The next morning at school, the students will go outside and find a flat space in an open area to place the tracker. Partners will use a compass to lay the tracker down according to the cardinal directions. At ten o'clock in the morning, the students will use a ruler and one colored crayon to draw a line directly on the shadow from the bottom of the pencil to the end of the shadow. They will use the ruler to measure this line in centimeters. They will record this on a recording sheet provided earlier in the lesson. The students will then repeat this procedure for the next four hours going outside at eleven, twelve, one and two o'clock. On their recording sheet, the students will have a list of questions that they need to answer after their observations are completed for the day: What made the shadow?, Did the shadow size change during the day?, Why do you think the shadow changed?

The next school day the students will review all the collected data and as a class will record the median length for shadow size in each of the time slots from the previous day. After all information has been displayed, I will ask the class to share observations that they may have about the numbers. Students will be noticing that the size of the shadows vary according to the time of the day. I will then ask them why they think that the shadow lengths changed throughout the day. The students should respond that since the Earth has rotated, this movement makes it look as if the Sun is moving across the sky. However, in reality the Earth's rotation makes the Sun's position change throughout the day.

Using the light source representing the Sun and the globe with the DE dot on it, I will demonstrate the Earth's rotation. After pointing to DE, the students will see that by turning the globe, the Sun appears to be in a different position in the sky throughout the course of the rotation.

Assessment

The students will complete a response sheet titled Daytime Shadows. This sheet addresses the following problem:

Taylor's class is learning about patterns of movement in the sky. By conducting an experiment using a Sun tracker, Taylor was able to prove that the Sun does not really move across the sky, it just appears to move.

The students will need to explain why Taylor's statement is true by answering what was really moving and how Taylor was able to prove her theory.

Investigation Three

Lesson Description

This lesson is designed for the students to understand that the Moon's phases change gradually and repeat themselves in a pattern, as well as the reflection of the Sun on the Moon's surface affects the appearance of the Moon and produces lunar phases.

Procedure

In earlier lessons, the students will have kept a Moon log tracking the phases of the Moon each night for about 30 nights. As a class, we have been keeping track of the daily log and have a chart displayed in the front of the room. I will draw the student's attention to this log and have them discuss their observations of how the Moon changed its appearance throughout the log. The students will share ideas of the patterns they see and possible explanations for why the Moon appears to change shape. In this experiment, the students will be completing an investigation to see why the Moon appears the way that it does in the night sky.

I will show the class a softball and have each student sit around the softball so that each student will see something different. I will turn on the overhead projector and position the ball so that we can only see one side of it, the side lit by the projector. The students will have a sheet in front of them in which they will draw a circle and shade in the part of the circle that they cannot see with their pencil and leave the lit part of the ball white on the paper. They are going to draw this in the same manner that they have been doing nightly for their Moon observations. Since the students are observing from all angles of the overhead, I will have three students approach the board to draw their observations for the class to see. Students from the far left, center, and far right of the room will come to the board. More than likely, their observations will be very different therefore posing the questions of how come their drawings are so very different yet we were all looking at the same ball.

Students will know that the ball represents the Moon in this investigation, with the overhead projector posing as the Sun. The Moon does not produce its own light, therefore reflecting light from the Sun. This can also be demonstrated by a flashlight and a mirror or bike reflector. The flashlight is the Sun and the mirror/reflector is the Moon. Just as the surface of the mirror/reflector reflects the light, the Moon's surface does the same. So, the light we see from the Moon at night is actually the Sun's light being reflected.

The students will gather in front of the overhead projector and I will explain the Moon's orbit around the Earth. Just like the Earth moves around the Sun, the Moon travels around the Earth. The ball represents the Moon and the projector is the Sun. But, we are missing the Earth in this model. Therefore, the students will hold the globe between the Sun and the Moon and position the softball directly in front of the light so the students see the fully lit side of the Moon. Moving the ball halfway around the Earth, the students are only seeing one side of the ball. After asking for observations that students should be able to share that as the ball is moving they are seeing less of the lit side of the ball. Stopping the ball where the students are not seeing any lit side, I will ask them what they see at this point. After replying that darkness is seen, I will begin to move the ball around the globe to its original position. The students should begin to share that the lit side of the Moon is increasing.

As the Moon moves around the Earth, we only see one side of it. Whenever we look at the Moon at night, we are always seeing the same side of the Moon. However, this is not the same side that faces the Sun, and is li up. Because of this, the Moon's shape changes. changes. These changing views of the Moon are called "phases". There are four main phases: new, first quarter, full, and second quarter. We have been viewing these phases throughout the month. The Moon goes through all of its phases in a month. Therefore, it takes the Moon only one month's time to travel around the Earth. Throughout the month however, these phases gradually change because as the Moon moves around the Earth we see different amounts of the Moon lit by sunlight.

The class will then break up into groups to explore the Moon's changing phases. Each pair of students will need a ball and a flashlight. One student will represent the Earth, the ball is the Moon, and the flashlight is the Sun. With a partner, one person holds the ball in front of their face as the other student stands behind shining the flashlight. The ball needs to be positioned so that you see the side facing you entirely lit by the flashlight.

Then, the student will turn their body counter clockwise so that they are facing the light. Holding the ball in front, the lit side of the ball should now be facing away. Partners will then switch phases so that everyone has a chance to experience the changing phases of the Moon.

The next day I will read aloud *The Moon Book.* After reading, we will review the lesson described above. The students will discuss their findings as to what was happening when they moved the ball around their heads. After viewing the Moon log for clarification, the students will notice that the Moon's phases repeat themselves in a pattern. Students will realize that we can predict what phases are going to come at what times of the month. Since the pattern is cyclical, we know what phase will come each night depending on the phase the night before.

Assessment

Teacher made assessment will be distributed.

Appendix

Vocabulary Chart

Reference

- Asteroid
- Comets
- Galaxy
- Meteoroid
- Milky Way
- Planet
- Planets
- Rays
- Satellite
- Solar System
- Tilt
- Star
- Universe

Connection

- Calendar
- Cycle
- Distance
- Equator
- Hemisphere
- North Pole
- South Pole
- Temperature

Essential Fact

- Atmosphere
- Axis
- Crescent
- Full Moon
- Gibbous
- Moon
- Movement
- New Moon
- Orbit
- Oxygen
- Phases
- Revolve
- Rotate
- Shadow
- Reflect
- Space
- Spin
- Sun
- Vast
- Waxing
- Waning

Bibliography

Student Readings

Adami, Cristina, and Neil Francis. *Space.* (2001) New York: Scholastic. Internet Linked book that recommends websites to explore based on the ideas and topics in the book.

Adler, David. (1983) *All about the Moon*. New Jersey: Troll Associates. A Question and Answer book about the Moon.

Amery, Heather. (1994) *Day and night*. Educational Development Corporation.

Atkinson, Stuart. (2001) *Extraordinary Solar System*. New York: First Scholastic Printing. Take a trip around the Solar System with this fact-filled book.

Becklake, Sue. (1998) *All about space*. London: Scholastic. Scholastic First Encyclopedia about the Universe, the Solar System and Space Travel.

Bendick, Jeanne. (1999) *Our very own star: the sun*. BT Bound. A simple introduction to the sun, its characteristics, and its importance.

Branley, Franklin. (1981) *The planets in our Solar System*. New York: Harper Collins.

Read and find out about the planets in out Solar System.

Branley, Franklyn M. (1991) *The big dipper*. New York: Harper Collins. Easy to read book about the Big Dipper.

Branley, Franklyn M. (1981) *The sky is full of stars*. New York: Harper Collins. If you are a stargazer, you would love this book.

Branley, Franklyn. (1987) *The Moon seems to change*. New York: Harper Collins. Read and find out about the phases of the Moon.

Bredeson, Carmen. (2003) *The Moon*. New York: Scholastic. Basic Information about the Moon.

Bredeson, Carmen. (2003) *The Solar System*. New York: Children's Publishing. Rookie Read-About Science Book.

Cole, Joanna, and Bruce Degen. (1990) *The magic school bus lost in the Solar System*. New York: Scholastic. Join Ms. Frizzle and her class on a field trip adventure you will never forget.

Cole, Joanna. (1999) *The magic school bus sees stars*. New York: Scholastic. Join Ms. Frizzle and her students on an adventure that you will never forget.

Gibbons, Gail. (1997) *The Moon book*. New York: Scholastic. Learn about the milestones, legends, stories and facts about the Moon.

Graham, Ian. (1993) *Looking at space*. New York: Scholastic. Provides an original and dramatic introduction into the discovery of the universe.

Hayden, Kate. (2000) *Astronaut living in space*. London: Dorling Kindersley. Stunning photographs and lively illustrations about living in Space.

Henbest, Nigel. (1997) *Planets*. New York: Ladybird Books. Kids can take a trip across the galaxy with this colorful and easy to read book.

Henbest, Nigel. (1979) *The night sky*. Great Britain: Usborne. Handbook for the night sky.

Hirschmann, Kris. (2004) *The Solar System.* New York: CB. Fact filled book with colorful photographs.

Jackson, Kim. (1985) *Planets.* New Jersey: Troll Associates. Extremely basic descriptions of the nine planets.

Jefferis, David. (2001) *Future space beyond earth*. New York: Tangerine P. This book is a journey into the future where human and robots live beyond Earth.

Kalman, Bobbie, and Niki Walker. (1997) *Space*. New York: Crabtree Company. Overview of the planets and other objects in our Solar System.

McNulty, Faith. *If you decide to go to the Moon.* New York: Scholastic. Join the astronauts on a journey to the Moon and learn about the objects in space.

Moche, Dinah. (1982) *My first book about space*. Wisconsin: Western Company. A question and answer book about space.

Nelesn, Jeffrey. (1988) *Space*. Checkerboard P. Jokes and Riddles about Space.

Ray, Deborah K. (1991) *Stargazing sky*. New York: Crown. Story about a young child who discovers the fascinating objects in the night sky.

Richardson, James. (1992) *Science dictionary of space*. Troll Associates. Dictionary of common Space terms.

Rutland, Jonathan, and David Nash. *The planets*. New York: Random House. Basic overview of the Solar System.

Simon, Seymour. (2002) *Destination space*. New York: Scholastic. Beautiful real life pictures take you on a journey through space.

Simon, Seymour. (1992) *Our Solar System*. New York: Scholastic. Full color photographs and easy to read text about the Solar System.

Simon, Seymour. (2003) *The Moon*. New York: Scholastic. Follow Apollo 11's first landing on the Moon.

Stott, Carole. (1991) *Observing the sky*. Troll Associates. Detailed information about the night sky.

Turnbull, Stephanie. (2003) *Sun, Moon and stars*. New York: Usborne. Easy to read text about the Sun, Moon, and stars.

Wandelmaier, Roy. (1985) *Now I know stars*. New Jersey: Troll Associates. Describes basic characteristics of stars.

Winthrop, Elizabeth. *My first book of the planets*. Wisconsin: Western Company. This book gives an elementary overview of the nine planets.

Teacher Readings

Becan, Jeff. (2004) *Astronomy for beginners*. Connecticut: Writers and Readers. Friendly and accessible guide to the universe.

Forey, Pamela, and Cecilia Fitzsimons. (1988) *An instant guide to stars and planets*. New York: Atlantis Publications. Reference Book for information about the Stars and Planets.

Freedman, Roger A., and William J. Kaufmann III. (2004) *Universe*. W H Freeman & Co. This is a premier text for the fields of astronomy and cosmology.

Web Sources

(2007, July 4th). Differentiated Instruction. Retrieved July 9, 2007, from Wikipedia Web site: http://en.wikipedia.org/wiki/Differentiated_learning . Free online dictionary of terms.

(2007). Earth's Seasons. Retrieved July 9, 2007, from Enchanted Learning Web site: http://www.enchantedlearning.com/subjects/astronomy/planets/Earth/Seasons.shtml. The Seasons and Axis Tilt Information.

(1995, December 1 st). Exploration. Retrieved July 9, 2007, from The Atmosphere Web site: http://liftoff.msfc.nasa.gov/academy/space/atmosphere.html.

Gardiner, Lisa (2007, February 28th). Earth. Retrieved July 9, 2007, from Windows to the Universe Web site: http://www.windows.ucar.edu/tour/link=/Earthe/Earth/.html Learn about our Planet Earth in detail.

(2007). Moon. Retrieved July 9, 2007, from Kidsastronomy Web site: http://www.kidsastronomy.com/Earth/Moons.htm. Learn about the planets, Moons, asteroids and comets in our Solar System.

(2007, July 4 th). Moon. Retrieved July 9, 2007, from Wikipedia Web site: http://en.wikipedia.org/wiki/Moon. Free online dictionary of terms.

Russell, Randy (2006, November 6th). The Sun. Retrieved July 9, 2007, from Sun Web site: ://www.windows.ucar.edu/tour/link=/Sun/Sun.html This website explores all the features of the Sun and its properties.

(2007). Solar System. Retrieved July 9, 2007, from Kidsastronomy Web site: http://www.kidsastronomy.com/solar_system.htm. Learn about the Sun, Planets, Moons, Asteroids and Comets.

(2007). The Official U.S. Time. Retrieved July 9, 2007, from http://www.time.gov/about.html. This website is designed to give information about time zones, daylight savings time, and other general facts about time.

(2007). The Seasons. Retrieved July 9, 2007, from http://csep10.phys.utk.edu/astr161/lect/time/seasons.html. Detailed information about the seasons and clarifying the basic misconceptions.

(2006, June 8 th). Visible Earth. Retrieved July 9, 2007, from NASA Web site: http://visibleEarth.nasa.gov/. A catalog of NASA images and animations of our home planet.