Exploring the Planets: What if? How Come? And Why?

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Space, the final frontier. These are the voyages of the Starship Enterprise. Its five-year mission: to explore strange new worlds, to seek out new life and new civilizations, to boldly go where no man has gone before.

- Captain James T. Kirk, start of every episode of the original TV series 'Star Trek'.

Synopsis

What if the Solar System had formed differently? How come Earth is the only planet with liquid water? Why do we see the rings of Saturn but not the rings of the other Jovian planets? These questions are just the beginning in our study of the Solar System during this science unit. This unit is appropriate for middle school students studying the Solar System and the planets specifically. Students will create a culminating project that will be the driving force of instruction throughout the unit. Students will research, design and build a simulated Space Probe or Lander created for travel to a student chosen planet. The Space Probe will require parts to perform planet-specific tasks and achieve mission goals. Unit study will focus on a comparison of the planets to recognize their differences so that student probes will be factually accurate in their design. Hands-on, inquiry based learning stations will allow students to experience the characteristics of each planet. Students will investigate Mercury's craters, the greenhouse effect on Venus, and the composition of the rings of the Outer Planets. Students will recognize the vastness of our Solar System through creation of a simulated Solar System using a variety of objects.

Overview

I often feel that I am Captain Kirk and my sixth grade science classroom is the Enterprise. We dare to brave strange new worlds as we navigate the intricacies of middle school together. Regular science instruction is often a new life and civilization for my students as some elementary schools must focus so completely on literacy and math that science instruction takes a backseat. I ask my students to boldly go with me as we journey the Science content and learn together through an inquiry based classroom. Together we discover, question, and attempt to explain.

Space study is the perfect content with which to encourage wonder and discovery. The Universe is so vast and so complex that encouraging my students to contemplate What if? How come? And Why? is a natural process. During this unit students will investigate Earth and discover its uniqueness as it relates to the other planets. Students will explore the Solar System and describe its make up in relation to Earth. Students will research past space missions and relate these missions to current and potential space discovery. My students will experience what it is like to think like an astronomer. I want them to wonder… what if there is life on other planets? What if we could build a space probe to investigate the surface of Venus? How come Earth has such unique characteristics? How come the outer planets are gaseous and not rocky? Why is Uranus tilted on its side? Why do the outer planets have rings? Why is Earth so different from the other planets? These are questions that my students often ask and ones that I would like to address during this unit. Students will explore the concept of the Solar System through hands-on activities, investigative research, graphic organizers, multi-media presentations and more. During our planet study students will research and compare the planets through on-line sources as well as text reference. Students will conduct a series of investigations which will allow them to explore the properties of our planets first hand. We will contemplate and explore the what if, how come and why together. Come along for the journey!

Objectives

Sixth Grade Competency Goal #5 states: The student will gain understanding of the Solar System. This unit will address three of the six competency goals.

1. Compare and contrast Earth to other planets in terms of:
Size, composition, relative distance from the Sun, ability to support life

2. Describe the setting of the Solar System in the universe including:
Galaxy, size, the uniqueness of Earth

> Hands-on activities and real-life situations will be used to facilitate the investigation of the Planets. Students will view multi-media presentations and conduct independent online and reference based research. Students will use this research to create a comparison chart of the planets. Students will complete a research outline focusing on the Space Probe designed to travel to their chosen planet.
> Students will create a model Solar System using a variety of materials to simulate the placement of and distance between the planets. I also have an inflatable Solar System that I use for classroom demonstrations and role play.
> Students will create a planet specific Space Probe and design a set of mission goals for the probe to accomplish.

3. Describe space explorations and the understandings gained from them including:
N.A.S.A., Technologies used to explore space, Historic timeline
Space Shuttle, International Space Station, Future goals.

> Students will investigate the various space vehicles used to explore our Solar System. Multi-media will be used to display the space missions of travel to the planets. Students will investigate past and current space missions during planet research and use this information to design their own space probe. Students will recognize the benefits of space travel and the change in capabilities over time.

Rationale:

I plan for this unit to take approximately 4 weeks. This time frame will allow for independent research in our school computer lab as students prepare for their culmination project. Students will also present their projects during class. My sixth grade science class is scheduled on a rotating A day B day schedule. I teach the same lesson to six different classes over the course of two days. My classes are a heterogeneous group of students of varying abilities and science backgrounds. I create differentiated activities within the content objective to meet the diverse educational needs of my students.

My science curriculum is based on the North Carolina Standard Course of Study and is paced according to the CMS yearly pacing guides. Activities are chosen that will create an inquiry based science experience for my students. Most lessons are interactive and are divided into teacher input, guided practice or additional investigation, independent practice or group inquiry activity, explanation of results or investigation, and finally additional questions or ideas to explore. I incorporate the use of the SmartBoard, video clips from Discovery Education, YouTube, PBS, and National Geographic on a daily basis. Students use the computer lab often throughout the year for additional research or web activities. My students travel outside to investigate our environment as it relates to our curriculum. Geographically my school is located in an affluent suburban setting of Charlotte, NC in the Charlotte-Mecklenburg School District. 35% of our students qualify for free and/or reduced lunch. We are a racially diverse school of approximately 21% African American, 56% White, 14% Hispanic, 4% Asian, and 3% other students. 81% of our 8th grade students scored at or above grade level on the Science EOG and Carmel DID make Adequate Yearly Progress in 2009-2010 (the most recent year statistics are available). Our school is fortunate to have an active PTSA and exceptional parental support. My students come to me with varying levels of science education. Some have limited English skills and others have learning disabilities which require classroom modifications. I encourage my students to question and wonder and strive to create independent thinkers in my students.

This unit is only a portion of our overall study of Space and the Solar System. Previous study will incorporate the Moon, it's phases and formation, solar and lunar eclipses, Earth's tilt and its effect on our seasons, and the Moon's influence on our ocean tides. Generally students haven't studied the Solar System since third grade and it is interesting to recognize their increased ability to understand more complex theories and hypotheses. I enjoy listening to my students as they begin to study the planets from a point of comparison, and not simply stating facts. They have usually learned the planets but have limited understanding of how the planets are different. As we study the unique characteristics of each planet and discuss how our planet is such a rare planetary body students become aware of just how minute we are in the overall universe. I want my students to travel to a higher level of critical thinking and begin to question why Earth is so different from the other planets. Why did the Solar System form the way it did and what if it had formed differently? I do not see science education as statement of facts or regurgitation of textbook information but instead want to focus on independent thought and discovery. I encourage my students to use the scientific process to create independent investigations and practice inquiry when studying new concepts.

Strategies:

Instruction for this unit will center on a culmination project. Students will create a Space Probe and accompanying Space Mission Manual. This project was used at my school several years ago and I redesigned and fine-tuned the project for this unit. The Space Probe will be designed to travel to a specific planet and will be required to perform planet specific goals or missions. Project planning and probe design will require students to research and acquire knowledge about each of the planets but students will select one planet as a focus. Students will research using online and text references during two class periods. The rest of the project design will be done at home. Students without computer access at home will be allowed time before school or during our Science flex time in order to conduct further research on the computer. Students will also be permitted to check out reference books from the school media center. The accompanying manual will be designed to explain the travel plans of the mission and describe the missions that each probe will accomplish upon reaching the chosen planet. Students will create the probe from recycled and reused materials. Students may spend no more than $5.00 on this project. Students will be given the rubric requirements before beginning the project. Students will also receive a research outline to follow. An illustration or photograph must be included in each manual. The manual may be hand-written, typed or presented in the form of a PowerPoint. Students will be graded on the project components and not the method of presentation. I like to offer my students choices when assigning a project or large assignment. Many of my EC and ESL students are visual learners and enjoy the design and creation of the space probe. Some of these students excel at art and will show their strengths when creating and labeling the probe diagram. These students are often confused by the abstract when discussing planets and their characteristics. Creating a probe and conducting research about a specific planet will allow them more concrete experience with space. Using this project as a vehicle for planetary study provides students with a concrete practical use for their research and their study. I find that my students react well when they are given some control over their learning. By selecting the planet and creating an individual probe, students will be motivated to research and comprehend the characteristics of the planet.

This project is also helpful in discussing and understanding space travel. Students will research past and current missions to the various planets and investigate the successes and failures. This knowledge base will lay the groundwork for space probe design and mission goals. Students will view a variety of video clips from Discovery Education. They will watch “Liftoff into Space” from HYPERLINK "http://www.discoveryeducation.com" www.discoveryeducation.com and complete a graphic organizer at the beginning of the unit. To kick off our unit students will also create a paper rocket and participate in a class launch celebration. Students will be given the basic parts and will then design their rocket to fly the farthest. Students will be given three launch options as well: regular straw, tossing the rocket by hand, or large air launcher. This activity gets my students excited about space and will encourage them to consider design and rocket characteristics in order to achieve the perfect launch. *(I plan to set up the simulated Solar System outside and have the students launch their rockets into the Solar System)*

My student’s knowledge base is often quite varied and thus the use of a KWL (What I Know: **K,** What I Want to know: **W**, and What I have Learned: **L**) chart will prepare students and me to focus on learning gaps and weaknesses. This will be kept in the student’s Interactive notebook with additions made throughout the unit. The Interactive Science notebook will allow students to organize their science materials and information. The interactive notebook uses a section for note taking or teacher input and then the opposite page is used to practice or synthesize the new information. Students will fill this notebook with graphic organizers which compare and contrast such as the double bubble, organizers that compare such as a chart of planet characteristics, and those that display comprehension such as a foldable activity or KWL chart. Students will also record all lab activities and observations in the notebook. Students will be encouraged to think like an astronomer and incorporate our previous lessons on the scientific process by participating in the Mystery Box. A colleague offered this activity as a way for students to recognize the difficulties of experimentation without the benefit of physical touch. A variety of objects will be placed in a sealed shoe box and students will rely on their powers of observation and inference to determine the contents. This process will demonstrate the limitations placed on astronomers when examining celestial bodies. I also want students to begin to ask questions and not just seek answers about our Solar System. To accomplish this goal students will be shown pictures of the planets and asked to create a list of questions about each. Students will do a gallery crawl and post their questions on the planet poster for other students to read. Students will then discuss with their group the questions about each planet. Students will conduct online research to answer 2-3 of the questions on the posters. Students will attach the answers to their chosen questions on the planet poster. Students will rotate with their group to every planet until all groups have been to all planets and read all questions. *(I plan to borrow laptops from the computer lab and have them available to each group.)*

Students will participate in hands-on inquiry based labs for planet study. Students will investigate the craters of Mercury, the greenhouse effect of Venus, density of materials of Earth's layers, and how mechanical weathering changes Mars' surface. Students will also experiment with the albedo level of materials that make up the rings of the outer planets. Students will compare these levels of reflection to understand why Saturn's rings are visible yet the rings of Jupiter, Uranus, and Neptune are not. The use of hands-on investigative labs will allow students to see and touch just a bit of the untouchable planetary bodies of our Solar System. Students will also complete a series of research based learning stations and watch a variety of informational video clips from HYPERLINK "http://www.discoveryeducation.com" www.discoveryeducation.com. These video clips will be used for whole class instruction and discussion as well as individual learning stations. Several interactive videos will be used to further involve students in the investigative process during the learning stations.

At the end of our unit students will present their space probes and manuals to the class. Each student will be given a certificate and the breakdown of their performance on the rubric. Space Probes will be displayed in the classroom, hallway, and media center.

Background Information:

Students will conduct research on each planet through interactive learning stations. Students will watch video clips from HYPERLINK "http://www.Discoveryeducation.com" www.Discoveryeducation.com and HYPERLINK "http://www.NASA.gov" www.NASA.gov as well as glean information from reference texts and student literature. On-line research using the websites HYPERLINK "http://www.windows2universe.org" http://www.windows2universe.org and HYPERLINK "http://www.kidsastronomy.com/solar_system.htm" http://www.kidsastronomy.com/solar_system.htm will enable students to complete up-to-date research using 21st century technology skills. Students will use this research to answer questions mentioned above during the gallery crawl and complete their research outline in preparation for the space probe project. Students will complete an organizational chart about the planets and their specific characteristics. Students will record statistical information about each planet as well as one or two “Fun Facts” that make that planet unique. Students will record this information in the interactive notebook. This organizational chart will be broken into one for the Terrestrial planets and one for the Jovian planets. Terrestrial planets will be classified as to their similarities and differences to Earth in terms of structure, plate activity, volcanism, atmosphere, craters, water/ice, and Moons. The gas planets will be compared based on general composition, atmosphere, water/ice, presence of rings, and Moons. I feel that two different charts for the inner and outer planets would best suit the purpose of organizing the information and creating a physical reminder to my students that the two sets of planets are very different. Students will also create an illustration for each planet. Creating an illustration further requires my students to recognize the visual characteristics of a planet as it compares to others within the Solar System. Illustrations will be student drawn but may be based on images seen during class discussion and/or online research. NASA produced a set of planetary images that I have collected during my teaching. These images are letter paper sized and are excellent resources for student groups to examine.

Bibliographical note: Statistical information about the planets below is from the book Dakota, Heather. Space. New York: Tangerine Press, 2008 (2) unless otherwise noted.

Rocky Planets (Terrestrial):

Mercury:
Average Distance from the Sun: 36 million miles
Diameter: 3031 miles
Average Temperature: 750 F (day) -320 F (night)
Length of year: 88 Earth days
Atmosphere: Oxygen, sodium, hydrogen, and helium
Moons: None
Rings: None
Volcanism: Not present
Plate Tectonics: Not present today; presence of cliffs suggest that when the core cooled tectonic forces compressed the crust, causing the surface to crumple and shrink
Water ice: Polar ice found at the poles; possibly deposited when comets crashed into the planet(5)
Composition: Nickel/iron core, silicate mantle, rocky crust(5)

Fun Facts: Moves around the Sun faster than any other planet, covered in craters like our Moon, has extreme temperature variations due to lack of atmosphere

Venus:
Average Distance from the Sun: 67 million miles
Diameter: 7521 miles
Average Temperature: 872 F (hot enough to melt lead)
Length of year: 225 Earth Days

Atmosphere: Carbon dioxide and nitrogen; extremely hot and corrosive, air pressure 100 times greater than Earth, extreme greenhouse effect due to large amount of carbon dioxide and high-level clouds that block the release of heat(5)
Moons: None
Rings: None
Volcanism: Present; about 85% of Venus' surface is covered by volcanic formations from what are presumed to be lava eruptions. An actual eruption has never been witnessed.
Plate Tectonics: Not present
Water ice: Not present
Composition: Semi-molten nickel/iron core, deep, rock mantle, thin silicate crust(5)

Fun Facts: Venus is very unfriendly. The cloud layers around Venus are clouds of sulfuric acid. At the cloud tops the wind is 217 mph but at the surface there is no breeze. One day on Venus is 243 Earth days, it rotates very slowly. Venus is the only planet to rotate backwards relative to the other planets.

Earth:
Average Distance from the Sun: 93 million miles
Diameter: 7927 miles
Average Temperature: 59 F
Length of year: 365 Earth days
Atmosphere: Oxygen and nitrogen
Moons: One
Rings: None
Volcanism: Present, continues to affect Earth's surface
Plate Tectonics: Present; continues to reshape Earth's surface; possible due to Earth's relative large size which has allowed it to retain sufficient internal heat(1)
Water ice: More than 70% of Earth's surface is covered in oceans of liquid water(5)
Composition: Solid metal inner core of mostly iron, molten metal outer core, molten rock mantle, and rocky crust

Fun Facts: Earth is the only planet known to have life-sustaining liquid water. Earth is fifth largest in size of all the planets in our Solar System. Earth's surface is ever-changing and is made up of several large rocky plates that float around on top of the mantle. These are called tectonic plates and their movements give Earth earthquakes and tSunamis.

Mars:
Average Distance from the Sun: 135 million miles
Diameter: 4194 miles
Average Temperature: -207 F in winter to 80 F during the Martian summer
Length of year: 687 Earth days
Atmosphere: Very thin: carbon dioxide and nitrogen
Moons: Two: Phobos and Deimos

Rings: None
Volcanism: Mars is thought to have had volcanoes with the most recent eruption about 20 million years ago(5) Olympus Mons is the largest mountain in our Solar System and is an inactive volcano
Plate Tectonics: Not present
Water ice: Water ice and frozen carbon dioxide exist at the poles(1)
Composition: Solidified iron core, silicate mantle, rocky crust

Fun Facts: Mars has polar ice caps. Mars can't recycle carbon dioxide into its atmosphere so its temperature is unstable. Called the "red planet" due to high levels of iron in the crust. Contains the highest mountain in our Solar System; Olympus Mons. It is 16 miles above the surface.

<u>Gas Planets (Jovian):</u>
Volcanism and plate tectonics will not be considered as the Jovian planets are the Gas Giants. Their main composition is that of gaseous material thus not susceptible to volcanism or plate tectonics.

Jupiter:
Average Distance from the Sun: 484 million miles
Diameter: 88,850 miles, contains 2/3 of the planetary mass of the Solar System(4)
Average Temperature: -162 F
Length of year: 4329 Earth days
Atmosphere: Mostly hydrogen and helium, contains zones (warm material risen to the edge of the atmosphere shown as white stripes) and belts(cooler material shown as dark bands)
Moons: 64; including four large Moons name Ganymede, Io, Europa, and Callisto
Rings: Yes, ring is optically dark suggesting it is made up of impact debris(4). Only visible when lit from behind by the Sun.
Water ice: No direct evidence of its presence
Composition: Rock/ice core, liquid metallic hydrogen inner mantle, liquid hydrogen/helium outer mantle(5)

Fun Facts: The main part of the planet is liquid metallic hydrogen sustained by extreme pressure. The Great Red Spot is a huge storm kind of like a hurricane on Earth that has existed for over 300 years. The Great Red Spot is more than two times the size of Earth.

Saturn:

Average Distance from the Sun: 8.86 million miles
Diameter: 74,900 miles
Average Temperature: -218 F
Length of year: 10,753 Earth Days
Atmosphere: Mostly hydrogen and helium
Moons: More than 50 named satellites; larger Moons are Atlas,

Pandora, Prometheus, and Titan
Rings: Yes, each ring system has its own orbit. Rings are made of rocky ice materials and are 10cm to 10m thick. Are very reflective due to composition
Water ice: Yes, within the ring system
Composition: Rock/ice core, liquid metallic hydrogen inner mantle, liquid hydrogen/helium outer mantle(5)

Fun Facts: Saturn is a gas planet but has a liquid metal hydrogen base. Saturn has rings made of water ice and each particle in a ring is in its own orbit. Saturn has a very low density and if a bathtub big enough could be found and filled with water, Saturn could float in the water.

Uranus:
Average Distance from the Sun: 2.87 billion miles
Diameter: 31,765 miles
Average Temperature: -323 F
Length of year: 30,686 Earth Days
Atmosphere: Mostly hydrogen, helium, and methane/methane gives Uranus its blue tint
Moons: 27
Rings: Yes, made mostly of frozen methane ice. The rings are so dark that they were only discovered in 1977 when they passed in front of a star and caused its light to flicker.(4)
Water ice: Yes, the atmosphere covers an area of slushy ice
Composition: Core of rock and ice, mantle of semi-frozen ices, inner atmosphere of liquefied gases and outer atmosphere of hydrogen, helium, and methane(5)

Fun Facts: Uranus spins like it is lying on its side creating seasons that are years long in length. Uranus is the third largest in diameter but its mass is smaller than Neptune.

Neptune:
Average Distance from the Sun: 2.79 billion miles
Diameter: 30,777 miles
Average Temperature: -353 F
Length of year: 60,152 Earth Days
Atmosphere: Mostly hydrogen and helium
Moons: More than 13 including Triton which orbits the planet backward relative to the direction of Neptune's rotation(1)
Rings: Three noticeable rings and one faint ring. The rings are much darker than the rings of Saturn and appear to consist of dust particles. The outer ring has inconsistencies in its particle distribution(4).
Water ice: Yes, the atmosphere covers an area of slushy ice
Composition: Core of rock and ice, mantle of semi-frozen ices, inner atmosphere of liquefied gases and outer atmosphere of hydrogen, helium, and methane(5)

Fun Facts: Neptune often has a Great Dark Spot caused by its rapidly changing atmosphere and temperatures. This Dark Spot has been present in the past but as of now is missing from

Neptune's surface. Neptune has a small white cloud named "The Scooter" that zips around the planet every 16 hours. One of Neptune's Moons, Triton has features similar to geysers but instead of spewing water they eject nitrogen gas into the atmosphere(1).

The above information could be prepared into a teacher-made PowerPoint or multi-media presentation. During this unit I plan to use a variety of text and online sources to create learning stations through which students will learn about the individual planet characteristics. Students will complete a comparison chart in their interactive science notebook through which they will study the planets. Each planet will have a research based station and a variety of investigative stations will be incorporated into the study as well. Teachers should plan to locate a variety of video clips and/or internet resources to use during these stations. Some possible video clips from HYPERLINK "http://www.discoveryeducation.com" www.discoveryeducation.com are "Liftoff Into Space", "The Inner and Outer Planets" (an interactive video), Space Science: "The Basics: The Solar System", "A Closer Look at Space: The Planets"

During the investigative lab studying the ring systems of the Jovian planets, students will study the albedo level of the planetary rings. The measurement of albedo is a subjective scale ranging from 0 for completely dark to 1 for completely bright.(3) Albedo effect will be examined to guide students to understand why we see the rings of Saturn but not the other Jovian planets. Why are some rings visible and others invisible from Earth? Saturn's rings have a high albedo due to their composition. The rings of Saturn are composed of highly reflective water ice and ice covered rock therefore they are most reflective of the Sun's light. Conversely the rings of Jupiter and Neptune are composed mostly of rock and are not reflective of the Sun's light due to their low albedo level. Neptune's rings are made of ice but it is methane ice which has a low level of reflection. This composition of dark material affects our ability to view these rings clearly and consistently. Also, the farther away from the Sun that an object is located, the lower its albedo score because the intensity of the Sun's radiation reduces greatly over long distances.(3)

Cratering will be investigated to discuss how this process occurs on Mercury and our Moon. Both planets are considered to be geologically dead.(1) Students will create craters using cornstarch and a variety of sized balls to replicate the appearance of impact craters on the planet. Impact craters are visible over the entire planet of Mercury. This cratering indicates that the surface is extremely old as the creation of new impact craters has reduced over the last several million years. This slow down of activity is due to a reduction in planetary objects available to cause impact craters. Mercury has extreme cliffs that indicate that it at one time was larger than it is now. Over time the planet cooled and shrunk causing great disparities in elevation to occur. Students will investigate how impact craters form and describe their appearance in an inquiry lab.

Classroom Activities:

Introductory activity:

Students will design, create and launch paper rockets to simulate and gain an awareness of the difficulties of space travel.

Students will describe the vastness of the Solar System using a simulated model. Activities for this unit will begin with an attention-getting lesson involving paper rockets and the construction of a simulated Solar System. Teacher will instruct students that we are going to travel where no middle-school student has dared travel before…into the Middle School Solar System. Students will be shown a variety of images of the planets and a poster of the Solar System in its entirety. Teacher will explain that the Solar System has shrunk and landed on the football field. Teacher will show students the items and allow them to hypothesize which items represent which planets. Students will discuss their thoughts with their cooperative group and record their observations. Before going outside to design the Solar System students will create a paper rocket of their choosing. Students will be given the basic design and then add or subtract materials as they see fit. Students will launch the rocket into the Solar System using a variety of launch options.

The follow items and spacing will be used to create the Solar System:
Sun: goal post- home plate or large square cut-out (explain that the Sun is 333,000 times the size of Earth)(5)
Mercury: 1 yard- Marble
Venus: 2 yards- Walnut
Earth: 3 yards- Golf ball
Mars: 5 yards- Acorn
Jupiter: 16 yards- Basketball
Saturn: 30 yards- Soccer ball
Uranus: 60 yards- Softball
Neptune: 100 yards- Grapefruit

Students will compare their hypothesis with the actual materials. Students will make observations based on the outcome of the activity. Students will then take turns launching their paper rockets into the Great Beyond! Students will be allowed to modify their rockets based on previous launch experiences. Gold medals will be awarded to the most successful astronauts from each class.

Classroom Activity:

Students will activate prior knowledge about the Solar System using a QuickWrite technique. Students will write continuously for two minutes about the Solar System. Teacher will start the timer on the SmartBoard and students will write the entire time to encourage free thought. After this process students will transfer the QuickWrite information into the format of a **KWL** chart focusing on the K and the L at this point. The creation of this chart will focus students and teacher to needed content during the future lessons. Class will engage in discussion of the K and L portion of the chart. Students will be expected to add to the chart throughout the unit. Teacher will introduce the Space Probe Project to excite students about space exploration and study. The project explained in the strategies section of this paper will be the driving force of instruction during this unit. Students will be allowed class time to research but will complete the project at home. Students will create a simulated space probe designed for travel to a student chosen planet.

Project Description:

Space Probe Model:
3-D model made from household items, maximum size of 2feet X 2feet, include parts for studying the planet, collecting samples, sending data to NASA, design should match the chosen planet

Space Probe Manual or PowerPoint:

Part One: Mission Overview: one or two well-written paragraphs that include the name of the probe, date and location of the launch, type of launch vehicle(an existing shuttle or rocket), the planet the probe will visit, distance traveled from Earth, estimated date of arrival
Part Two: Space Probe Diagram: illustrate and label the probe including parts used during the mission, an alternative would be to label a photograph of the probe
Part Three: Mission Goals: design 4 realistic goals (jobs) that your probe will accomplish on the mission to your chosen planet. Write a paragraph for each goal to explain how the probe will perform each task and what parts on the probe will be used to achieve these goals.
Students will present their probes to the class at the end of the unit.

Classroom Activity:

Students will engage in a variety of activities to allow them to think like an astronomer. Students will participate in the Mystery Box activity explained earlier. Students will use their powers of observation and inference to determine the contents of a sealed box. Students will be given two clues as to the contents of the box. Students will work with their cooperative group to create a hypothesis about the contents of each box before beginning the activity. Students will also create a set of questions about the planets after viewing a variety of images for each planet. Images may be obtained from the *"UNIVERSE"* book listed in the bibliography. Excellent images are also available at HYPERLINK "http://www.NASA.gov" www.NASA.gov. Students will perform a gallery crawl after viewing the images and a set of introductory videos on the planets. Students will place questions on post-it notes on the poster for each planet as they view each during the crawl. These questions will be used later as a set of essential questions during the learning stations.

Research Based Learning Stations:

Students will participate in a variety of research based learning stations about each planet. Students will complete a two-part organizational chart for the Terrestrial and Jovian planets as explained above. A sample learning station would include a small group of students watching an interactive video through Discovery Education. Students would be given a list of essential questions from the gallery crawl to answer or vocabulary to define during the station. Students would complete a teacher supplied answer sheet or set of cloze notes that would be kept in the interactive notebook. Another example would be an activity using the Microslide viewer and a set of Microslides of the planets. Students would work with their small group to answer questions about the unique characteristics of each planet and create a comprehensive illustration of each planet.

To incorporate the other disciplines, students would be exposed to the symphony “The Planets” by Gustav Holst. Students would engage in a listening lab of a portion of the symphony for each planet. Students might create a list of adjectives that describe each piece. Further into our unit students could choose a specific portion of one of the compositions and create an original song, poem, or rap using newly learned vocabulary to the tune of the symphony piece. The band and orchestra teachers would be engaged to further emphasize the interconnectedness of the content.

Investigative Research labs:

Students will investigate and explore the unique characteristics of each planet through a series of inquiry based labs.

Mercury: Impact Craters

Students will create craters using balls of various sizes and cornstarch. The cornstarch will be spread in a small pan and students will drop the balls to create the craters. Before beginning the lab, students will read a small passage on impact craters and view a variety of illustrations. Students will choose three different sized balls and hypothesize what the difference will be when the balls are dropped. Students will maintain control over the other variables of the experiment (height, test material, force) and allow the ball size to be the independent variable. Students will complete an independent investigations lab sheet requiring them to list the materials, variables, and steps of the experiment. Students will follow the scientific method to conduct the test and record their results. Students may change the variable and complete the experiment again if time allows. Students will respond to questions from the gallery crawl during the experiment evaluation. Sample questions could be: How has impact cratering changed over time? Why are some planets more susceptible to impact craters than others?

Venus: Greenhouse Effect

Students will explore how the greenhouse effect relates to rise and/or fall in room temperature. Students will read a short informational passage about the extreme greenhouse effect on Venus and how this compares to the effect on Earth. Teacher will prepare two 2 liter bottles. The bottom will be cut off the bottoms and the top sealed with a thermometer. A light source will be placed in between the two bottles. To prepare the bottles one will be kept in its solid state while the other bottle will have small slits cut out to allow for the escape of heat. Students will hypothesize about the temperature in the two bottles. Students will complete the independent investigations lab sheet as described above. Students will maintain the constants in the experiment and allow the bottle material be the independent variable. Students will measure the temperature of the two bottles at the start and then once every two minutes for ten minutes. Students will compare their results to their hypothesis. Students will again respond to questions from the gallery crawl during the experiment. How does the greenhouse effect affect Venus’ surface? How does this exist on Earth? What changes have occurred on Earth due to the greenhouse effect?

Earth: Density of Materials

In order to investigate and understand how density affects materials, students will perform a density experiment using water, salt, and food coloring. Students will place equal amounts of water into two similar glass beakers. To one beaker students will ad 4-5 teaspoons of table salt being careful to stir and completely dissolve the salt. Students will then add 4-5 drops of dark food coloring into the salt water. After this water has been stirred, students will **very slowly** pour the salt water into the plain water. This must be done extremely slowly to achieve the desired effect. Students should see the darker water at the bottom of the new cup with a noticeable line of clear water still at the top. This creates a basis for discussion on density and how denser materials sink. Students will refer back to this experiment in our examination of how even the gas planets have icy or rocky cores. Students may record their observations in their interactive notebook. Students should also create an illustration of this demonstration for reference later in the unit.

Mars: Mechanical Weathering

Students will investigate how the surface of Mars changes due to mechanical weathering and the presence of wind activity. Students will use the independent investigations lab sheet to conduct the experimental lab "Shake it Up". Each student group will be given a sturdy box or coffee can and a supply of thee rocks. Rocks of lower hardness level will be chosen to allow for a better chance of weathering. Students will hypothesize about the experiment results before they begin. Students will weigh their rocks and record this data on the chart. Students will then place the rocks in their container and shake them vigorously. After a while students will remove the rocks and weigh them again. Students will record their results and observe the difference. Students will examine the dust in the container and discuss the process that caused this reaction. Students will relate this type of physical or mechanical weathering to the happenings on the dry dusty planet of Mars. Students will again read an informational passage before beginning and complete a set of questions after completing the activity.

Gas Giants: Albedo Score

Students will investigate how the composition of a material and its location in space affects it albedo level. Students will read an informational passage or watch a video clip on the Jovian planets and their ring systems. Students will hypothesize as to why Saturn's rings are so visible but astronomers really have to hunt to find the rings of Jupiter, Uranus, and Neptune. Students will hypothesize and create a set of steps to follow during the experiment. Students will first examine the reflective properties of a black piece of paper vs. a white piece of paper. Students will record their observations and look through the spectrograph to further analyze the light spectrum seen in each reflection. Next students will compare the composition of the rings through the use of charcoal to represent the rings of Jupiter, Neptune, and Uranus and ice cubes or mirrors to represent the rings of Saturn. The material will be placed in a clear plastic container and students will shine a light on each material. Students will record the reflection created and make observations based on what they see. Students will again view the reflected light through the spectrograph. Students will respond to essential questions created during the gallery crawl or focus on new questions that they have based on this experiment.

Students will use the information gathered during the learning stations to further refine their research for their space probe. Students will present their probe and manual in class. Students will also watch the movie Apollo 13 at the end of our space unit. It provides a real-life experience showing the difficulties of space travel and man's desire to explore the great beyond.

It is my desire that this unit will encourage my students to look up at the sky and ask what if? How Come? and Why?

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An in-depth teacher resource which provides facts and explanations for the unique characteristics for each planet. Includes an interesting section on the changing perspective of space exploration over time.

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This book is very child-friendly in its design and content. Every planet has its own two page spread consisting of quick facts and impressive photographs and images. Facts are presented in a bullet point format which will hold the attention of even your struggling readers.

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Sparrow, Giles. *Voyage Across the Cosmos*. London: Quercus Publishing Plc, 2008.

Great as a teacher resource but basic enough for students to read and understand. Oversized book with detailed images of each planet and their unique characteristics. Fascinating up close views of the planets. Interesting feature is a cut out view of each planet’s core and layers. This helps to visually explain the rocky core of the gas giants.

Teacher and Student Annotated Bibliography

Asimov, Isaac. *Isaac Asimov's The rocky planets* . New York: Modern Pub., 1994.

While this book is older it is very child-friendly in its design and reading text. The book boasts interesting artist illustrations and actual photographs of the planets and other solar objects.

Astronomy adventures . New & expanded ed. New York: Learning Triangle Press, 1997.

This book is part of Ranger Rick's NatureScope series through the National Wildlife Federation. Students are provided with background information and then a set of activities to put their knowledge into action. An excellent source of enrichment ideas for teachers as well.

Bennett, Jeffrey O.. *The essential cosmic perspective* . 4th ed. San Francisco: Addison Wesley,

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An in-depth teacher resource which provides the facts and explanations for the unique characteristics for each planet. Includes an interesting section on our changing perspective of space exploration over time.

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This is a short book written in question and answer format. Interesting Interesting photographs and images quickly capture your attention. Easy to read and well suited for classroom use.

Dakota, Heather. *Space*. New York: Tangerine Press, 2008.

This book is very child-friendly in its design and content. Every planet has its own two page spread consisting of quick facts and impressive photographs and images. Facts are presented in a bullet point format which will hold the attention of even your struggling readers.

Jefferis, David. *Space probes: exploring beyond Earth*. New York: Crabtree Pub., 2009.

Excellent photographs and descriptions make this book a student favorite. This book provides real-life examples of space probes and their accomplishments.

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A basic article about albedo, the measurement of an object's reflection of the Sun's radiation. Excellent background information for teachers.

Marriott, Leo. *UNIVERSE*. NEW JERSEY: CHARTWELL BOOKS, 2007.

Excellent teacher resource. This is an impressive book both in size and content. The large book is over two feet tall and is packed with detailed photographs and illustrations. As its title suggests, this book covers the entire Universe in an exciting and thorough manner. Large enough for use in classroom display or under a document camera.

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Excellent resource for teachers yet exciting reference for students as well. This is an oversized book with detailed photographs and images of the planets and other solar bodies.

"Welcome to Discovery Education." Welcome to Discovery Education.

http://www.discoveryeducation.com (accessed November 1, 2010).
Educational website containing a variety of videos, images, and interactive media for all Science topics. Great resource for whole class as well as learning station activities.

Appendix: Implementing District Standards

Goal One: The learner will design and conduct investigations to demonstrate an understanding of scientific inquiry.

Students will create and perform experiments to investigate the unique characteristics of each of the Planets.
Students will use science inquiry to determine the contents of items in the "Mystery Box" which encourages students to think like an astronomer and recognize the difficulties they face in observation.
Students will research and create a simulated space probe designed for travel to a student chosen planet. Space probe will require parts to perform planet-specific tasks and achieve mission goals.
Students will design, create, and launch paper rockets and adjust the construction for maximum flight.

Goal Two: The learner will demonstrate an understanding of technological design.

Students will investigate space travel and recognize advances in design over time.
Students will design a simulated space probe as described above.

Goal Five: The learner will build an understanding of the Solar System.

Students will create a set of questions in response to images and video clips of the planet within our Solar System. Students will think like an astronomer.
Students will research the attributes of each planet in our Solar System and classify the planets according to their characteristics.
Students will explore the planets through a variety of hands-on investigative labs which examine the properties unique to each planet.
Students will participate in a paper rocket launch into a simulated Solar System.
Students will select a planet to further research for which they will design and build a simulated space probe. The space probe will conduct planet-specific goals.

Why Commercialize Space. Learn how NASA is changing the way it does business: investing in commercial space transportation and making the National Laboratory aboard the International Space Station available for research. â€º View this interactive feature. Why do we explore? Follow along with this story from the NASA Kids' Club about why and how we explore new places! â€º View Interactive. Beyond Earth. Expanding Human Presence Into the Solar System.Â Why We Explore. Human Space Exploration. Humanity's interest in the heavens has been universal and enduring. Humans are driven to explore the unknown, discover new worlds, push the boundaries of our scientific and technical limits, and then push further. Space exploration helps us to look inward as well as outward, helping us all to find the changes that are necessary to keep our planet healthy for our children, grandchildren, and beyond. List of the Disadvantages of Space Exploration. 1. Our current technology makes it dangerous to get into space in the first place.Â There have been two individuals (Gus Grissom and Peter Siebold) who were able to survive a problem that resulted in the loss of a space vehicle. 2. There are cost considerations to look at with space exploration. The cost of exploring space is one of the biggest criticisms of the efforts to launch a program that takes us beyond our planet. When the space shuttle program was active in the United States, the total cost of the launch was about $500 million. Every planet has a dynamic ecosystem or environment. We have learned that they all behave in some similar ways, but there are strange differences between our world and the other bodies in the Solar System. There are seas of frozen water just under the surface of Mars, seas of methane on Saturnâ€™s moon Titan, puddles of frozen water at the poles on our own moon, and strange moving continents on the dwarf-planet Pluto. All of these worlds act in according to our understanding of the laws of physics but each world has taught us something new about how those laws work. We have learned that planets