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To Infinity and Beyond: using non-fiction text and study to promote science-fiction writing

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Introduction

English and Language Arts (ELA) in the elementary school setting is a comprehensive course that includes Reading, Grammar, Writing, Spelling, and more. Revolving around communication, it encompasses a wealth of information, strategy and technique for the teacher and pupil. The country is rife with school districts that have created a "block" of class time for the instruction of these subjects. With the amount of content and practice that needs to be delivered and implemented, one might imagine it would be difficult to add more, however, this curriculum unit sets out to do just that. The goal is to seamlessly incorporate the original ELA standards while infusing those from the field of Science, in order to make a rich and robust addition to the existing curriculum during which students will expand upon skills in pursuance of strengthening comprehension in not only non-fiction, which historically can be troublesome for young readers, but also creative writing within the Science Fiction genre. Moreover, the students will be provided with the opportunity to transfer their stories into scripts for sharing with their peers. In order to accomplish this goal, I will focus on vocabulary development along with comprehension skills paired with writing and science standards.

Teaching ELA may be extremely familiar for me, however, incorporating the Science standards is a new, but welcomed, endeavor. Using the subject of Astrobiology as the foreground for such an endeavor will whet the students' appetite for the segue into the writing genre of science fiction.

For as long as I can remember, I have mused upon space and all of its possibilities: the distance, the wonder, the questions. As a child, I didn't understand how "we were down here on Earth, but up in the sky at the same time." My young mind couldn't wrap itself around the idea of the atmosphere and beyond. Similarly, as an adult, there are still so many aspects that I continue to wonder about. During my childhood, movies like "Star Wars," television shows like "Star Trek" and cartoons like "The Jetsons" guided many of my mental depictions of how things worked in "outer space." Examining my musings even further, I recall movies like "E.T.," "Close Encounters of the Third Kind" and "Cocoon." These films added a touch of Science Fiction to what I thought I already knew about space, its make-up and its possible habitants. To even imagine what the planets were like was an absolute adventure. I would ask, "if the sun and other stars like it are in space, why is it so dark?" The truth is that there is so much that we still do not know and are learning about space that the science-fiction aspect is not that hard to drum up.

In this unit, I will examine many facets of the Universe as we know it, as well as a bit of the vast amounts that we don't. Discussions will revolve around the sun, stars, moon, Earth, the solar system and beyond. Additional components will examine smaller features such as comets, asteroids and meteors. Highlights will include exoplanets and dwarf planets. All of these items are specifically chosen to partner with three guiding questions.

1. What is Life?
2. Do you think that there can be life elsewhere in the universe?
3. How do you envision life other than that on planet Earth?

These three questions will help students hone their current thinking of not only the science of space, but the idea of what is habitable and why? They should be able to begin putting their thoughts and imagination together with facts and truths.

This unit will become a true integration of subjects in that the Scientific, non-fiction content will coalesce to form ideas for a writing within the science-fiction genre. This will mesh with the subjects within ELA and provoke opportunities for not only writing, but script development as the students extrapolate their ideas from stories, to script, to stage!

Rationale

The city of Pittsburgh in Pennsylvania is one of exhilarating history and tradition. It's known for its industry, innovation and tenacity as well as its artistry and performance, with many stage and screen actors and other performers hailing it as home. The Pittsburgh Public School District is no different and has been forging trails for its students for over a century.

Pittsburgh Dilworth Traditional Academy is an arts and humanities magnet school within the district and is distinctive in its student population. With roughly 400 pupils and a staff of veteran teachers as well as young innovative instructors, it is a quaint school with a neighborhood feel. There are about 219 African American students with approximately 127 Caucasian students. With smaller percentages of Asian and Hispanic pupils, our school is one of the most diverse in the district. The Title I percentage is about 76%.

The rationale for this particular curriculum unit is that students functioning at all levels will partake in the reading, discussing and listening of non-fiction materials (developmentally appropriate), to information surrounding the solar system and the portion on exoplanets and dwarf planets. As previously stated, the goal is for the children to explore more of their creative side by synthesizing the information learned into individual Science Fiction tales that will end up as scripts.

With Dilworth being an arts and humanities traditional academy, many of our students continue to the Creative and Performing Arts (CAPA) middle and high schools within the district. They need to build a strong portfolio that showcases their talents in the field/major for which they are applying. This is inclusive of writing and theater. Even without heading into the world of creative and performing arts, the rich relationship that integrating lessons from multiple subjects provides is an invaluable educational component that will enhance any portfolio. Building the skills needed for children to attend to lessons and orchestrate writing artifacts is one that teachers should not be afraid to expand upon. Creative writing in this genre has the potential to

produce lifelong skills and strategies in a myriad of subjects and topics.

Teaching Strategies

ELA Strategies:

The strategies used for teaching various subjects and projects under the ELA umbrella almost always includes versions of the Readers' and Writers' workshops. Included are individual and partner work, questioning, discussing, brainstorming, drafting, revising and editing, etc. In addition to those common strategies, I will include a focus on listing, and freewriting, mixed with marathon writing.

Marathon Writing

In marathon writing on the third-grade level, the students will learn to build stamina, physically and mentally, as they set out to produce their science fiction (SF) works. They will begin at simply a few minutes on a prompt and expand upon their time to then work on focus and volume. The goal is to provide a "training-like" experience for the children that will prepare them for their SF piece.

Listing/Clustering

When listing, the children will hone their ideas crafted from brainstorming activities. It can be easy to lose sight of solid ideas and organization, leading to chaotic storylines that can be confusing to readers trying to make sense of an already harried genre and topic. By making use of the "listing" technique, students can keep their ideas categorized (sometimes using bullets) and then clustering ideas and categories using graphic organizers, which will aid when drafting their work. Listing/clustering is a great way to keep the children's enthusiasm intact as well as remaining on track with solid ideas and themes.

Vocabulary Development:

DEA Vocabulary (Define-Example-Ask)

This is a fantastic vocabulary routine to use with intermediate elementary students. The concept is quite simple. When addressing a new term, first define the word. Don't be afraid to add to the definition by discussing the context in which it is used. Next, provide an example of the term being used properly in a sentence and again, in context. Finally, ask a question around the word so that the children are able to really think about the term as it has been defined, as it is used in the story and as it should be used in discussion. This routine allows a natural absorption of new and unfamiliar words.

Clarifying Routine: Elaborating Vocabulary Instruction

KWL

A classic strategy in any subject area, I am using the KWL charting strategy to draw a true designation of what the students desire to learn since it is embedded among such a large amount of non-fiction information. The KWL chart uses the acronym to touch on important components of reading. The children become the learning leaders in that they address what background information they already "***know***," while turning to discussion on

what they would like to, or "***want***" to know, followed by a well-rounded conclusion with what they "***learned***." The KWL strategy is a reading strategy that uses questioning to activate prior knowledge, to understand metacognition, and to write to learn. These charts can set a purpose for what will take place in the unit. Moreover, by being aware of some of the students' interests, instructors find that they have a better opportunity to create projects and assignments that the students will enjoy. KWL chart are tools that can be used to drive instruction as well as promote student-led learning[1]

Think Pair Share

Using a Think Pair Share strategy as the students work within an integrated subject setting will draw information learned from the Science lessons and help children work through any questions or uncertainties they might have regarding the topics provided. It is equally useful in the Science field as it is in ELA in that they can revisit notes and *think* about them individually and then together before *sharing* out to their classmates.

Note Taking

Unit Content Objectives

The objectives for content within this unit include a guided discussion around the solar system which leads with the Sun and other stars. Additional conversation revolves around Earth, and the planets of our solar system. Afterward, the conversation shifts to the moon and other bodies such as comets, asteroids and meteors. A final piece regarding the solar system includes exoplanets and dwarf planets. This last portion will lead to discourse on science fiction (SF) and best practices for writing within this genre.

To tackle a subject such as space, astronomy, etc. with elementary school students is a daunting task. Examining the literature available, it seems reasonable to conclude that very young children possess very limited ideas about the solar system, if any at all, but with careful and calculated lessons and content delivery, their ideas become increasingly scientific with age and the more often the solar system is encountered at school.[2]

It also seems reasonable to conclude that learning about the solar system, like so many other areas of science, is a constructive process, one that appears to take place mainly through acts of personal and social cognition rather than direct transmission.[3]

The Sun and Stars

Basic Background Information

The morning light, a touch of warmth on our skin, the orange glow melting into the evening, our very own star. Located in the center of our solar system, the Sun is our light source and also the source of our energy. Without it, our planet Earth would be inherently uninhabitable. We must not forget that the Sun is a star and there are several billion like it within the galaxy. Nevertheless, there are specific characteristics of our star that make it different from the others. It is extraordinarily hot and is composed mostly of hydrogen and helium. The Sun is approximately 27,000,000 degrees Fahrenheit at its core, while at its surface, is around

10,000 degrees, therefore it has no true solid “surface” as it is comprised of gases. There are even rings of dust.[4] This solar body, about 4.5 billion years old has the largest volume in our solar system and affects nearly everything around it.[5]

Our sun or “sol” as it is known in Latin, is a medium sized star amongst billions of others in the universe. It is a “yellow dwarf.” This means that it is not that old in terms of the life of a star. Other stars exist that are the same size, larger, and even smaller. Amazingly, there are stars in the universe that are 100 times larger as well as some that are 10 times smaller than our Sun.[6] They go through a life cycle with distinctive changes along the way. At about 10 billion years, stars like the Sun tend to “die.” They become larger and cooler, transforming into what is called a “Red Giant.” After this, the stars get rid of most of their outer material, leaving behind a smaller and very hot exposed core. This particular stage is called the “white dwarf” stage.[7]

Solar Activity

One of the most common occurrences of activity from our sun is called a solar flare. They can happen at varying levels of intensity. Solar flares are sudden and consist of eruptions of electromagnetic radiation. Depending on the intensity and the location in the atmosphere, the flares can cause interruption of radio waves, which results in “radio blackouts.” The flares mostly occur in the area of the sun’s regions known as “sunspots.” These are areas with a strong magnetic field.[8]

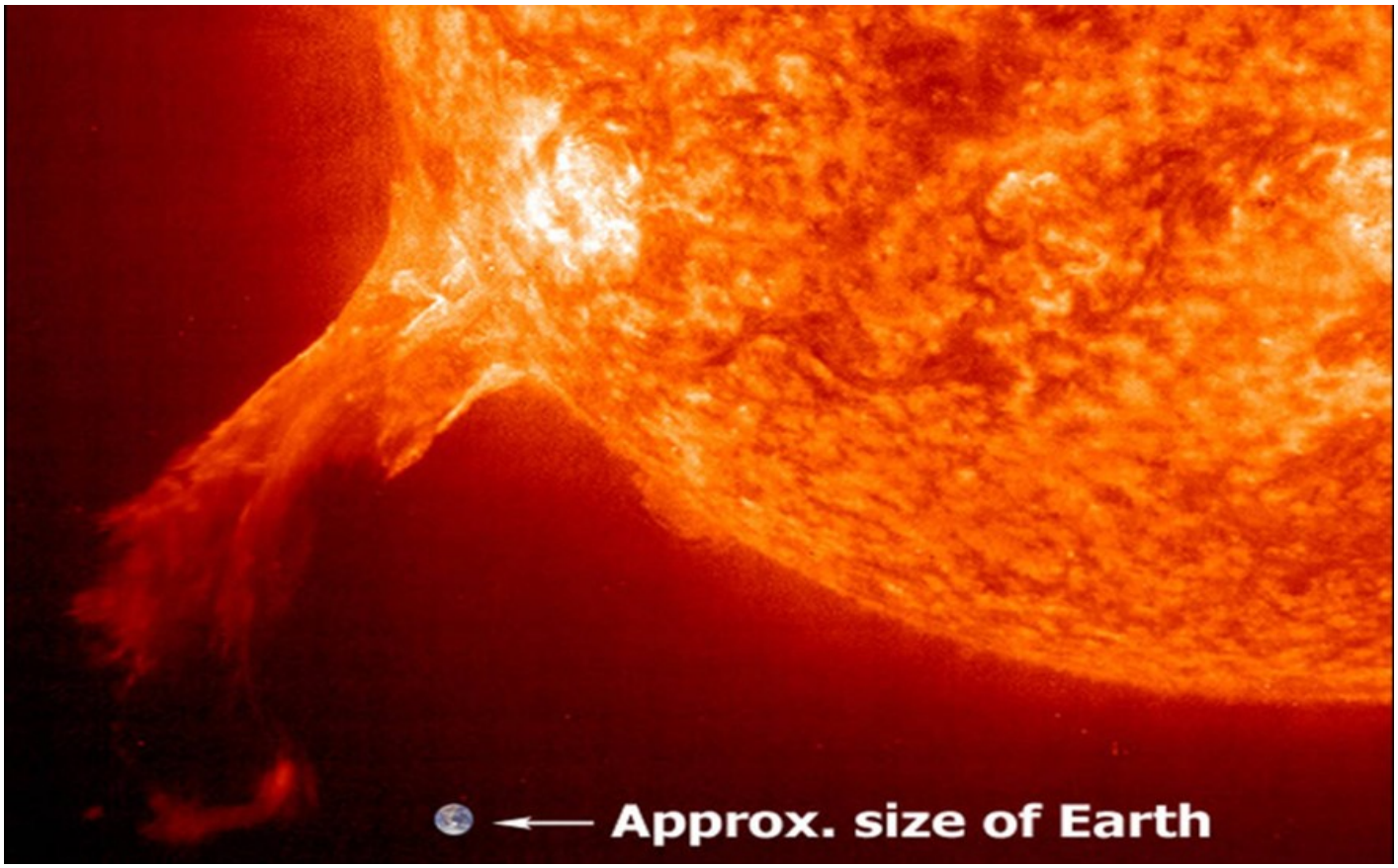

Fig. 1 – This image shows a solar flare as well as a comparison of Earth’s size to the sun (not to scale). Photo credit: NASA

The Moon

Basic Background Information

In 1965, the children's author Jan Wahl wrote a story called Cabbage Moon. It tells the tale of a young princess and her dog as they try to save the moon from an old miser who had stolen it from the night sky. There is talk of the Moon's beautiful, greenish glow and its warm, smiling "face" as it beams. In this story the Moon is made of cabbage and is personified as a gentle soul. I was enamored by the tale and would beg my mother to read it again and again. I even reordered the book as an adult. Several stories exist that fantasize about the moon. They tend to be tales of wonder and amazement at the mostly the same thing…its "silvery glow," "the man in the moon," and the age-old question, that is "what is the moon made of?". Whether people try to figure out what the moon is made of or how to get there, they have usually been enthralled with its mere existence and welcomed presence most evenings.

In July of 1969, Apollo 11 successfully landed on the moon, making it the only location "out of this world" in which human beings have physically traversed.

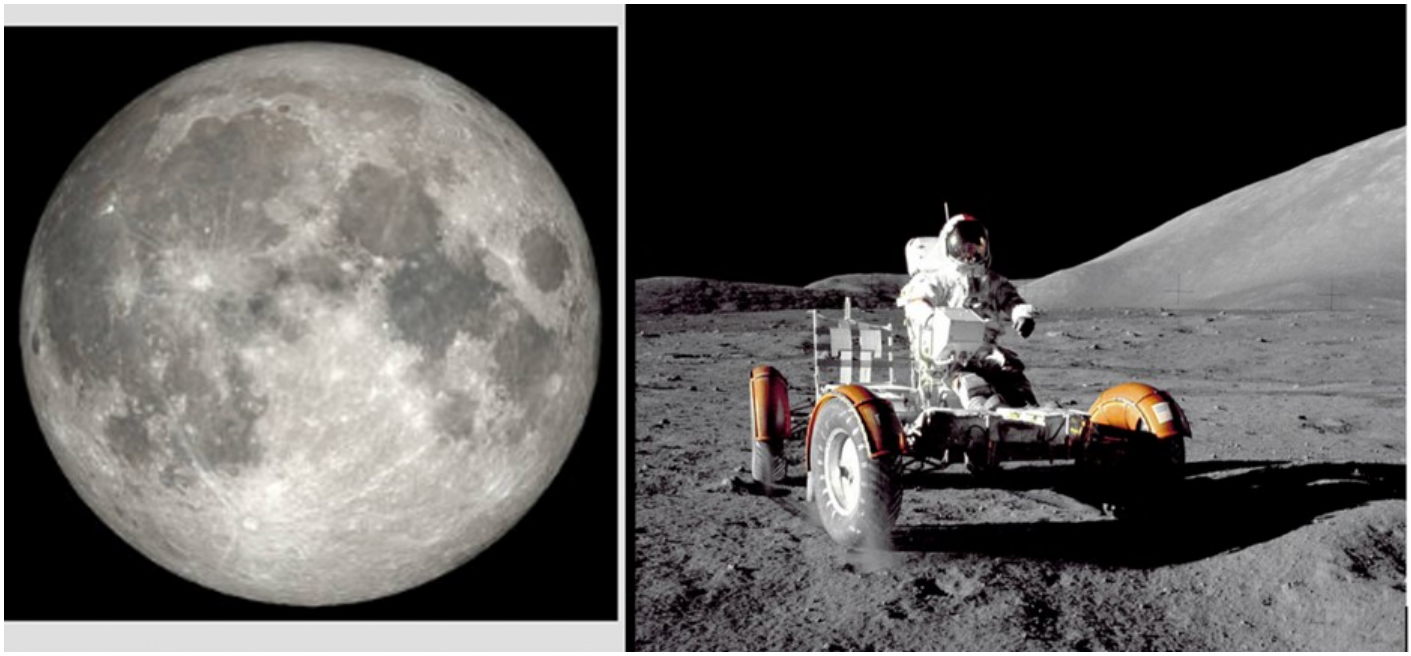

Fig. 2 – The visible face of the moon and a Lunar Roving Vehicle from the first moon landing (Apollo 17) in 1969. Photo credit: NASA

The Moon is Earth's one and only satellite and can be easily observed on most evenings.[9] It actually has no glow of its own but does reflect the light of the sun as it orbits the planet Earth. The Moon is approximately 239,000 miles from Earth and has its own gravitational pull. It is this pull that influences the tides of Earth's oceans. The Moon, which has a minimum temperature of -387 degrees Fahrenheit and maximum 253 degrees Fahrenheit orbits the Earth in about 27 days.[10]

There are a few theories that exist regarding the origin of the moon. One theory (The Fission Theory) suggests that at one time, the moon was actually a part of the Earth, but was separated.[11] Composed of mostly rocky terrain from a likely collision with a space object and the Earth, the moon has only about one sixth of the gravity that Earth has.[12] Another theory (The Capture Theory) surmises the moon already existed somewhere

else in the solar system and was “captured” by the Earth.[13] Most scientists believe that the Fission Theory is likely7 to ethe true scenario.

The Planets of the Solar System

The Latin term “sol” means sun, hence the name “solar” system. Basically, this is a group of planets that orbit one star; the “Sun.” There are now eight planets in our solar system, with Pluto having been reclassified as a dwarf planet because many of its characteristics differ from those of conventional bodies that we have learned about historically. The eight planets range in composition, tilt, size and density among many other measures. They are (in order of distance from the Sun) Mercury, Venus, Earth, and Mars, known as the inner solar system. Jupiter, Saturn Uranus and Neptune round out the latter half of the planets known as the outer solar system. In this section, we will examine information about each of these eight amazingly complex planets of the solar system.

Mercury

If you look at side by side images of the Moon of Earth and the planet Mercury, you may have a bit of trouble distinguishing which is which. They are similar in many ways, but also vastly different as heavenly bodies that inhabit our solar system. A common comparison is that the Moon and Mercury have next to none or no atmosphere. Mercury does not have an atmosphere, whereas the Moon has one which is quite thin.

Mercury is closest to the sun. It was most likely formed of what may have been a violent event.[14] It is the smallest planet in our solar system and is just a little larger than the size of the Moon. Strangely enough, Mercury is not the hottest planet within the solar system as you might think due to its location nearest the sun. Venus is actually the hotter of the two![15] Mercury is not only the smallest planet but is also quite dense due to its massive core. Temperatures can reach approximately 430 degrees Celsius and drop to about -180 degrees Celsius. Interesting details surrounding Mercury include the fact that due to its tilt, there are places that never see sunlight. It also has heavy volcanic and tectonic plate activity, leaving it marred and cratered (similar in appearance to the moon).[16] Mercury has no moon and only takes 88 days to orbitthe sun.[17]

Venus

The planet Venus is the second planet nearest the sun. It seems like it is very bright due to the fact that it has reflective cloud cover that is composed of Sulphur and sulphuric acid.[18] Venus has an atmosphere (mostly comprised of carbon dioxide) that is dense and traps the heat of the sun. Therefore, Venus is an extremely hot planet that can reach temperatures of 465 degrees Celsius.[19] Because of its brightness and close proximity to the Sun, Venus can be observed as a “morning” or “evening” star.[20] Due to its size and mass, Venus has been called Earth’s twin, however, Venus’s atmosphere is immensely dissimilar to that of Earth in that it has a surface pressure nearly 100 times greater than ours.[21]

Earth

The planet Earth is the third from the sun among the eight planets of our solar system. The “sweet spot” known as Earth has a myriad of characteristics that make it the sole planet that is habitable by life as we know it. Our Earth has a diverse geological make up and an atmosphere that makes it just enough to exist comfortably for several different organisms. There are biomes and ecosystems that harbor organisms and organic materials that thrive individually and symbiotically.

Simply put, Earth is unlike any of the other planets in our solar system. It is made up of large amounts of surface water (which account for the blue coloring) and has plenty of oxygen in its atmosphere.[22]

Earth is one of the planets that has a moon which orbits it. The Moon's gravity works with that of the Earth, helping control the "wobble" that occurs in Earth's rotation. Earth's Moon also affects the tides of the ocean and can be seen in different "phases" throughout its 27-day cycle.

The Earth is what is known as a "terrestrial" or rocky planet that was formed approximately four billion years ago. It is considered a medium-sized planet at about 12,760 km in diameter. There is a multilayered atmosphere which makes the environment "just right" for living creatures, with mostly nitrogen and oxygen.[23] There are additional layers from the surface of the planet to the interior, beginning with the crust, to the mantel, the core and inner core.[24]

Mars

Mars is a planet of lore, being magnified in pop culture as a likely planet to find life. Martians and other creatures were thought to have lurked here on the "red planet." Science and exploration have taught us that there is lots more to learn about this planet than meets the eye.

Named after the "God of War" due to its famous coloring, Mars is the fourth planet from the sun and notably smaller than Earth with a diameter of 6790 km. This rocky and dusty planet has a small metal core and no global magnetic fields.[25]

Mars is one of the only planets that humans have been able to exploresuccessfully, having placed roving vehicles on its surface. Viking 1 and 2 have provided us with abundant photography of the surface of this amazing planet, the rovers added to our knowledge. Other helpful explorations from these landers include weather stations that have provided a wealth of information on wind patterns and more. Furthermore, the landers have shown several land masses similar to Earth such as, volcanoes, canyons, sand dunes and even massive dust storms.[26]

Even though Mars has been shown to have a very thin layer of unbreathable air, one of the most astonishingdiscoveries is that there is evidence of water/ice on Mars. This is exciting, because water is almost always a sign that life (in any form) is a possibility.[27]

Jupiter

The massive Jupiter, named after the King of the Gods in Greek and Roman mythology, is the largest planet within our solar system.[28] The "Gas Giant," also known as a Jovian planet (from Jove, the ancient Roman name for Jupiter) is the fifth planet from the sun as well as five times the distance from the sun as Earth.[29] It has a diameter of approximately 142,800 km, 11 times larger than Earth.[30] It is an astonishing size and could possibly have become a star like the sun if it were only a bit larger. Although it takes Jupiter about 12 years to complete its orbit around the sun, one day (or complete rotation) is only 10 hours, making this one of the shortest "days" in the solar system. Fascinatingly, the axis's tilt is merely 3 degrees, which means that this particular planet has no seasons.[31]

One of the most compelling features of this gas giant is the large and mysterious "Red Spot." On After imaging from Juno, a spacecraft that orbits Jupiter, the "Great Red Spot" is not a mind bender at all. It turns

out that it is a humongous, hurricane-like storm that has been continually occurring for centuries.[32] The linear patterns as well as the large swirls visible on the mammothplanet are cloud structures that consist of ammonia and water. Jupiter's atmosphere is made up of mostly hydrogen and helium which is similar to that of the sun.[33]

Fig. 3 – Jupiter and its moon (Europa). The Great Red Spot is visible in this image. Photo credit: NASA, Voyager 1, JPL, Caltech.

On August 5, 2011, NASA launched Juno, a spacecraft that reached its orbit around Jupiter on July 4, 2016. Juno's mission is to gather more information about the Jovian planet by measuring to discover if Jupiter has a solid core, gathering data on magnetic field and noting the amounts of water and ammonia in Jupiter's atmosphere.[34]

Of the approximately 138 moons (satellites) in our solar system, Jupiter has 13 noted satellites. Four of them are the size of planets. They are Ganymede, which is the largest of all the satellites, Callista, Europa, and Lo.[35]

Saturn

Known for its admirable rings, Saturn is another Jovian planet, or gas giant. Its diameter is approximately 120,540 km,[36] which is about nine Earths side by side.[37.] Like Jupiter, Saturn is comprised of lighter gases such as hydrogenand helium but has a mass 95 times our planet Earth.[38.] Again, verymuch like the planet Jupiter, Saturn has clouds that are made of ammonia crystals.

Saturn, which was thought to have been the furthest planet from the sun at one time[39] , orbits the sun in the equivalent of 29 Earth years, but only 10.7 hours to complete its orbit around the sun at a distance of about 886 million miles.[40]

Saturn is another planet that is known to have multiple moons, and again, some of these moons have more characteristics of life sustaining composition than their giant parent planets. Saturn's more well-known moons include Titan, Tethys, Mimas, Enceladus, Rhea and Dione.[41]

Saturn is among the planets that have seen successful space missions using various spacecraft. Among these was Cassini-Huygens. Named after the early astronomers Christiaan Huygens and Giovanni Cassini, this Saturn orbiter and lander helped to revolutionize the amount of information we had regarding Saturn, its moons and its rings.[42]

The striking rings of Saturn were discovered around the time of the 17th century. As time went on, it was discovered that the rings were composed of ice and rock fragments in the millions.[43] The rings have small and large gaps among them said to be the sizes of ping-pong balls, tennis balls and basketballs.[44] The rings are about 275,000km wide and approximately1 km thick.[45]

Uranus

Uranus, like each of the other planets spoken of, is a unique celestial body. It is the third largest planet and also has rings. However, Uranus's rings are very thin and not as visible as those of the planet Saturn.[46] Uranus is so far away from the sun that its temperature can be as low as -214 degrees Celsius. This planet takes approximately 84 years to complete its orbit.[47] One of the most remarkable things about Uranus is that is rotates at an angle of 98 degrees. This means that it is basically lying on its side. Therefore, with the Sun hovering directly over the poles at times, they end up having a summer and a winter lasting about 21 years each.[48.] The reasoning behind the massive tilt of Uranus is yet unknown but is the cause such extreme periods of time in the Sun, versus away from it. One hypothesis is that an event of extreme proportions with a very large body, knocked the planet to the tilt that it is experiencing today.[49]

The composition of Uranus is mostly water, methane and ammonia, while the atmosphere contains hydrogen, helium and a bit of methane. This is why the coloring of the giant icy planet is blue.[50]

Neptune

Approximately 49,500 km in diameter Neptune is named after the God of the Sea. Said to be the twin of Uranus, Neptune's fabulous indigo hue is caused mainly by the amount of methane in its atmosphere. Like its fellow gas giant Jupiter, Neptune has winds that create storms. At one time, Neptune was known to have a "Great Dark Spot," similar to Jupiter's "Great Red Spot." It was approximately 10,000 miles long.[51] However,

in the 90s, during a fly-by, the Hubble Telescope recorded no such spot after examining the planet.[52]

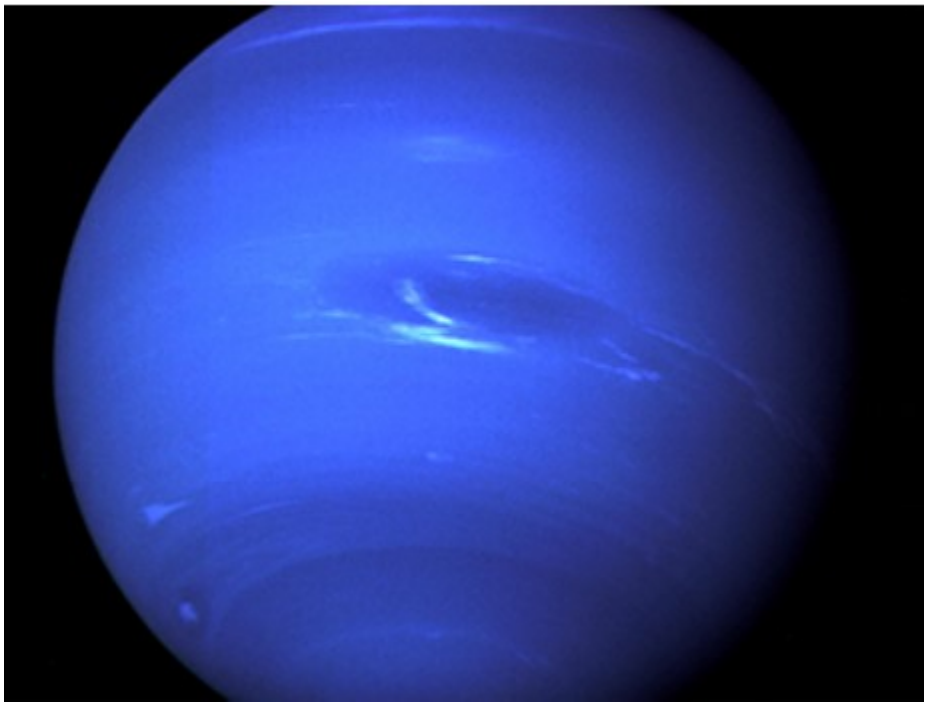

Fig. 4 – Neptune, as seen by Voyager 2 in green and orange filters. Photo credit: NASA, Voyager 2.

Neptune has about five rings that are very dark and not so visible while recording 13 moons. Triton is Neptune's well-known moon and is about the size of Pluto. It is extremely cold but does have a thin atmosphere.[53.] The mysteriousmoon is thought to have been captured by Neptune and travels in the "wrong direction (from east to west)."[54]

Voyager 2 has captured images of these outer planets including Uranus. Images include proof of cloud cover, winds and storms.

In 2011, the planet Neptune completed its maiden 165-year journey around the sun.[55]

Dwarf Planets

The name may be amusing, but these planets are giants when one considers the amount of information and wonder they carry. Dwarf planets have many of the same characteristics as the other eight of our solar system, but they have not yet cleared their path, or orbit around our sun. Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune are all on the same orbital plane. Our ninth planet, Pluto, which was previously included as one of the known planets, has been found to fall under the category of "dwarf." Other factors for this designation and demotion, in a sense, are that it has a small size and more elliptical orbit. Additionally, dwarf planets, though smaller than most, are not considered satellites.[56]

There are five most well known dwarf planets that are a part of our solar system are Ceres, Pluto, Makemake, Haumea and Eris.[54] There are also many others. Each of these dwarf planets exist in what is known as the Kuiper Belt. The only exception is Ceres, which can be found within the Asteroid Belt located between Mars and Jupiter.[55]

Comets, Asteroids and Meteors: space debris

Within our solar system lies a star, known as the Sun, many moons, and of course, the planets. Though quite significant these bodies are not the only materials in space. Additional materials known as asteroids, comets and meteors also share the massive amount of open space in the solar system. Maybe you can recall catching a rare glimpse of Haley's Comet or fearing that and asteroid would hit the Earth and destroy life as we know it. Here, I examine a world outside of simply stars, moons and planets by zeroing in on these very significant bits and pieces.

In 1801, Gianni Piazzi unexpectedly discovered what he thought to be a small planet. He soon realized that this was not so. Called a "minor planet," Piazzi named the discovery Ceres. Later, 3 more such bodies were discovered. The discoveries were located in the area we all know now as the "Asteroid Belt."[56] Asteroids in this zone follow the same orbit as the rest of the planets and lie in the space between Mars and Jupiter.[57]

Asteroids are not just floating rocks that threaten our existence if they come close to the Earth. The come in three different compositions and vary greatly. These three classifications are C (carbonaceous) which are dark like coal. The second and third classifications are S (stony/silicate) and M (metallic).[58] Asteroids are thought to have originated from the birth of the solar system and the sun. In other words, they might be described as the leftovers from the formation of the sun and the planets.

Some wonder if asteroids will collide with the Earth. This is a question of the ages. There are many objects that have entered Earth's atmosphere but have burned up upon arrival. These are known as meteors or meteorites (when they hit the ground). They are small pieces of asteroids that have made it through to land on the Earth's surface[59] And in fact, the extinction of dinosaurs is linked to such an impact. A great time to seemeteors is, of course, during a meteor shower. This is caused when the Earth moves past dust leftover from a passing comet.[60]

Comets are also a type of space debris that was left over from the formation of the solar system. Comets, however, consist of dust, rock and ice.[61] Although it is highly likely that there are billions of comets within the open space, currently, there are almost 4000 known comets in our solar system.[62] Most times we cannot see comets. It is when these icy, rocky bodies come closer to the Sun that they put on a glorious show. Upon approach toward the Sun, the comet forms a tail due to the Sun's heat. This tail can trail the comet for millions of kilometers.[63]

Exoplanets

So far, the greater focus has been on the well-known planets, moons and sun of our own solar system. Lest we forget, the universe is filled with billions of stars that are like the sun, our own star. Scientists and astronomers all around the world are looking way beyond our solar system and way beyond "just us." There are planets that exist elsewhere our Galaxy and perhaps in other galaxies too. Some far and some near. They have characteristics and compositions similar to Earth and the other planets. Their size is larger, smaller or close to the same size as Earth. In fact, there are a quite a few that have the possibility of supporting some type of life, or even life as "we do not know it." These planets have the moniker "Exoplanet" a shortened form of "extra-solar planet." Simply put, an exoplanet is that which likes beyond our solar system and is in orbit around another star. But the question of whether or not life exists outside of our solar system is quite common and not even a stretch of the imagination. The closest exoplanet lies not far away, at a mere 4 light years from our solar system.[64]

The properties of exoplanets are measurable and some are similar to the eight planets that exist in our solar system. They have volume, mass and density as well as notable temperatures and orbits.[65]

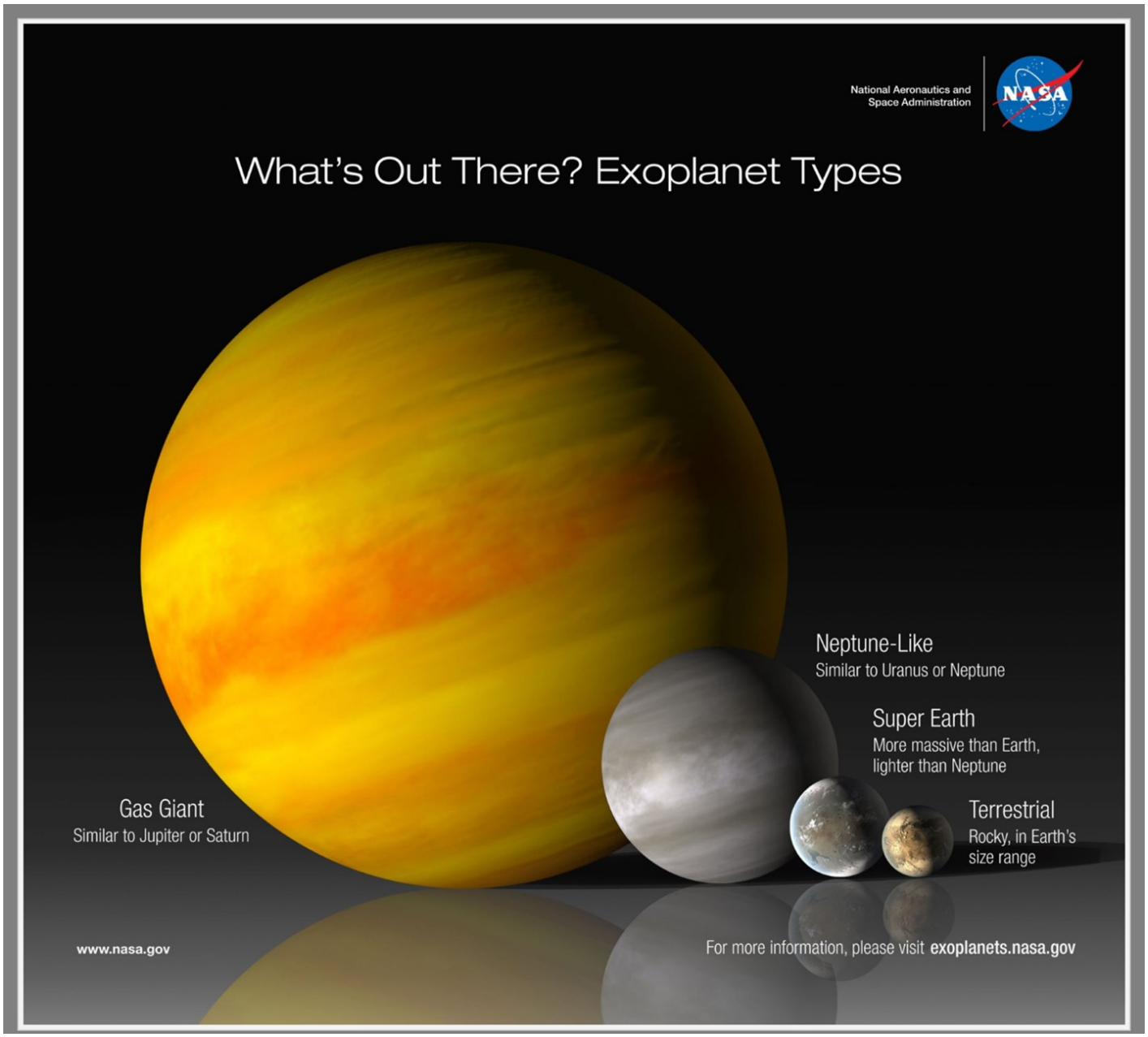

Fig. 5 – The above image shows the varying types of exoplanets that scientists have shown exist beyond our solar system's own sun. Credit: NASA

Proxima Centauri b is just a bit larger than Earth. Its orbit is around a star known as a red dwarf. This star is called Proxima Centauri ("proxima" because it is the star that is closest to the Sun and our solar system). Proxima Centauri is a part of a larger system that has three stars! This system is named Alpha Centauri.[66]

Proxima Centauri b is thought to be a rocky type of planet. It is just one planet orbiting one of the closest systems outside of ours. However, there are over 100 billion stars in our galaxy! The possibility for the number of exoplanets is nearly endless when you imagine if each one of those stars may have just one planet a piece. If it is a system like ours, there may even be upwards of trillions of exoplanets![67]

Science Fiction Genre:

When students enter the intermediate level of learning during their elementary years, there are, of course, several different types of writing in which they are expected to partake. Some of the pieces to be included in their portfolio consist of the summary, personal narrative, fictional narrative, informational and explanatory. Also, students at these grade levels (3-5) are expected to respond in writing in order to show comprehension. This is inclusive of responding to writing prompts after reading passages as well as TDAs (Text dependent analysis). Any of these particular writings can be found in the state assessments.

In order to implement a successful unit that includes a writing with a science fiction the genre needs to be examined thoroughly through history, lessons and readings. For this purpose, I have chosen to review two major contributors to the field in Jules Verne and H.G. Wells. "Frenchman Jules Verne and Englishman Herbert George Wells remain, arguably, the two most famous writers of science fiction in the genre's history."[68]

> There are so many different aspects of the science fiction genre, and many individuals argue over just what comprises it. There are a great many critics that deny that Verne wrote science fiction at all, even going as far as saying it is misleading to call Verne a science fiction writer, he goes on to quote Jean-Pierre Picot's flat denial of any science-fiction aspect to his work [Harris, 109]. Andrew Martin, whose The Mask of the Prophet: The Extraordinary Fictions of Jules Verne (1990).[69]

According to Roberts, "Character and action was frequently static, but the conceptual and imaginative elements were not only in constant motion but also related to a fundamental belief in the primacy of change. For many (myself included) this makes Wells by far the more interesting writer."[70]

Lessons and Activities

Introduction

The lessons and activities in this unit can be adapted to fit varying grade levels from third to fifth grade. The goal is to provide an authentic subject integration that will offer robust content and vocabulary along with rich, interactive experiences with staff and classmates. I have provided a look at the basic set up and implementation ideas. Notice the categories of "Blast Off," "Cruising," "Space Lander" and "Galactic Exploration." These headings refer to the type of lesson activity, and can be added to upon preference.

- *Blast Off:* Introductory set that can be used for multiple lessons, especially while introducing planets, etc.
- *Cruising:* Information sessions that provide the bulk of the non-fiction content. Students take notes, discuss and even add information from their own research.
- *Space Lander:* Vocabulary sessions that the children can refer to in folders/notebooks as they build on content and begin their science-fiction pieces.
- *Galactic Exploration:* Writing lessons and sessions in which the students brainstorm, draft, conference, revise, etc.

Always keep the three *essential questions* at the forefront as the lessons and activities continue.

"Blast Off": KWL Activity and Discussion

Objectives:

The students will share their background knowledge on the solar system as well as what they want to know about it.

Procedures:

After completing the KWL chart, the students will use: "Think-Pair-Share" to ponder the meaning of life. This is one of the three recurring and essential questions in the unit. Both sections will explore their classmates' contributions to the KWL chart as well as the essential question "what is life." They will/should be prompted to think deeply and search for ideas they may not have thought of in the past. The robust nature of this question and all that will come with it, is one of the keys to the success of the unit. Students must be scaffolded as they probe new ideas.

Materials:

- Unit Journals
- Organization/Information Folder
- Graphic Organizer (KWL Chart)

"Cruising": Information Sessions and Discussion

Objectives:

The students will take notes on information regarding the solar system and organize it properly, for future reference.

Procedures:

The students will embark on their information journey as they begin to delve into the solar system. Beginning with the sun and discussion on stars, students will take useful notes using key words and robust vocabulary. They will slowly build a solid and grade-appropriate knowledge base on the sun using information, interaction, and images from NASA, ESA, SETI and NOAA. Journals will be used for questioning and tracking any changes in students' thoughts on the essential questions. Notetaking is key and will be stored in folders for future reference.

- Unit Journals
- Organization/Information Folder (Notetaking)
- Graphic Organizer (Essential Questions and daily content)

The "Cruising" sessions will be ongoing throughout the unit as each area is introduced and discussed.

"Space Lander" Activities: Vocabulary

Objectives:

The students will define, discuss, write sentences, ask questions and *use* new and unfamiliar words within the

unit. Students will record content terminology along with notes from the sections of the units for future reference.

Procedures:

During the Space Lander activities, students will keep track of all new and unfamiliar terms in order to broaden their learning and construct word banks to use when they begin transferring their knowledge to science-fiction writings. Use the Define, Example, Ask (DEA) and Clarifying routine to help students unpack new terminology. By recording the words physically, they will retain the information a bit more. This will come in handy when they begin writing their science-fiction works. Encourage students to use the words frequently, in and out of the classroom so that it becomes embedded in their language.

Materials: Vocabulary organizer

***"Galactic Exploration" Activity:* Writing in the science fiction genre**

Objectives:

The students will use the information from the unit to write a science fiction piece which they will edit, publish and share with classmates.

The students will incorporate information from notes along with vocabulary into their science-fiction works.

Procedures:

After the content has been delivered, students will begin writing a science-fiction piece. Using the Writer's Workshop model, students will brainstorm, draft, revise, edit and publish their pieces. This will occur with teacher and peer input in order to help formulate well-rounded, robust writings with dialogue, character development and temporal terminology for clarity and comprehension.

Appendix on Implementing Academic Standards

The following standards are from the Pennsylvania Department of Education. They address the subjects under the heading of ELA and Science and cover grades 3 and 4.

Due to the integration aspect of this unit, I have included a few of the standards from each subject area the classes will be touching on (ELA-Reading and Writing/Science).

1. ELA: Reading informational Text

   Students read, understand and respond to informational text-with an emphasis on comprehension, vocabulary acquisition, and making connections between texts with a focus on textual evidence.

   Reading (key Ideas and Details, Main Idea, Text Analysis)

   CC.1.2.3.A: Determine the main idea of as text; recount the key details and explain how they support

the main idea.

CC.1.2.3.B: Ask and answer questions about the text and make inferences from the text to support responses.

CC.1.2.3.F: Determine the meaning of words and phrases as they are used in grade level text, distinguishing literal from non-literal meaning as well as shades of meaning among related words.

CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text.

Reading (Vocabulary Acquisition and Use)

CC.1.2.3.J: Acquire and use accurately grade-appropriate conversational general academic and domain specific words and phrases including those that signal spatial and temporal relationships.

CC.1.2.3.K: determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade-level reading and content, choosing flexibility from a range of strategies and tools.

2. ELA: Writing (Informative/Explanatory Content and Narrative Content)

   Students write for different purposes and audiences. Students write clear and focused text to convey a well-defined perspective and appropriate content.

   CC.1.4.3.A: Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

   CC.1.4.3.C: Develop the topic with facts, definitions, details and illustrations as appropriate.

   CC.1.4.3.M: Write narratives to develop real or imagined experiences or events.

   CC.1.4.3.O: Use dialogue and descriptions of actions, thoughts, and feelings to develop experiences and events or show the response of characters to situations.

   CC.1.4.3.P: Organize an event sequence that unfolds naturally, using temporal words and phrases to signal event order, provide a sense of closure.

   CC.1.4.3.Q: Choose words and phrases for effects.

3. Technology and Publication/Conducting Research

   CC.1.4.3.U: With guidance and support, use technology to produce and publish writing using keyboarding skills as well as to interact and collaborate with others.

   CC.1.4.3.V: Conduct short research projects that build knowledge about a topic.

4. Physical Science, Chemistry and Physics (Describe the composition and structure of the universe and Earth’s place in it)

   3.4.4.D: Identify planets in our solar system and their general characteristics. Describe the solar system motions and use them to explain time.

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