The Universe. It's full of Star's: Understanding the Scale of Planet Earth and the role of Gravity in our Universe

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Introduction and Rationale

Thankfully, science is becoming a bigger push of importance within the State of Delaware! After having worked in the state for five years now, the importance of science is continuing to grow and does not seem to be stopping. The Appoquinimink School District is continuing to integrate PBIS (project based inquiry science) along with Next Generation science standards. As our district has recently come out of the state science coalition (in which science kits were used), we are responsible for the planning and curriculum development to ensure all students meet the Next generation science standard stands. This curriculum unit is developed to ensure our 6th grade middle school students are able to access Astronomy curriculum. Astronomy is one of the large topics that students in Sixth grade are expected to master, along with Earth History and Force in Motion. Unfortunately, our district has not yet found a great fit for Astronomy curriculum. This unit topic will address the Next Generation Science Astronomy standards. This unit is built around the big question: What is Earth's place in the Universe? In addition, there are three guiding lesson questions that will ensure students will understand this big unit question. Those questions include: What is the scope of Earth in our Universe? What is the true size of our Universe? What is the role of gravity within our Universe? This curriculum unit will provide background research as well as activities for middle school teachers to access in order to lead their students towards mastering this Next Generation Science Standard.

The unit topic that I have decided upon is: Understanding the scale of Planet Earth and the role of Gravity in our Universe. This unit topic is supposed to get the students to understand the scale and size of planet Earth in comparison to the rest of the universe. An additional goal of this unit will be for students to also understand gravity and its role in our Universe.

This curriculum unit will be taught to a group of 6th graders at Louis L. Redding Middle School. These students will be a part of a 6th grade Science inclusion classroom. Overall, there are approximately 130 students split up amongst four classes. Within each classroom there are approximately 15 of 30 or more students that have an individualized education plan (IEP). These students' disabilities range from Learning Disabled, Mild Intellectual disability, Autism among others. There is overall an equal mix of boys and girls within these classrooms. In addition, there are approximately 30% African American, 60% White and 10% other.[1]

Three years ago the Appoquinimink School district adapted a new science curriculum to replace the Delaware science kits. This curriculum is entitled: Project Based Inquiry Science. This curriculum hits all the major topics of the Next generation science standards while giving students an interactive learning experience. Within the PBIS (project based inquiry science) unit students are given a major question or challenge. Throughout the units of study students will investigate and use scientific knowledge they have learning to work together collaboratively to solve the question.[2]

As stated above, the Appoquinimink School District adopted the PBIS (project based inquiry science) science curriculum three years ago. Thus far 6th graders have done three different PBIS units throughout the year that address three of the four Next generation science standard strands that 6th graders are supposed to learn. The unit that 6th graders have missed the past few years is Astronomy! That is where this DTI lesson will come in handy, this DTI unit will address this missing Astronomy piece that our students have not received in previous years. In addition, Astronomy sparks great interest in our Middle School students! So far in their education career, students have a basic understanding of the planets within our solar system but not an understanding of what is going on outside of our solar system and what Earth's place is within our Universe. I believe this Unit will address these weaknesses that many students carry with them into 6th grade. Teaching astronomy with connect to other units already embedded within our curriculum. Students have already learned about the Earth and the processes that occur within the earth.

Learning Objectives

As previously mentioned, this Unit's primary goal is to address pieces of the Astronomy strand of the Next Generation Science Standards that the Appoquinimink School District has adopted. Thus far, the Appoquinimink School district has not adapted curriculum to address the specific astronomy strand of the Next Generation Science Standards. Moreover, it has been determined by our school district that 6th grade teachers will be responsible for covering this strand this year. The astronomy unit will be the last unit taught this year and we will have approximately two weeks maximum to go through this strand. This unit curriculum will only address a piece of what will be covered eventually in sixth grade. Overtime, we will work to ensure a unit has been developed that address all aspects of the astronomy next generation science standard strand. There are three astronomy objectives within Next Generation Science Standards that 6th graders must master[3]. Those include: What makes up our Solar System? What is Earth's place in the universe? As well as, how can the motion of the Earth explain seasons and eclipses? The learning objectives are a mixture of creation from both the Next Generation Science standards, PBIS (Project Based Inquiry Science) science curriculum as well as the Learning Focused Strategies (LFS) that we following as a school district.

Coming into 6th grade, students have a basic understanding of our solar system and the planets but many do not understand aspects of what is going on outside of our solar system[4]. This DTI curriculum will address some of the following standards:

1. What is Earth's place in the Universe?
2. What is the roll of gravity in the universe?

Essential Questions (APPO LFS):

On top of adapting the next generation science standards as our basis for Science standards and goals the Appoquinimink School district also implements LFS (learning focused strategies). LFS entails a Unit essential question that the students must answer by the end of the unit as well as lesson essential questions that students must answer throughout the mini lessons within the unit.

LFS is a very successful guide for students, families, administrators and teachers to follow. For all, it gives us the ability to understand the progression in a unit and where things are going next. When students are fully introduced to their unit as well as their lesson essential questions, they are able to understand what they need to work on to gain the scientific knowledge that they need.

It is a continued expectation by our school district that we are using Unit and Lesson essential questions. In previous years these essential questions were provided along with the Delaware State Science Standards. Since adopting the PBIS (project based inquiry science) science curriculum and next generation science standards we as teachers now must create these essential as a team. They go hand and hand with the standards, in order to create these essential questions we simply dissect what students need to learn through each standard and convert that standard into question format. This can be easily done throughout any science unit as long as the teacher is able to access the standards students must gain.

Unit Essential Question:

One of the key components of LFS are the unit essential questions. The unit essential questions are presented to the students at the start of the unit. The unit essential question will be the major topic that students are expected to learn. In addition, the unit essential question will be the topic addressed in a student's final assessment for this unit. The unit essential question for this unit is:

- What is Earth's place in the Universe?

Lesson Essential Questions:

To build upon the unit essential question it will be important to have a few lesson essential questions. The lesson essential questions help build student knowledge to help students get to the final goal of the unit essential questions. It is understood that following each major topic within the unit the students will be able to correctly answer these questions. Combining the answers to the three questions below will guide students towards and answer to the unit essential question. The following three questions are the lesson essential questions that students must build upon:

- What is the scope of the Earth in our universe?
- What is the true size of the universe?
- What is the role of gravity within our universe?

Content Objectives

Student Prior Knowledge

This is our students first year working with a full astronomy curriculum. In previous school years, students have basic knowledge of space, the earth and the planets but they have not gone into greater detail and specifics. 6th grade in the Appoquinimink School District is the first year that students consistently have one hour of Science instruction on a daily basis.

Astronomy will be the last unit that students will receive in the year. Students have previously focused on three units. The first unit gave students background and developed their next generation science standard engineering and design processes. This unit allowed students to learn to work together as scientists, develop problems, complete research and answer questions and/or challenges based on a phenomena.[5] This idea and these NGSS engineering and design processes and strategies will be helpful to these students for many years to come.

The second unit this year that students focused on was Ever Changing Earth. Ever changing Earth focusses on the processes of the earth. Here students learned about the basics of the earth, the processes of the earth as it is changing and the geography and topography of the Earth. This unit gave the students the background in understanding the Earth as a planet within our solar system.[6]

The third unit of the year student's studies was entitled Vehicles in Motion and it discussed forces at work on our planet. Specifically it relates to how forces interact to cause an object to move. One of the biggest ideas the students learn is gravity and its role on Earth. Students understand that Gravity is the force pulling all objects to the center of the Earth. In addition, students understand that Gravity is the force that is keeping to

moon in the solar system. Further than that students must gain knowledge to understand gravities role in our Universe as a whole.[7]

Our Universe

The Universe includes many different aspects. It is everything that is detected with our five senses. Some of the aspects that are included within our Universe include living things, stars, and planets, galaxies, light and time among the few. Before the existence of the Universe these items did not exist. Our Universe contains billions of galaxies, more than we even know. Even for adults this is a hard topic to understand let alone for students to understand. Once examples given from "Story of the Universe" is that it would take a modern jet fighter one million years to reach the nearest start to the Sun and there are billions more to add to that. In addition, it would take approximately 100,000 years to cross the Milky Way galaxy.[8]

The largest known theory recognized by Scientists is that of the Big Bang Theory. The Big Bang theory is the scientific theory that addresses the expansion of our Universe. This theory describes a massive heat explosion that caused the start of the Universe close to 14 Billion Years ago. The start of the big bang was extremely hot, hotter than even our most brilliant Scientists can understand. Over time (and continuing), our Universe is cooling down. Similar to the era's represented in the formation of our Earth, the Big Bang Theory is represented by Era's as well. First, came the Big Bang in which the temperature was so hot an explosion occurred. Following the initial Big Bang came the radiation era. The radiation era occurred soon after the Big Bang and was a very short era in which the size of the Universe was about the size of a football and quickly began to expand! Following this came the "Dark Ages" of the Universe in which matter and anti-matter partook in a fierce duel to win over Space! This occurred about 300 million years following the big bang and lasted a total of 1 billion years. The term the Dark Ages comes from the idea that there were no stars or planets at this time therefore resulting in literally a very dark phase of the Universe development. After this 1 billion years of the Dark Ages duel, the stars and galaxies begin to form.[9] It is very important that we discuss with students that the universe is constantly growing and changing. As with all topics in science new items are being discovered everyday so what we know now could change tomorrow.

Earth's Place in our Universe

As stated above in the prior knowledge, many students do not fully understand the scope of Earth's place in our Universe. Similar to the thoughts of astronomers many years ago, our students know of the Earth, the sun and a few other planets within our Universe and that is about all.

When astronomers first began exploring our earth, space and atmosphere it was believed that Earth was in the center of the Universe and the only planets and stars believed to be within our Universe are those that can be seen with the naked eye. The part of the universe that has been touched by light within the observable universe (through any form of telescope, rover etc.) is said to be titled our observable universe. The observable universe will depend on where you are located at that given time. Of course, in our case the observable universe is typically what is able to be observed from Earth?

Beginning in the 17th century, the heliocentric model was adapted. This model was adapted from observations made by William Herschel and other colleagues. This model expanded our view of Earth's place in the universe and explained that the Sun was a part of a disc shaped galaxy and this disc shaped galaxy was made up of stars. By the 20th century observations of the spiral nebulae were made which led to the idea that our galaxy was one of a billion other galaxies in an expanding universe.[10]

Following the many years of observations scientists now believe that there is no center or edge of the universe. Therefore, it is very difficult to pin point Earth's exact location in our Universe. Therefore, scientists describes Earth's location as being the center of Earth's observable universe.

When discussing Earth's place in the Universe with our students it will be important to discuss this phenomenon with them so that they get a basic understanding that much is still unknown. The best way we will explain this to our students is we will to compare the location of Earth with other structures within our galaxy and our universe.[11]

Size of the Universe

Another very difficult topic for students to understand is how larger our solar system is. Students in the past have understood that the Universe is huge but possibly the largest things they have ever seen is an airplane! I cannot begin to fathom how many airplanes you would need to explain to students the size of the universe. [12]

The Universe is known as all of space and time and their contents. Their contents are known as the planets, stars, galaxies and any other form of matter and energy. The actual spatial size of the Universe is still unknown as it is near impossible to measure. All we can truly measure is our observable Universe.

The space is so vast that it is difficult to truly define the size of the Universe. Scientists believe that since the Universe is ever changing, it is possible that any light or radio waves we admit will not even make it to the end of the Universe before more of the Universe has been created.

Scientists have found a measurement of the universe at this specific present time from Earth to the edge of the observable universe and that is 46 billion light years. This means that the diameter of the observable universe is approximately 93 billion light years. But remember, this is only the measurement of the observable Universe it is known that there is much more vast time, space and contents beyond what is observable.[13]

It is important to mention that just because we are discussing our observable Universe there is still a vast about of parts of the Universe that we cannot see. This is due to the finite speed of light. We consider all objects to be with our observable Universe if the light reaches that piece of the Universe.

In order for students to understand this phenomenon we will have to use specific models and simulations to have students understand that the Universe is as vast as it is. The Andromeda Galaxy is approximately 2.5 million light years away (this is the sister galaxy to the milk way). We can use this to compare the distance and size between these parts of the Universe.[14] Throughout this unit we will be able to use the ages listed above to scale them down so that we can get a more realistic view as to the true size to the universe.

Gravity's Role in our Universe

Prior to this unit students have spent two months on the PBIS unit entitled "Vehicles in Motion". This unit encompasses the forces at work that cause a vehicle to move. Throughout this unit one of the big force topics is gravity. At this points students understand that gravity is pulling us vertically downward toward the center of the earth.[15]

Gravity is the force that acts as glue to hold the universe in place. This is a great analogy to tell to students. As stated, students thus far understand that gravity pulls us vertically downward towards the center of the Earth. We can in turn describe to students that Gravity is like the glue that holds us onto the Earth and it works the same way by gluing all of the Universe together.[16]

The force of gravity depends on the overall mass of an object. Although, it is important to take into consideration that it does not only depend of the mass of one objects but the mathematical formula of the two masses of the two objects that are interacting. Therefore, the greater the mass of an objects the greater the gravitational pull that the object exerts. Gravity holds all of our planets in orbit around the sun. In addition, gravity holds our moon in orbit around the Earth.[17] The ocean tides are also caused by the gravitational pull that the moon is giving off – the moon is pulling the ocean water towards it causing these tides. Within our solar system, the sun in the largest object and is much more vast that the rest of the planets. Because the mass of the sun is larger than any other object in the solar system, the planets and all other object orbit around the sun. Once again we think of the gravity of the glue that is holding the planets inward towards

the sun. Without gravity within our universe planets, suns and other contents of space would be flying around all over the place! Gravity is key to keeping our solar system the way it is.[18]

Strategies

Kagan Cooperative Structures

One of the many strategies used in my classroom daily are Kagan Cooperative Structures. There are close to 60 Kagan structures that promote student collaboration in the classroom. Some of these structures are Round Robin, Think Write Round Robin among others. The two that will be used throughout this unit consistently are the Round Robin and Think Write Round Robin collaborative structure. These Kagan cooperative structures are to get at least 50% of the students simultaneously engaged at one time.[19]

Kagan cooperative structures are a big push throughout the Appoquinimink School District. It is an initiative within our school and is supported by our administrators as well as Kagan officials that come to observe to ensure we are using best practices when using the structures.

Science can be a very difficult task for many 6th grade students. We find as teachers that science in the elementary level is completed at times but it is not a huge push and often students only get science a few days a week. Therefore, when students come to 6th grade there is a large discrepancy at times between students that have large science background as well as those that do not have a science background. This is where Kagan becomes very helpful as it engages all students! Kagan structures allow students to build off one another's ideas, problem solve as well as gain new ideas. Kagan is a great strategy for any student in any school and I highly recommend its use!

Learning Focused Strategies

The Appoquinimink School District is a learning focused strategy school district. Learning focused strategies are based around a unit essential questions and subsequent lesson essential questions. Learning focused strategies are based on getting students to understand the big ideas of a unit in question form that they will need to answer. Not only are learning essential questions helpful to the students (as they are made to be students friendly), but they are very easily understandable by parents and families as well. All students receive a learning map at the beginning of every unit. This learning map first lays out the unit essential question – this is the overarching question that the students will be able to answer at the end of the unit. For this particular unit the unit essential question is: "What is Earth's place in the Universe?" Following this the learning map is broken up into separate lesson essential question that students will be able to answer following each lesson. These lesson essential questions will build upon one another and guide students to

answering the unit essential question. The lesson essential questions for this unit are: What is the scope of the Earth in our universe? What is the true size of the universe? What is the role of gravity within our universe? In addition, learning focused strategies also focus on vocabulary integration through the units and this is also an important component of students learning maps.

Appoquinimink School District left the state science coalition soon after the Next Generation Science Standards were adapted. This was due to the fact that the school district leaders felt that the state science kits did not directly correlate with the Next Generation Science Standards. Therefore, we began use the PBIS science curriculum by it's about time for these units. Although this program does not lay out specific essential questions the units all base around the Next Generation Science Standards and either pose a question or a challenge. From these questions or challenges that are proposed by the PBIS units teachers can easily create essential questions that support LFS strategies.

NGSS Engineering and Design Process

NGSS stands for next generation science standards and is the basis for the Delaware Science Curriculum. Next generation science standards describe different behaviors, activities and behaviors to attempt or to solve a phenomena. There are eight different strands when discussing the next generation science and engineering practices. The eight strands that the science coalition refers to as NGSS science strands are asking questions and defining problems, developing and using models, planning out investigations, analyzing and interpreting data, using mathematics and computational thinking, constructing explanations and designing solution, engaging in argument from evidence, and obtaining, evaluating and communication information. Throughout this unit students will use all eight in a capacity but students will use three of these eight in detail. I will explain in more details below the three main next generation science standard strands that will be addressed in the unit.[20]

The Next Generation Science Standards have been adopted by the entire state of Delaware and have replaced our Delaware state science standards. The Next generation science standards have many benefits to increase our student's performance in the area of science. The national wildlife federation lays out six benefits of using the next generation science standards that are a great idea![21] Some of these are the first is that these standards encompass major content focuses having to do with space and the Earth's environment. Second, next generation blends the use of successful teaching practices and methods that get students involved in the scientific process. Below, I will lay out some of these Next generation teaching practices that this curriculum unit will cover. Third, NGSS truly promotes the strong relationship between science and engineering as students will continue to gain throughout their schooling career. There are just some of the many benefits to incorporating NGSS into our science courses.[22]

Next Generation Science Standards: Developing and Using Models (only strategies not activities)[23]

Developing and using models is one of the key practices of NGSS developed by the NSTA (national science teacher association). This practice is also extremely important for a variety of students. As my background is one of an inclusion teacher, my classes are made up of close to 50% special education students. Since adapting NGSS and science units based on these practices I have seen student's scientific knowledge soar!

Developing and using models is crucial as helpful tools and resources for students in their everyday science classroom. Models could include anything from diagrams, drawings, replicas, analogies as well as simulations. This practice is especially important for this unit. It will never be an option for our students while in school to travel and see space, the earth from space, the moon etc. Developing models for our students allows them to work with objects most like what they would see if they were able to travel and explore these locations.[24]

Throughout this unit our unit essential question is: What is Earth's place in the Universe?" Students will need to develop models to truly understand this and our learning essential questions. Some of the activities we will cover throughout this unit are developing scale models to represent the scale size of the earth, sun and moon. In addition, we will develop models to help students visualize the size of our solar system and the distance between different planets, moons and stars.[25]

Next Generation Science Standards: Using Mathematical and Computation Thinking

While teaching science, there are many times when mathematical and computation thinking come into play. This next generation science standard strand goes hand in hand with our students developing models and simulations. When developing models students must understand how to scale down and represent something very large into something smaller following an appropriate scale.

For this unit students will need to understand how to use mathematical and computational thinking to translate scales of the sizes of different parts of the Universe. One of the activities that will be designed for this unit is for students to translate the scaled difference between the sun and different planets. For example if we tell the students the actual difference between the Earth and the Sun, we will expect students to carry out mathematical computation in order to simulate and model the distance between the sun and Earth as we can see in either in our classroom or outside of the school.[26]

An example of an activities students may complete during this unit is to go outside and understand on a scale model the distance between the sun, earth and other places in the universe. Students will receive the actual distance between these locations in space

and an equation in order to lead them to understanding this distance on a smaller scale. Students will compare the size of the object on a smaller scale with the space objects they will be given. In the end students will use their mathematical and computational thinking strategies that they have developed to model a scaled example of the distance between these different objects in the earth.[27]

Technology Integration

Technology is a huge push within the Appoquinimink School District. All middle school and high school students are one-to-one technology programs. Our middle school students receive an iPad in 6th grade that follows them through to 8th grade. In addition, high school students receive a chrome book at the beginning of 9th grade and keep it until they graduate. Having the capability for students to use one to one technology on a daily basis gives us the ability to access videos, programs and other items on the we at all times.

As we know, space is difficult for students to understand and with the ability to use technology to incorporate into this unit, students have vast resources at their fingertips. There a few ways students will use technology throughout their activities. Some of these include, drawing pictures of distances on their drawing apps, simulation and constellation applications, the ability to view videos as well as the ability to have infinite research at their fingertips.

As students continue to advance through schooling and into the workplace technology will be a huge push. Technology is a key component of both guiding our students towards becoming a 21st century learners as well as guiding our students to mastering the next generation science standards by the end of their schooling career.

Classroom Activities

Activity 1: Technology website use & Reflection

All students within the Appoquinimink School District receive an iPad to both use in school as well as at home. As stated above technology integration is a large component of this unit of study. Students will visit the website on their ipad: http://joshworth.com/dev/pixelspace/pixelspace_solarsystem.html. Students will have learned about the scope of the Universe and the basics about the size of the parts of the Universe. Students will spend approximately ten minutes exploring the site with their table groups. Students will complete a reflection activity through Schoology following their observations of the website.

The website provided above is a great resource for students. First, it integrates the ever important aspect of technology within the activity that truly engages students. This

website shows a linear scrolling scale of the Universe. It shows in comparison on this scale of the size of the sun (which is shown as the size of a golf ball) to that of mercury (that looks the size of a fine dot from a thin point pen). In addition, the website scales the distance between the objects as well.

The reflection Activity within schoology will be set up as a discussion board. Students will discuss the question – "What surprised you about the scope and size of our Universe?" Following answering this question students must respond to at least two other classmates scientifically. (Worksheet 1)

This activity is an intro activity that students will begin after they are introduced to the basic concepts of our Universe and how vast it truly is. This activity will allow them to explore the site and get a firsthand look at the size of the Universe before moving on to the more complex activity 2.

Activity 2: Model development & Scale of our Solar System

One of the most difficult aspects of understanding our universe is for students to understand the size of the universe. Therefore, we will be completing an activity so that students can model within the confines of our classroom the size of the sun and planets. Students will be given a worksheet for the first part of this activity in which they will need to do some mathematical calculations as well as analysis in order to determine models that represent the earth.

Students will receive the worksheet "Scale of Our Solar System" (worksheet 2) in order to complete part 1 of this activity. Students will also need their iPad in order to complete research throughout the assignment and as a calculator resource.

Included on the worksheet is the mathematical computation scale that the students will use to determine the model scale of the universe they will need to find. Students will take the diameter in kilometers of the planet, divide that number by 63,780 (as shown in worksheet 2) then, students will receive the scale in centimeters of each planet.

Step one – students will need to conduct research with their table groups to determine the actual diameter of each solar system object listed. Students will record their findings in column 2 of their worksheet (see worksheet 2).

Step two – once the actual diameter is recorded, students will use the scale at the top of the worksheet to calculate the model diameter size (in cm) their model must be in order for it to accurately represent the Universe. Students will record their findings in column 2 of their worksheet (see worksheet 2).

Step 3 – students will need to pick an actual model that represents the model size of the solar system object. They may need to do actual research to determine objects of this size. Students will record their findings in column 2 of their worksheet (see worksheet 2).

Following the completion of this activity we will ask students to bring in examples of their model to school the following day so we have a show and tell type lesson to represent the objects of the solar system.

Activity 3: Understanding Gravity

Students will complete a basic gravity lesson and then complete correlation between gravity and how it has helped formed the universe that we know. For example the reason that the sun has so much orbiting around it and smaller moons do not.

I will first review with students some basic concepts in a whole group format. Those terms include, gravity, planets and models. Gravity is the force that keeps the planets in orbit around the sun. Planets are objects in space that have size, mass, density and composition. Lastly, models are objects that help us observe large item scales.

In addition, it is important that students remember that the mass of both objects in question and the relationship between those masses (in this case the planets and the Sun) determine the gravitational pull on that object and the strength of the gravitational pull.

Students will receive 5 different objects of different mass to represent the difference in mass between the Sun, Mercury, Venus, Earth, and Mars. Students must first order the solar system objects from greatest mass to least mass. Following this students will find objects of 5 different masses to represent these solar system objects. Students will record on worksheet shown on worksheet 3.

After the materials are gathered, students will complete an activity step by step using Kagan strategies in order to determine how gravity affects mass while discussing the objects they decided upon.

Once students complete their in class discussion with their groups they will work with their groups to attach two different models of space objects to a string (for example Earth and Mercury). They will then hold the string so both objects are the same height from the graph. Students will the realize that the side of the string holding Earth will require more force to even out with Mercury because the mass of earth is larger. This will prove that Earth has a greater gravitational pull than Mercury.

In the end, students will complete a summary of the activity on their worksheet in which they will determine that the larger mass of an object the greater gravitational pull is required. (See worksheet 3)

Appendix A: Next Generation Science Standards Addressed

MS-ESS1-1 Earth's Place in the Universe

Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.

MS-ESS1-2 Earth's Place in the Universe

Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

MS-ESS1-3 Earth's Place in the Universe

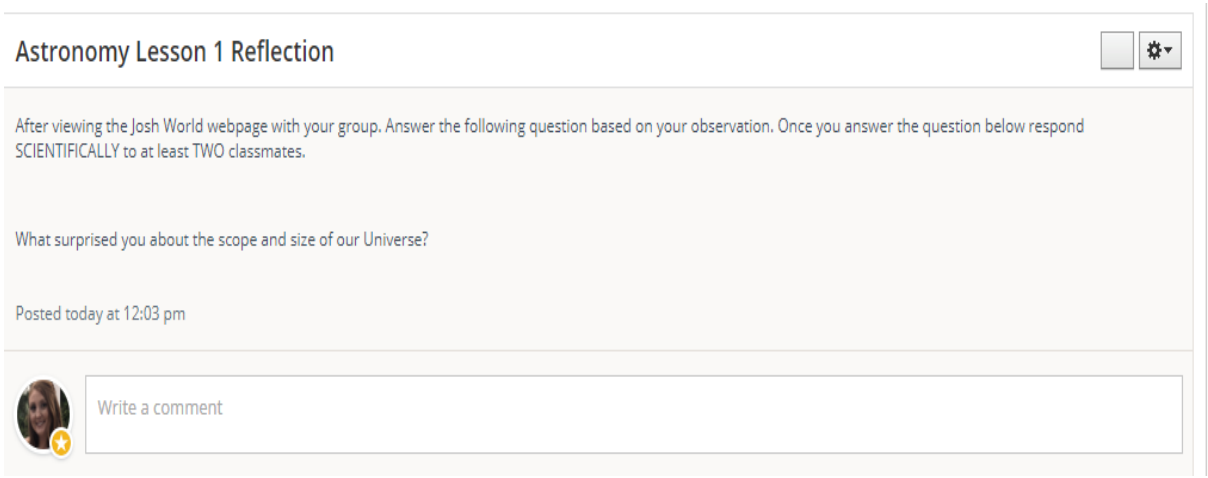
Analyze and interpret data to determine scale properties of objects in the solar system.

MS-ESS2-1 Earth's Systems

Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

Curriculum Unit Worksheets

Worksheet 1



Worksheet 2

Name: _____ Date: _____

Scale of Our Solar System

Scale: 1 cm = 63,780 km

	Actual Diameter (km)	Model Diameter (cm)	Model
SUN			
MERCURY			
VENUS			
EARTH			
MARS			
JUPITER			
SATURN			
URANUS			
NEPTUNE			

Worksheet 3

Name: _____ Date: _____

Gravity and the Solar System

1. Order the Sun, Mercury, Venus, Earth and Mars from greatest measurement of mass to least measurement of mass.

   _____

   _____

   _____

2. What objects will you use to represent the difference in masses between the solar system objects?

   a. Sun _____
   b. Mercury_____
   c. Venus _____
   d. Earth _____
   e. Mars _____

3. Conclusion: What is the relationship in the Universe between mass and gravity?

   _____

   _____

   _____

   _____

   _____

Notes

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This resources was used to access the Next Generation Science Standards that must be covered in 6th grade Space Science.

Holveck, B. Gadbaw & S. 2017. "Moving Students towards a more accurate view of the solar system." *Science Score*, March: 40-65.

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It's About Time. 2016. *Ever Changing Earth.* Mount Kisco: 2nd Printing.

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J. O Bennett, M. Donahue, N. Schneider and M. Voit. 2017. *The Cosmic Perspective.* Boston: Pearson.

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Mant, J. & Summers, M. 2006. "Some Primary School Teachers understanding of Earth's place in the Universe." *Research Papers in Education,* 101-129.

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NASA. 2017. *What is Gravity?* May 4. https://spaceplace.nasa.gov/what-is-gravity/en/.

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NSTA. 2014. *Access the NGSS by topic.* https://ngss.nsta.org/AccessStandardsByTopic.aspx.

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Parker J., Heywood D. 2007. "The earth and beyond: developing primary teachers understanding of basic astronomical events." *International Journal of Science Education,* 503-520.

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Pearson Education, Inc. 2013. *Lecture-Tutorials For Introductory Astronomy.* Pearson.

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This resource provided demographic information for Louis L. Redding Middle School where I am currently a 6th grade teacher.

Thornburgh, W. & Tretter, T. 2017. "Explaining patterns in our solar system and the role of gravity in space." *Science Score*, December: 78.

This resource provided factual information to better understand gravity in the Universe and how that places the planets and other objects in our Universe where they are.

Williams, G., Oulton R., & Taylor, L. 2017. "Constructing Scientific Models through kinulations." *Science Score*, December: 64.

This resource gave explanation and examples of how to construct models with students to better understand large scope ideas - such as Space.