

Unpacking Place Value

Navajo Constellations

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“Mathematics is not about numbers, equations, computations or algorithms, it is about understanding.” William Paul Thurston

“Navajo astronomy reflects the idea that with age comes wisdom in the constellation Áltse Etsoh. This constellation translates to English as “The First Great One” and depicts a man with a cane in his hand who represents the elders. Elders are our story tellers” Navajo Code Talker

Introduction

This unit is on the Navajo Constellations. It will provide an insight on how math is embedded using the place value system. Understanding place values will help students understand and comprehend the scientific notation and why it is used when writing and multiplying large numbers when talking about the constellations. On the Navajo reservation many people are able to see the bright stars because many Navajos do not have electricity and live in rural areas of the reservation. The bright stars can be seen in rural areas because our nearest neighbor lives many miles away from us. If they live in town and they wanted to do some star gazing then all they need to do is drive a few miles away from their homes to take in the breath-taking views of the night skies that we have here on the reservation.

After graduating from high school I moved to Tempe, Arizona to go to college. On weekends we would take trips back home just to enjoy the cooler weather and look at the bright stars that filled the night sky. Leaving the city to see the bright stars was an adventure. Childhood memories for me was sitting on the tailgate of my dad’s old Ford truck and looking up at the stars to find and identify the most common constellations in the sky. I always wondered what it would be like to be an astronaut up in space and be surrounded by the stars, the moon, and different planets.

Context and Rationale

School and Community Demographics

I teach at a state funded school located in a rural part of the Navajo reservation. The school is called Tsehootsoo Middle School. This is my second-year teaching there. The school is 10 minutes away from the capital of the Navajo Nation called Window Rock. It is also 50 miles west of a nearby town called Gallup where most people shop for food and other goods. The school is located in the Apache County and has seven schools within the district that serves communities within a 65-mile radius.

According to the 2010 Census count there was 332,129 Navajos living in the United States with 173,667 residing on the Navajo Nation. The Navajo Nation span across 17,544,500 acres of land. The reservation sits in four states, which are New Mexico, Arizona, Colorado and Utah. The Navajo Nation has a variety of breathtaking terrain which includes, desert, forest, plateaus, mesas, and mountains. Some families today still live in homes where they lack running water or electricity. In addition, some families do not have internet access which makes it sometimes difficult for students to continue to learn at home.

Tying in culture with math lessons is important. Our Arizona Merit scores shows students who took the test at the end of the year in 6th grade, SY 19-20, showed the need for an increase in

knowledge of mathematics. 13 students were on my caseload and 2 students were in the New Mexico School District. The scores only reflected 11 of the 13 ESS students on my caseload. 91% performed in the minimally proficient category and 9% scored in partially proficient. These scores reflect that students are struggling in math and need more opportunities to learn their knowledge of place values and how to interpret math problems and solve them. Strategies are intended to; 1. Build meaningful links between the world of written number symbols and the world of concrete reality and 2. Provide examples of linking diverse number models from discrete (counting) to continuous (visual-spatial, pattern oriented) of number relationships and place value (Sharma, 1993).

History of the Community

Looking back in history, Fort Defiance was first noticed by U.S. military Colonel John Washington. Fort Defiance was established on September 18, 1851, by Colonel Edwin Sumner to create a military presence in Navajo territory. The fort was built on valuable grazing land which the federal government prohibited the Navajo's to use. Once the U.S. military was established they were allowing white settlers to live on the land. This upset the Navajo's which created raids and conflict between the Navajo's and U.S. military. When the Civil War occurred, Fort Defiance was abandoned. Raids continued within the area so Brigadier General James H. Carleton sent Kit Carson to impose order. The fort was reestablished in 1863 for Carson's operation against the Navajos. General Carleton's solution was cruel and his plan forced thousands of Navajo's off the reservation. The Navajo's endured a 450 mile walk to Fort Sumner, New Mexico. This walk is known as the, "Long Walk." In 1864 the fort was abandoned once again. Eventually a treaty was established between the Navajo's and U.S. military, "The Navajo Treaty of 1868" allowed Navajos to return back to their homeland and Fort Defiance was reestablished (Wood, 1991). The first day school was in 1869, the first boarding school was 1871 and the first public school was established in 1894 (Donovan, 2018).

Past and Present Education

The Navajo Treaty of 1868 required the government to provide education to Navajo children. Eventually boarding schools were created; the first off reservation Indian boarding school was founded in an old army barracks in Carlisle, Pennsylvania in 1879. Boarding schools forced parents to have their child receive an education off the reservation away from the families. Native Americans were forced to have an education because past presidents wanted to civilize the "red man". The phrase "Kill the Indian, save the child," was what the white man believed would have been a better lifestyle for all Native American children. A child's Native language and culture was forbidden so a lot of stories and history of who we were as Diné people were told orally and rarely written in books. This makes our history and stories very valuable because it is a record of our existence and who we are as Diné people.

Despite the trials and barriers we have faced over the years, education has always been a priority and the way it was approached long ago is different from how it is taught today. Some recent changes we have to adapt to is, our delivery of instruction, and lack of resources in rural communities. We need to ensure that our students have teachers who are willing to provide students with the extra support that they need to be academically successful. It especially needed now more than ever due to the recent pandemic which has affected many families and the way

we will be delivering our instruction to our students. It is imperative that we persevere and prepare our students for the technology and jobs needed in the future. Although we are going through all of this as a nation we are still trying our best to promote and advocate the importance of an education despite the resources we lack on the reservations.

Influence to Why the Unit was Written

My goal for writing for this curriculum unit is to help educators realize that the most important principle for a teacher is to be culturally responsive. A teacher who knows who and where their students are coming from will have cultural knowledge of how to address issues that may arise when educating their students. This method will not only help to make a more equitable classroom where we make meaningful connections with our students-but also yield useful data so as to inform our yearly curriculum and instruction (Polleck & Shandin, 2013)

I will be starting my 17th year in the Education Field. I was a General Education teacher for 12 years. I taught kindergarten and first-grade for 5 years. When I graduated with my Masters degree in Special Education, I applied for the Special Education position and was hired and continued to teach the kindergarten and first-grade students. I left the school district I had taught at for 12 years. I knew it was time for a change and decided to move home to the Navajo Reservation. I accepted a teaching position with the Window Rock Unified School District as a 2nd grade General Education teacher. When the opportunity came along to transition into the Special Education field, I took it. I serviced kindergarten through third grade for a year. I decided I needed a change after working with the elementary students for so long. After looking at the district data, I knew that there was a high need for teachers in the upper grades who could help students with learning the basic skills of reading, writing and math. Students must have knowledge in the basic skills in order for them to learn new concepts and build on it. This will be my second-year teaching middle school students.

Having knowledge of how to teach students their foundational skills in these content areas was going to be crucial. Ensuring that students can read, write and perform their basic calculations would help them become successful academically. After teaching at the elementary level for so many years I knew the importance of numbers sense and place values. Place value is the representation system, the only one in common use throughout the world; it forms the basis of understanding the concept of numbers and its use (Sharma, 1993). If students do not have the knowledge of place values, comprehending the use of numbers, will continue to be a challenge for them, which will affect the way they use and understand numbers.

The Importance of Culture

I remember as a kid we would go to my grandma's house for traditional ceremonies. Before the ceremonies would take place, they would gather all the kids into the hogan or tepee and tell creation stories or other traditional stories of why and how things were the way they were. One of the stories that gets told from generation to generation is the story of ma'ii which means coyote in Navajo. The Navajo mythology says that the Holy People were gathered around Black God who was placing stars in the sky. While he was arranging these stars, he was giving meaning to why he was doing this. Coyote became angry and impatient and took Black God's pouch and threw the stars in the air. Coyote also placed one star in the south which can only be

seen for a few days each year. Black God was angry with coyote and asked why he did that. Coyote said, "He wanted the sky to look beautiful." These types of stories would also continue early in the mornings after the ceremonies were done. My parents always wanted us to learn and hear these stories from the medicine man or our elders that were present. Sometimes we had to sit and listen for a couple hours and this was sometimes difficult to do especially if you spent all night staying awake to partake in the ceremonies. It taught us tolerance and patience. We grew up to learn to respect our elders and our Navajo healers. As a parent I also teach these important characteristics with my own children and the students I teach.

We live in a different generation now and our students come from diverse homes. This is why teachers need to be culturally responsive and not assume that their students are able to have access to the same curriculum and resources as their peers within their school, state and across the nation. Some students are raised by grandparents and can still listen to the creation stories once told to them by their grandparents. It is important for our students to learn about their culture and stories that have been told from generation to generation, before they get lost forever. I have learned that Navajo Astronomy is enriched in our culture and plays a role in our creation stories through Navajo rug designs and even the string games that are taught in some schools today. Constellations have some meaning in the Greek mythology when teaching it but if you teach kids the Navajo mythology then it holds more meaning to how they play a role in how we once interpreted the night skies long ago. It also teaches them lessons. The story of coyote tells us that we need to have patience and not just jump into things. It also teaches us to think things through. Navajo culture stories have meaning and lessons to teach. It must be continued to be told.

As teachers we have to be flexible and willing to adapt and make changes to meet the needs of our students. Providing students with a unique curriculum that allows students to learn about their culture and hear a story in their Native language is a great opportunity for them. We should always be willing to give students the opportunity to establish the background knowledge needed before teaching them something new. Treating students equally, along with challenging, assisting, and meeting their needs is important. Teaching the cultural stories will allow students to make the connections needed when bringing in place value while talking about the Navajo constellations.

The Lowell Observatory Outreach Program in Flagstaff, Arizona wrote, "When asked to describe a professional astronaut before ever seeing one, many students in several 7th and 8th grade Navajo classes described an astronomer as a middle aged, white male with a foreign accent. This picture is not conducive to having students think of astronomy or science as a career for themselves." Native American children need more opportunities to have access to the math and science field. Native American children do not see themselves pursuing the fields in science and math because they do not have the opportunity to learn and apply a deep understanding of how to truly understand the topics in those areas. Stigler a professor at the University of California Los Angeles stated, "Based on placement tests, a staggering 60 percent of U.S. students who enter community colleges are not qualified to take a college mathematics course, even though they have graduated high school." This can be an alarming statistic for educators and parents across the nation. All children should have an opportunity to an excellent education. Native Americans have had many issues with trying to establish themselves as sovereign nations so they could

establish schools for the families who reside on the reservations. History shows that it would be a long journey before schools opened up on the reservation.

Navajo's have faced many barriers and trials over the years to get to where we are today. It is worth noting and telling students how Navajo's long ago persevered through hardships they encountered to establish a place they can call home. They fought for the land we live on today so that we could be a sovereign nation. Living on the reservation allows families to live and work and raise their children here. Over the years despite how much Navajo's endured they still were able to continue to value their culture and most importantly the Navajo language. We have schools here on the reservation who are doing their best to preserve the culture and language. One way they do this is by incorporating the Navajo culture and language as an elective in schools for students.

We want children to be proud of who they are and where they come from. We also want them to have fun and be eager to learn so that they can become lifelong learners. Navajo students were always taught through school curriculum that used textbooks. A majority of these textbooks did not have their own cultural perspective or teachings embedded into them. Students can become bored with the textbooks and would prefer hands on activities to help them have a better understanding of what is being taught. One barrier we face in Navajo schools today is the lack of funding to buy resources and materials to make learning more engaging. If we can give students the material needed to conduct science experiments or provide field trips to places off the reservation, like an observatory, science centers, zoos and other places, it will help them make connections to lessons being taught. They can learn about the universe from professors, science from professionals in the field, or about animals from a zoologist. These kinds of experiences can or may spark more of an interest for students to be willing to go into the math and science field. According to the National Science Foundation, "In 2016, 0.5% American Indians or Alaskan Natives, earned a bachelor's degree in science and 0.3% earned a bachelor's in engineering." Based on these statistics we need to encourage and implement more activities to make students become eager to take an interest in the math and science field.

Content Objective

Math in the Navajo Culture

The history of numbers and how numbers were utilized varies from culture to culture. We do not have written information of how numbers originated in the Navajo culture. Long ago math was used when planting, weaving, irrigating, building, cooking, pottery making and in a lot of other ways but we do not know how it was learned and used. When we were young my mom would send us to my grandma's house for the summer. My grandma was a skilled weaver and wove the most beautiful detailed rugs. She did not have to draw out her designs she just would weave and knew what she was going to weave. Sometimes when it was raining and thundering she would tell us to stay inside and we would sit there and watch her weave. We would listen to her sing songs in Navajo and listen to her use the comb to push the yarn down. We would watch her use her arm or hands for measuring how much more yarn she needed. She did not use a measuring tape or ruler. Weaving was her only source of income and it still can be for many Navajo's today. I know math requires a variety of calculations as well as a type of system that Navajo's must have showed to their children and had orally passed down from generation to generation.

The Importance of Place Value in Math

We live in a fast paced world where students are required to learn and acquire so much information that it can be difficult. If we are rushed with teaching activities and not teaching for understanding and mastery then we need to ensure that we slow down and ensure students are having opportunities to learn their number sense and place value. Many students with disabilities struggle with retaining information taught. This can make it hard for them to memorize the basic math facts that are needed to help them develop and understanding of number sense and a visual understanding of how place value works in context. According to Seehorn, “The mistakes children make when learning place value generally are of two types: errors and misconceptions. Errors are mistakes due to lack of attention and misconceptions stem from a student’s misunderstanding of the central concept.” As teachers we need to make sure we are addressing this when teaching our lessons. We need to make sure we are checking and correcting these errors and misconceptions while they are young so that when they are entering the upper grades they are not struggling.

Place value can be a difficult concept students have a hard time attaining especially if schools do not have the effective programs in place for teachers to implement. An appropriate program for developing skills found to be lacking, this should be incorporated into the mathematics curriculum for all children seen to be in need, it must be emphasized that what is lacking is not practice of the algorithms (Jessen, 2007) Schools need a diagnostic tool that will help teachers identify students who do not have the adequate skills in place value. The data gathered will inform teachers on how to instruct their students and give them an idea of how to modify and adjust for those who need more time learning place value.

All educators need to advocate for students to ensure that they know and understand the place value system. Educating students to appreciate the key role that place value parts play in the base ten arithmetic is crucial; students need to understand the five stages of place value (Howe, 2018). According to Howe the first stage is the knowledge of the standard form of writing using numbers. The second stage identifies and isolates the place value parts of the number, and displays the number as their sum. The third stage is having an understanding of base ten using addition and subtraction. The fourth stage exhibits the base ten units as products of several factors of ten, or as power of ten and requires comfort with multiplication. The fifth stage is using exponential notation to write the powers in more compact fashion. If we are not aware of the importance of these five stages of place value, students will continue to go through the education system struggling with this important skill and how to interact and understand the numbers which could eventually deter them from occupations where this skill is needed.

Unit Design and Important Topics to be discussed within Place Value

This unit is designed for eighth grade students. The duration of the lessons are going to be about 50 to 55 minutes long and taught two times a week for nine weeks. The unit is intended to bring cultural awareness to the creation stories or heroes within our Navajo culture. The unit will also have students using the scientific notation procedure and utilizing place value charts so they can place large numbers into a place value chart. The activities are designed to be interactive, and information will be presented using cultural videos from Navajo elders. The effective teaching strategies within this unit will help students become fascinated with science and math and I hope

this will promote them to become interested in pursuing jobs in the math and science field as well. Math is not only taught one way and in one subject it can be embedded across the curriculum. When teachers include number talks, math activities, using cards, charts or manipulatives to help students understand, it will help them make sense of numbers. Activities include a focus on the visual representation of numbers, they are using different pathways in the brain, which deepens their learning, as shown in brain research (Boaler, 2015).

Lessons within this unit will have students rounding numbers to the greatest place value to help them estimate very large numbers used to understand the miles from earth to each star in the constellation by using the light years of the constellations. Students will learn about the powers of 10 and how to multiply numbers by the power of 10. They will learn about rounding, estimating and making approximations when having to use very large numbers. Large and small numbers can be difficult to understand and can be difficult for students to use. The Indian mathematicians needed a way to express very large numbers, and so they created a method of counting that could deal with very large numbers. Once zero was invented it transformed counting, and mathematics, in a way that would change the world. Zero is still considered India's greatest contribution to the world, for the first time in human history the concept of nothing had a number (News, 2012). These large numbers are important to understand when learning about the universe. Scientist who study the universe have to use large numbers and using the scientific notation and powers of 10's is important. When solving problems and interpreting large numbers students need a variety of methods to ensure that they understand what they are learning. The place value concept quite clearly demonstrates that this symbol system is very compact and efficient, it has provided a system which makes working with numbers enormously simple and useful (Sharma, 1993). We cannot continue to teach a concept or skill involving place value if students do not understand the value and place of numbers.

When teaching students as teachers we need to ensure that they know the math terminology that will be used and ensure that we are using visuals of it as well. Terminology like place value, digit, value, decimal, exponents, rounding and the scientific notation are words they will need to make sure they know and are exposed to. Students should be able to interact with each math terminology which will help them make the connection to the lesson being learned so much easier. Tapping into a student's prior knowledge of vocabulary words will help with building on what they have previously learned when learning about the basics of place value.

Place value charts are helpful when teaching students about numbers. It gives them a visual perspective of where a number's position is based on where it is in the chart. For example in the number 4, 563 the 5 is in the hundreds place, the 3 is in the ones place, the 4 is in the thousands place and the 6 is in the tens place. This is important for students to know because as numbers increase students need to know how to read the numbers based on their place in the place value system. Students also will be able to manipulate numbers if they understand place value. For example they can add and subtract tens and ones fluently and should know that it changes the value of the number. Place value is the understanding that the same numeral represents different amounts depending on which position it is in (Charlesworth, 2012).

A digit is the symbol used to make a numeral, just like letters make words, digits make numbers. Numbers between zero to nine are digits that make up numbers. For example the digits 3, 4, and 5 can make up the numbers of 345, 435, 543, 354, 453 or 534. Knowing that digits make up a

variety of number patterns is important for students to know this will help them realize that a digit is not always consistent in one place and once that digit is placed in a different part of the place value system then the value of it changes. People who have a good understanding of numbers are able to use numbers and understand how numbers are used in the world around them (Turkel, 1988).

A value is what an individual digit is worth in a number depending on where it is placed in the place value system. This is crucial for students to know because they are able to work with very small or very large numbers and understand the value it is worth if they know where it stands in the place value system. For example a 1 in the ones place is worth one unit, 1 in the tens place is worth ten units, 1 in the hundreds place is worth 100, and so on. This is an important life skill for students to know so they know how much a number is worth. It is also important when talking about large numbers when converting the light years to miles. Numbers are just numbers and they have no meaning if they do not understand the value of them.

A decimal is a point between a whole number and a decimal fraction part which is separated by the decimal point. The digits following the decimal point show a value smaller than one. When multiplying by powers of 10, the value of a digit in any given column goes up by a power of ten which changes the value of the number. Utilizing the place value chart is important so students can make the connection with the numbers being used. For example .038 would be read as 38 thousandths because the last digit falls in the thousandths place. Rounding decimals to the nearest whole number, tenth, hundredths, thousandths, etc. is important for students to know.

Students need to know the importance of the scientific notation. The standard way of writing a number in scientific notation is writing the number as a product of a number greater than or equal to 1 but less than 10 followed by a power of 10. For example $602,000,000,000 = 6.02 \times 10$ to the 11th power, the main purpose of scientific notation is to allow us to write very large numbers or numbers close to 0 without having to use so many digits (Green, 2020). The students will get a review of how the powers of 10 are operated. They will learn about the importance of the exponents. The exponents tell how many times to use 10 as a factor. So for example 10 to the 2nd power are represented as 10×10 which equals 100. 10 to the 3rd power is $10 \times 10 \times 10$ which equals 1,000.

Numbers become more complex as students get older. As students move up in grades it is assumed that all students are ready for the next level of standards they are taught. In reality this is not always true. The gap continues to widen because students left the previous grades not having a strong grasp of the place value system. Numbers can be a very complicated skill to learn and understand for some children. It has a long history of how it was developed and eventually accepted by many people to use in the major fields of science and mathematics. Using Arabic numbers Muslim mathematicians invented entirely new methods of mathematics. Besides just simple fractions they turned Arabic numbers into quadratic equations, and algebra, and these numeric breakthroughs enabled science, mathematics and astronomy to reach new levels in the Middle East (News, 2012).

The learning of place value is not only taught one way. Students should know a variety of ways numbers can be represented. Teaching one way and only during math is not benefiting students. Place value should be taught with a variety of strategies and presented during a variety of lessons

and contents. We need to ensure that we are establishing connections with the culture as well and making learning relevant. One can argue that to be competent and engaged citizens today requires facility with large numbers, this in turn would entail understanding at a deeper level the nature of approximation and how it interacts with computation (Howe, 2018).

Once you understand the level and capabilities of the students then this will help with planning. We want to be able to provide students with a curriculum based on their level of need and academics. If teachers have a majority of their students who struggle with math then as teachers, we want to make sure we teach them the skills needed to be successful so they can learn the content being taught to them on a daily basis. Using data from the previous teacher or assessments will help with planning and instruction as well. This will also save the teacher time and it also benefits students because they get more instruction time rather than the teacher taking the time on trying to reteach concepts of crucial skills or concepts that students need to know before they can move onto a lesson being presented.

Teaching Strategies

KWL Chart: Is a 3 column chart that will help assist teachers in gathering information about students. **K** stands for know. Presenters or teachers will want to know about a student's prior knowledge of what they know about a topic they are learning about. This starts to trigger the student's curiosity and helps with brainstorming what they already know. **W** stands for what. What does a student want to learn about the topic they are learning about? This triggers students to be motivated about the lesson being taught and they start to develop some questions that they have always wondered about. **L** stands for learned. And the end of the unit we want to know about what students learned. This is a form of self monitoring of student knowledge and what they have gained from the topic. The purpose of a KWL chart is to help drive instruction as well as guide student learning. This will be just to gauge my knowledge and help get the students interested in the lesson and will not be part of the assessment.

Circulation: A technique that encourages teachers to move around their room. Doing so adds energy to your teaching and allows you to observe what students are doing (Lemov, 2015). This also ensures that students are on task and using their time effectively. It holds all students accountable and allows a teacher to circulate the room to see what changes need to be made so students are successful in gathering material if needed. This strategy could be utilized after teaching a lesson to ensure that students have the lesson material in front of them and to make sure they are prepared to learn. Now that students are online we can still look to see what the zoom participants are doing by ensuring they have their cameras on and are taking notes.

Check for Understanding: This strategy is helpful and will help students stay focused on the intended lesson being taught. While a teacher is circulating he or she is also checking for understanding. While Checking for Understanding teachers may notice that some students may need scaffolding this allows a teacher to give a quicker response so that students are not wasting their learning time. Knowing you taught something is easy but knowing they learned it is hard and requires you to be able to ask questions (Lemov, 2015). One way to check for understanding is to randomly ask students to share their answers to a problem given. When students cannot share it most likely means they do not understand the lesson, concept or activity being taught. As teachers we want to give opportunities to have students to share their answers and tell how they

got their answers by showing their work. Math is all about accuracy so if students write the wrong number or miss an exponent then it can throw off their numbers.

Vocabulary and Literacy: Students will have the opportunity to read short passages about the Navajo constellations. They will have the opportunity to read and pronounce the constellations in Navajo as well. Collaborating with the Navajo culture teacher or former Navajo teacher would be good for teachers who are not fluent in the Navajo language. This will give students the opportunity to ask questions and ensure that Navajo words are pronounced correctly. Pictures will go along with the constellation story to help them make the connection needed when viewing the constellations. Math vocabulary words helps a child understand what people are saying. Unfamiliar words become holes in problems which prevents a child from completely understanding what the information they are learning. Having a rich vocabulary will help your child communicate in a more engaging way (Learning Reading and Math, 2014).

Videos: To stimulate the students interest in constellations and enhance the activities, short videos will be implemented with Navajo elders speaking about the, “Navajo constellations” and the origin of how the constellations came about and what they mean. Students do not always get to hear the traditional stories that were once told long ago. Students will have the opportunity to reflect on the videos during break-out sessions. Allowing them time to reflect will give them the opportunity to make connections if needed. There's no denying that videos are always filled with information, not only that, but they do provide the information in an easy to consume, fun manner that you will appreciate and enjoy, this helps the learning experience quite a bit (Brown, 2020).

Think and Share: This will allow the students to have the opportunity to collaborate with their peers in their virtual classroom. Think and Share would allow students to build their understanding by collaborating with their peers and gain more knowledge if needed which would eventually help them refine their thinking and knowledge so that it teaches them to understand what is being taught. This type of strategy also helps students acquire new knowledge that they have learned from their peers or teachers. Sometimes we are so rushed when teaching that we do not always take the time for students to share their thoughts. In sharing their ideas, students take ownership of their learning and negotiate meanings rather than rely solely on the teacher's authority (Cobb, 1991).

Visuals: Providing students with visuals is important. Students need to see how people long ago interpreted the constellations. Visuals help students with understanding the concepts being taught. This will be especially useful when presenting numbers and having to see it on a place value chart. Bigger numbers are difficult to comprehend but with a visual this may help them. Seeing images of what is being taught is a powerful way to build student engagement and boost retention (Ipatenco, 2020). I would implement the visuals when presenting the place value chart, when demonstrating how large numbers can be and what it looks like and visuals will be available when looking at the Navajo constellations and how the image looks for them to transfer that image when looking at the stars.

STEM: The benefits of STEM encourages creativity in students and gives them the opportunity to apply a variety of concepts to help them interact with the topic in a variety of ways to help them understand. STEM education includes problem solving, critical thinking, creativity,

curiosity, decision making, leadership and acceptance of failure (National Inventors Hall of Fame, 2020). The science part of the lesson is learning about the constellations. Technology would involve them using the internet to research and put together their power point presentation so they can prepare their zoom, Engineering and math is them converting the miles to scientific notation form. They will also write the standard form of the number and place it into a place value chart when presenting their number.

KeyNote Presentations: When students are given the opportunity to create and conduct presentations it provides students with a variety of learning approaches. Students are stimulated and become eager to learn and it encourages independence among learners. They provide opportunities for the development of team skills and listening, it also increases a student's expertise of not only in terms of knowledge, but also in presentation skills, confidence and self esteem (Curtis, 2020) Students will present their presentations through zoom. The first slide will be the introduction page, the 2nd slide will be about the Navajo constellation they learned about, the 3rd slide will be about the miles that are from the constellation to Earth based on light years and the 4th slide could be a reflection about the unit. This will be part of their post test and could be part of their grade for the 2nd semester in their general education classroom. Giving students a variety of ways to earn grades is also important. This presentation will give them an opportunity to apply what they have learned and present it in a way to their peers, parents and their general education teachers as well. Through their presentation they can also talk about the need for more funding so that they could take a field trip to a local planetarium to learn more about the solar system and constellations. Encouraging students to think beyond the text books is important. It allows them to be active learners and researchers of a world that is bigger then what they read about. Allowing them this kind of flexibility will entice them to be curious and eager to learners as they get older. We need more students to be interested in the math and science field because it is an interesting filed that they could get the younger generation interested in as well.

Classroom Activities

Week 1- Pre-Assessment and Introduction

Day 1: A pre-assessment will be given to demonstrate prior knowledge of some math terminology, scientific notation, standard form of writing numbers and some knowledge of Navajo Constellations.

Constellation Unit			
Name: _____		Date: _____	
Circle <u>Pre</u> Assessment or Post Assessment			
Match the following words to the definitions.			
<i>Scientific Notation</i>	<i>Exponents</i>	<i>Power of 10</i>	
<i>digit</i>	<i>Place Value Chart</i>	<i>Constellation</i>	
Definition	Word	Definition	Word
1. ten multiplied by itself a certain number of times		4. any number from 0-9	

Week 2- Understanding Place Value

Day 1: In this lesson students will get an overview of place values and the importance of knowing the place of numbers. This will help them make sense of the value in numbers and how to read the numbers they have to convert later in the lesson. In this activity students will finish creating a place value chart with me and write the word in each place. We will also talk about the standard form of numbers and the expanded form so they have an understanding of what the value is and what it looks like in a place value chart.

Materials: Students will need a half filled place value chart

Name: _____												Date: _____			
Understanding Place Values –Week 2															
Directions: You will finish creating a place value chart and write the names of the missing place.															
hundred billion	ten billion		hundred million	ten million		hundred thousand	ten thousand					• decimal	tenths		thousandth

This is what the chart will look like when it is completed.

hundred billion	ten billion	billion	hundred million	ten million	million	hundred thousand	ten thousand	thousand	hundreds	tens	one	• decimal	tenths	hundredths	thousandth
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Understanding Place Value –Week 2

Name: _____												Date: _____			
Understanding Place Value –Week 2															
Directions: You will finish creating a place value chart and write the names of the missing place.															
hundred billion	ten billion	billion	hundred million	ten million	million	hundred thousand	ten thousand	thousand	hundreds	tens	one	• decimal	tenths	hundredths	thousandth
Standard Form	360	Expanded Form	$3 \times 100 = 300$ $6 \times 10 = 60$ $0 = 0$ $300 + 60 + 0 = 360$												

What does it look like on a place value chart?															
hundred billion	ten billion	billion	hundred million	ten million	million	hundred thousand	ten thousand	thousand	Hundreds	Tens	One	.	tenths	hundredths	thousandth
									3	6	0	decimal			
1.															
Standard Form		5,897			Expanded Form										
What does it look like on a place value chart?															
hundred billion	ten billion	billion	hundred million	ten million	million	hundred thousand	ten thousand	thousand	Hundreds	Tens	One	.	tenths	hundredths	thousandth
												decimal			
2.															
Standard Form		8,897,943			Expanded Form										
What does it look like on a place value chart?															
hundred billion	ten billion	billion	hundred million	ten million	million	hundred thousand	ten thousand	thousand	Hundreds	Tens	One	.	tenths	hundredths	thousandth
												decimal			
3.															
Standard Form		12,987,437,034			Expanded Form										
What does it look like on a place value chart?															
hundred billion	ten billion	billion	hundred million	ten million	million	hundred thousand	ten thousand	thousand	Hundreds	Tens	One	.	tenths	hundredths	thousandth
												decimal			
4.															
Standard Form		554,578,093,234			Expanded Form										
What does it look like on a place value chart?															
hundred billion	ten billion	billion	hundred million	ten million	million	hundred thousand	ten thousand	thousand	Hundreds	Tens	One	.	tenths	hundredths	thousandth
												decimal			

Day 2- We will continue with what we did on day 1 and tell them about the bigger numbers and how it continues to increase as you go further left of the decimal. It will make sense when talking about the light years of stars and the distance between some stars within a constellation to Earth. When placing numbers in a chart, and writing and reading them it will make sense. I want students to understand the place value before we start calculating them. The students will watch a video about place value <https://www.youtube.com/watch?v=T5Qf0qSSJFI>

Week 3– Place Value Activity

Day 1: Application of concepts is important for students. Students have to be given opportunities to interact with the numbers they are given. Allowing students to apply what they know about numbers is important and will allow them to understand how it works. Students will be given numbers and they will place it in the place value chart and write the written form of those numbers. This will give them the opportunity to see how numbers are used when referring to place value. We will only work on ones to a hundred thousand.

Name: _____	Date: _____
-------------	-------------

Directions: Place the following numbers in the place value chart and write the number out.

Number	Place Value						Written Form
	hundred thousand	ten thousand	thousands	hundreds	tens	ones	
623,149	6	2	3	1	4	9	Six hundred twenty-three thousand, one hundred forty-nine
1,345							
65							
34,987							
564							

Day 2: Application of applying numbers continues but with larger numbers.

Name: _____

Date: _____

Directions: Place the following numbers in the place value chart and write the number out.

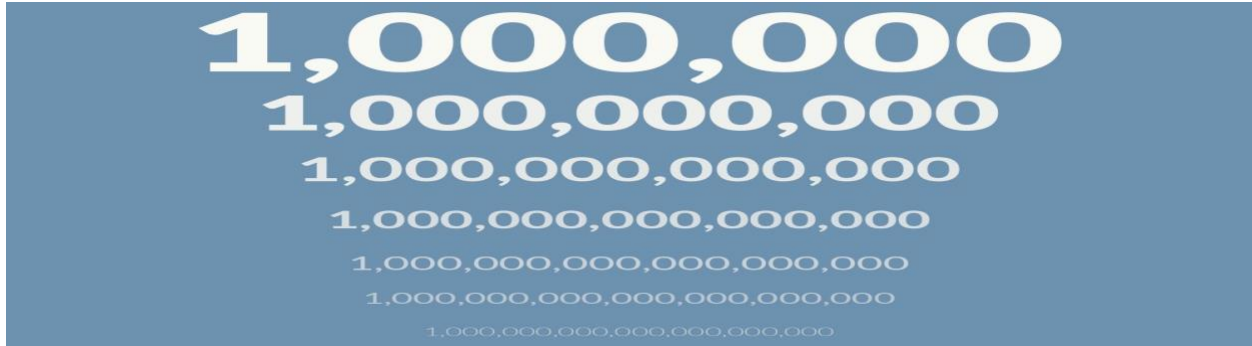
Number	Place Value									Written Form
	hundred million	ten million	million	hundred thousand	ten thousand	thousands	hundreds	tens	ones	
573,821,042	5	7	3	8	2	1	0	4	2	five hundred seventy-three million, eight hundred twenty-one thousand, forty-two
682,890,678										
3,456,876										
95,900,786										
45,309,878										

Week 4 – Scientific Notation and Light Years in Constellations

Day 1: Introducing students to the scientific notation when using large numbers will be used with the following visual. Students will be shown this picture to show how numbers continue to increase and how many zeros can be in numbers and it can go on and on. So using the scientific notation method is important. Students will watch a video showing how much more or less


numbers increase when multiplying by a power of 10.

<https://www.youtube.com/watch?v=44cv416bKP4>




Students will learn that every number in the scientific notation must be in the form of the following equation: $a \times 10^n$

To convert a number to scientific notation, first we have to identify where the decimal point and non zero digit go. If a non zero digit comes first and the decimal point comes next as we multiply a power of 10 this will make the powers of 10 increase. We will do the following problems in a T chart like the one below: We will do this through Zoom using a DocView Camera if we were in person I would use the smart board or the white board.

Name: _____		Date: _____
Converting Standard Form Numbers to Scientific Notation		
Standard Form	What to do	Scientific Notation
96,000.	When multiplying by 10 it will change the quantity of the number and add a power of 10 when writing the scientific notation. 	9.6×10^4
37,000.		
402.0		
3,720,000.		
32,000.		
2301.8		

Day 2: Scientific Notation- Students will get to review the lesson on Scientific notation and then watch a video on scientific notation https://www.youtube.com/watch?v=Q_klLmTSyyw After the video students will get to ask questions if they need to. We will practice with converting the scientific notation to standard form.

Name: _____		Date: _____
Converting from Scientific Notation to Standard Form and Written Form		

Scientific Notation	What to do	Standard Form & Written Form
9.225×10^{10}	Write the number. When multiplying by a power of 10 this will make the number increase. 9. 2 2 50 0 0 0 0 0 0 	92,250,000,000 ninety-two billion, two hundred fifty million
428.5×10^{15}		
34.0×10^5		
652.9×10^9		
2.34×10^{17}		
978.3×10^{23}		

Week 5- Navajo Constellations and Light Years

Day 1: Students will learn about constellations and what they are.

Constellations are terms generally referred to as a recognizable pattern of stars whose appearance is associated with mythological characters, creatures, earthbound animals, or objects. **Light Years** is a measurement of distance and not time. A light-year is the distance a beam of light travels in a single Earth year, one light-year equals 5,878,625,370,000 miles or we can round it off to 6 trillion miles. For this activity we are going to use the first 8 digits which is 5.8786254 when calculating the miles of a given light year within a constellation. To understand the structure and organization of celestial things, we must know their distances. Students will watch a video on light years <https://www.youtube.com/watch?v=aOjJ2VwnEY> this will give them an idea of how to perceive light years when talking about constellations.

Day 2: Students will be introduced to Navajo Constellations. They will know that different cultures have created different constellation groupings. We will start with a video about how the stars came about and some of the constellations will also be mentioned in the video.

Students will get to watch a video about the constellations spoken from a Navajo elder. <https://www.youtube.com/watch?v=ILNA1aO30Qk>

After showing the video I will give students Appendix A: This gives them a list of some Navajo Constellations that they will be learning about. It also has the light years we will be using for an activity. There will be 8 Navajo Constellations they can choose from to do their KeyNote presentation at the end of the unit.

1. Nahookos bi'aad- female revolving one- Cassiopeia
 - Schedar (shed-are) – 228.5 light years
 - Caph (Kaff)- 54.4 lights years
 - Cih – 612.8 light years
 - Ruehbah (ruck-bah)- 99.4 light years

2. Atse ets'ozii- First Slender One- Orion
 - Betelgeuse (bet el-jooz)- 427.3 light years
 - Rigel (rye jel)- 772.5 light years
 - Bellatrix (beh-lay-trix) – 242.9 lights years
 - Mintaka (min-tah-kah)-915.7 light years
 - E-elnila, (al-nigh-lam)- 1341.6 light years
 - Alnitak (al-nigh-tack)- 817.0 light years
 - Saiph (safe)- 721.2 light years

3. Hatiin sik'ai'ii- Man with a Firm Stance with Legs Ajar-Corvus
 - Alchiba (al-key-bah) – 48.2 light years
 - Kraz (tso hea china)- 139.7 light years
 - Gienah (gee-nah)- 164.8 light years
 - Algorab “the raven” – 87.8 light years

4. Atse etosh- first big one- Scorpius (upper)
5. Gah hahat'ee- rabbit tracks- Scorpius (lower curve)
 - Antares (an-tay-rease) – 603.7 light years
 - Graggias (graf ih as)- 530.1 lights years
 - Dschubba “ the forehead- 101.5 light years
 - Scorpil- 65.4 light years
 - Sargas- 271.9 light years
 - Scorpil- 463.7 light years
 - Shaula- 702.6 light years
 - Lesath- 518.3 light years

6. So'ahots'ii- pinching or doubtful stars- Twin Sisters in Hyades Taurus
 - Aldebaran- 65.1 light years
 - Nath 131,0 light years
 - Tauri or Hyadum – 154.0 light years

7. Naayee neizghani doo tobajishchini- Monster Slayer and Born for Water (Lyra)
 - Vega Arabic- 25.3 light years
 - Sheliak- 881.1 light years
 - Sulufat- 534.3 light years

8. Ii'ni- Thunderbird- Pegasus
 - Markab- 139.6 light years
 - Scheat-199.1 light years
 - Algath- 333.0 years
 - Enif- 672.2 light years

Week 7 - Navajo Constellations and Light Years Continued

Day 1: Students will continue to learn about the Navajo constellations and the stories behind the constellations and what the constellations represent. The stories found on Appendix A will bring knowledge about their culture and the significance of the constellations. We will then watch a video about the constellations told by Courtney Etcitty

<https://www.youtube.com/watch?v=l8dfHBMhxKY>

Day 2- Students will do the activity of converting light years in the Navajo Constellations to miles. We will practice with one of the constellations and then they can do one on their own. The formula they would use to convert light years (ly) miles is: $ly \times 5.8786254 \times 10^{12}$

Week 8- Converting light years in Navajo Constellations to Miles

We will be converting light years in the Navajo constellations to miles																
1. Atse etosh- first big one- Scorpius (upper) 2. Gah hahat'ee- rabbit tracks- Scorpius (lower curve)																
Star	Light Years	Converting light years to miles Numbers in the place value chart														
Antares (an-tay-rease)	603.7	$603.7 \times 5.8786254 \times 10^{12} = 3.548926154^{15}$ <u>3,548926,154,000,000 miles</u>														
		Quadrillion	trillion			billion		million			Hundred thousand	ten thousand	thousands	hundreds	tens	ones
		3	5	4	8	9	2	6	1	5	4	0	0	0	0	0
Graggias (graf ih as)	530.1															
Dschubba “ the forehead”	101.5															
Scorpii	65.4															
Sargas	271.9															
Scorpii	463.7															
Shaula	702.6															
Lesath	518.3															

Week 9– Post-Assessment and Presentations

Day 1: Students will take a post test and demonstrate their knowledge of what they had learned.

Day 2: Presentations of Projects: Students will have the constellation projected which will be used when they talk about the constellation they learned about.

Name: Navajo Constellation: _____				
Category	Exceeds Standard 3	Meets Standard 2	Approaches Standard 1	Below Standard 0-1
Math Content Knowledge	Student will score 91-100% on the Scientific Notation for stars that are converted in Light Years	Student will score between 80-90% on the Scientific Notation for stars that are converted in Light Years	Student will score 70-79% on the Scientific Notation for stars that are converted in Light Years	Student scored below 69% on the Scientific Notation for stars that are converted in Light Years
Content Knowledge of Navajo Constellation	Students will give 3 details about the Navajo Constellation they picked	Students will give 2 details about the Navajo Constellation they picked	Students will give 1 details about the Navajo Constellation they picked	Student gave 0 details about the Navajo Constellation they picked
Presentation Appearance	4-5 Graphics to go with their presentation	3 Graphics to go with their presentation	2 Graphics to go with their presentation	0 – 1 Graphics to go with their presentation

Student Assessment Plan

Students can be tested a variety of ways and taking the opportunity to assess in a variety of ways is important. We teach in a society where we have diverse cultures, language and abilities in the way we learn and perceive information. As teachers we know this because when they present and show their work it is not always the same outcome. Knowing the variety of ways students learn helps inform our teaching so we can modify or adjust to help them learn. Teachers should be familiar with, “Howard Gardner’s Eight Multiple Intelligence Theory”. They are linguistic intelligence, logical-mathematical intelligence, spatial intelligence, bodily-kinesthetic intelligence, musical intelligence, naturalist intelligence, interpersonal intelligence, and intrapersonal intelligence (Gardner, 2011). This allows us to be flexible in the way we teach and assess. It is not fair to students to expect them to learn and be assessed one way. As teachers we should be using informal and formal observations as on-going assessments which would allow us to get the information we need to see how students think and what they understand.

When creating teacher made assessments take into account the stages of development students are at based on observations collected (Piaget, 1957). We should not assume that students know or have mastered the content taught just because it was taught. As teachers we need to ensure we gather multiple evidence of the concepts taught, to show that students understand and are mastering the skill before we continue to move on. If we move on without teaching for understanding or mastery we are only widening the gap for students who truly do not understand and are not able to apply what they have learned.

Before assessing students we should give them opportunities to learn the concept or skill in a variety of ways. According to Ormond, he states that we should do the following: (1) Give children a great deal of hands-on practice with the skills that serve as building blocks for more complex skills like reading comprehension or solving math problems. (2) Provide a wide range of experiences in order to build a foundation for concept learning and language. (3) Give opportunities for student to develop and learn through concrete activities so they become abstract learners (Ormond, 2000).

Embedded in this curriculum unit are the following assessments; informative, summative and informal assessments. The formative assessments will be a teacher created pre and post test that will assess student's knowledge of some math terminology and identifying some of the Navajo Constellations. This includes their knowledge of the standard form of scientific notation and writing the scientific notation for numbers given. They will also be assessed on their knowledge of the Navajo constellations by identifying the constellation that depicts a given description of the constellation. The summative assessment will be their keynote presentation which is based on a rubric. Students will present their knowledge of what they learned based on the following criteria which is scored on a rubric. This includes math content, Navajo Constellation learned and presentation appearance. Another assessment is the informal assessment which will be based on student assignments. Students will show progress and understanding by scoring 80% or above on assignments given.

Alignment with Standards

The cultural standards and teachings addressed in this unit, is Concept 2 Nahat'a: I will apply and practice the Diné way of life through planning. PO1: The students will practice the cultural teachings of earth and sky. In this unit students will have the opportunity to learn about the importance of why Navajo's relied on the constellations and the significance of it. Early Native Americans paid more attention to the celestial patterns and cycles happening above them, recurring celestial events, like the rising of a certain group of stars, were used by Navajo's to mark the proper time for planting corn and guided them on when traditional ceremonies could take place (Childrey, 2008). The second concept that will be addressed in this unit is Concept 4 Siihasin: I will apply and practice the Diné way of life with confidence. PO 3: Students will explore the constellations and winter-related games. Constellations, creation stories and certain games cannot be talked about during certain seasons of the year. Navajo's have always been strict about telling certain stories or even conducting certain ceremonies. Navajo's say constellations can't be talked about until the winter season. I will also address Concept 4 I will express gratitude in everything. PO 4: Students will present the teachings that they have learned to appreciate from earth and sky. Medicine men use the colors to represent earth and sky when performing traditional ceremonies. The author Don Childrey wrote in the book, "Star Trails" a traditional story he was able to partake in and writes about how a medicine man used the colors in his ceremony, he said four colors were used to draw Mother Earth and Father Sky. The four colors used were white, blue, yellow and black. The white signified the white light of approaching dawn, blue represented the brilliant blue of the midday sky, yellow represented the golden glow of twilight, and black represented the darkness of night.

Place values will also be addressed in this unit. Two standards will be taught. EE.3 Students will use numbers expressed in the form of a single digit times an integer power of 10 to estimate very

large or very small quantities. Students will get to watch videos about how large numbers can get and that's why using the powers of 10 would be better to use. The other standard is EE.4 which is performing operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation is used. Activities for place value will be for students to calculate the miles from some of the stars in the constellation to Earth. Not all stars in a given constellation can be converted to miles but just some.

Appendix A: Navajo Constellations and description of what that constellation is.

Maryboy, Nancy (2008). A Collection of Curricula for the STARLAB Navajo Skies Cylinder. Indigenous Education Institute. Retrieved August 5, 2020 from https://www.raritanval.edu/sites/default/files/aa_PDF%20Files/6.x%20Community%20Resources/6.4.5_SD.10.NavajoSkies.pdf

1. Nahookos bi'aad- female revolving one- Cassiopeia

This constellation is the female partner of Nahoojos bi'ka. She is a woman who represents motherhood and regeneration. She provides growth, stability in the home and the strength necessary for harmony. Instead of a bow and arrow, her weapons are the grinding stone and stirring sticks, which ensure that she will always be able to feed her family.

Alpha-a: Schedar (shed-are) – 228.5 light years

Beta- b: caph (Kaff)- 54.4 lights years

Gamma-y: cih – 612.8 light years

Delta- 8: ruehbah (ruck-bah)- 99.4 light years

2. Atse ets'ozì- First Slender One- Orion

This constellation is depicted as a young man in the major part of his life. He carries a bow and arrow and is a warrior protecting his people. Like Dilyehe, this constellation is related to planting and is seen every season except for part of the summer. Atse ets'osi is often spoken of as the son-in-law to Ate etsoh, they are part of the constellation.

Alpha-a: Betelgeuse (bet el-jooz)- 427.3 light years

Beta- b: Rigel (rye jel)- 772.5 light years

Y Bellatrix (beh-lay-trix) – 242.9 lights years

8 mintaka (min-tah-kah)-915.7 light years

Epsilon- e elnila, (al-nigh-lam)- 1341.6 light years

Zeta- alnitak (al-nigh-tack)- 817.0 light years

Kappa- Saiph (safe)- 721.2 light years

3. Hatiin sik'ai'ii- man with a firm stance with legs ajar Corvus

The constellation is a representative of unity, strength and the stability of cycles. At the same time, it stands for parting of the seasons between summer and winter. The constellation emerges in early October as ghaaji, the parting of seasons between hot and cold, and is fully manifested in November.

Alchiba (al-key-bah) – 48.2 light years

Beta- b kraz (tso hea china)- 139.7 light years

Gamma- y gienah (gee-nah)- 164.8 light years

Delta- 8 algarab “the raven” – 87.8 light years

4. Atse etosh- first big one- Scorpius (upper)

This constellation depicts an elderly man with a cane and a basket of seeds. He represents the wisdom of the elders with a cane that provides strength and stability. The basket signifies the entire cosmos and regeneration.

Atse etsoh represents the wisdom and knowledge that come with old age. He is depicted as an elder, who is strong and assures the stability of life. He is located in the upper part of the Greek constellation Scorpius and includes other stars adjacent to Scorpius.

5. Gah hahat'ee- rabbit tracks- Scorpius (lower curve)

This constellation depicts the tracks of a rabbit running and leaping out. When rabbit tracks turns on its side in the early fall, it signifies that deer are old enough to survive without their mothers, and people can begin to hunt them. The constellation thus aids the beginning of deer hunting season.

This constellation is located in the lower curved tail of Scorpius, it is found in the south west sky in the fall and slowly tilts to the west as the months progress.

A Antares (an-tay-rease) – 603.7 light years

N graggias (graf ih as)- 530.1 lights years

Dschubba “ the forehead- 101.5 light years

Epsilon- e scorpii- 65.4 light years

Theta – sargas- 271.9 light years

Kappa- k scorpii- 463.7 light years

Lambda a Shaula- 702.6 light years

Upsilon lesath- 518.3 light years

6. So'ahots'ii- pinching or doubtful stars- Twin Sisters in Hyades Taurus

According to the storytellers. Atse etsozi and Dilyehe were arguing over which of them were the rightful parents of two beautiful twin girls. In Navajo the names of the girls are Sa'ah Naaghai and Bike Hozhoon, loosely translated as long life and happiness, which embodies the whole life.

When the girls attained maturity the sun visited them and in time they gave birth to children. Sa'ah naaghai gave birth to a son. Yeiitsoh, who became one of the monsters who terrorized people on earth. Bikeh hozhoon gave birth to twin sons, who became the hero twins in Navajo oral histories. Naayee neizghani and tohajishchini (monster slayer and born for water). These twins' boys eventually visited their father the sun, and received weapons with which they used to slay most of the monsters on earth. The hero twins have their own stars, close to So'ahotsi'i

Changing woman is a beloved deity of the Navajo. She represents the cyclical processes of growth and regeneration of all life. In the Navajo oral histories, she was found on the top of a mountain by talking god and raised by first man and first woman. The sun was the father of her twin sons, monster slayer and born for water. She is thus one and the same with bik'eh hozhoon, one of the two twin girls, in the so' ahotsii constellation.

Alpha- Aldebaran- 65.1 light years

Beta- el nath 131,0 light years

Gamma- tauri or hyadum – 154.0 light years

7. Naayee neizghani doo tobajishchini- monster slayer and born for water (lyra)

This constellation includes two stars that depict the hero twins, who slay the monsters and make earth safe for humans. There are many stories of their exploits, which are well known to most Navajos. Major enemy way ceremonies that take place in the summer months feature the heading energies of monster slayer and born for water. In many versions of the stories monster slayer is the warrior who kills enemies, and born for water is gentler side of man, who provides assistance and healing.

Alpha-a: vega Arabic- 25.3 light years

Beta-b: sheliak- 881.1 light years

Gamma-y: sulufat- 534.3 light years

8. Ii'ni- thunderbird- Pegasus

The thunder constellation is similar to the bear constellation. It is considered a spring and summer constellation. This occurs about the same time that the first thunder of spring sounds on earth signifying the coming of springs. The emergence of the first thunder and the appearance of the thunder constellation in the sky awake the life processes and emergence of spring and

moreover signals the rejuvenation of seasonal life cycles on earth. The thunder constellation manifests the intricate interconnection of all life in the universe, animals, plants, humans, thunder and lightning.

The essence of the thunder constellation is depicted as a feather containing six stars. Each star represents a month and can be identified with the morning heliacal rise of the first bright star in the east, following the new crescent moon, for each of the six months. Unlike most Navajo constellations, the thunder constellation covers a major portion of the sky and appears over many months. The first indication of its feather comes in the early morning hours in September/October (Denebola in leo) and is completed in February/march (tip of Pegasus) the body takes an additional three months to completely appear, march, April, and may and remains visible during the rest of the summer.

A Markab- 139.6 light years

Beta b schein-199.1 light years

Gamma y algenet- 333.0 years

Epsilon- E Enif- 672.2 light years

Appendix B: Name of stars in the Navajo constellations and the light years

Koontz, Lowell (2002). Your Guide to the CONSTELLATIONS. Library of Congress. Retrieved August 5, 2020 from <https://glenallenweather.com/astromy/constellations/constell.htm>

1. Nahookos bi'aad- female revolving one- Cassiopeia

Alpha-a: Schedar (shed-are) – 228.5 light years

Beta- b: caph (Kaff)- 54.4 lights years

Gamma-y: cih – 612.8 light years

Delta- 8: ruehbah (ruck-bah)- 99.4 light years

2. Atse ets'ozi- First Slender One- Orion

Alpha-a: Betelgeuse (bet el-jooz)- 427.3 light years

Beta- b: Rigel (rye jel)- 772.5 light years

Y Bellatrix (beh-lay-trix) – 242.9 lights years

8 mintaka (min-tah-kah)-915.7 light years

Epsilon- e elnila, (al-nigh-lam)- 1341.6 light years

Zeta- alnitak (al-nigh-tack)- 817.0 light years

Kappa- Saiph (safe)- 721.2 light years

3. Hatiin sik'ai'ii- man with a firm stance with legs ajar Corvus

Alchiba (al-key-bah) – 48.2 light years

Beta- b kraz (tso hea china)- 139.7 light years

Gamma- y gienah (gee-nah)- 164.8 light years

Delta- 8 algorab “the raven” – 87.8 light years

4. Atse etosh- first big one- Scorpius (upper)

Gah hahat'ee- rabbit tracks- Scorpius (lower curve)

A Antares (an-tay-rease) – 603.7 light years

N graggias (graf ih as)- 530.1 lights years

Dschubba “ the forehead- 101.5 light years

Epsilon- e scorpii- 65.4 light years

Theta – sargas- 271.9 light years

Kappa- k scorpii- 463.7 light years

Lambda a Shaula- 702.6 light years

Upsilon lesath- 518.3 light years

5. So'ahots'ii- pinching or doubtful stars- Twin Sisters in Hyades Taurus

Alpha- Aldebaran- 65.1 light years

Beta- el nath 131,0 light years

Gamma- tauri or hyadum – 154.0 light years

6. Naayee neizghani doo tobajishchini- monster slayer and born for water (lyra)

Alpha-a: vega Arabic- 25.3 light years

Beta-b: sheliak- 881.1 light years

Gamma-y: sulufat- 534.3 light years

7. Ii'ni- thunderbird- Pegasu

A Markab- 139.6 light years

Beta b schein-199.1 light years

Gamma y algenh- 333.0 years

Epsilon- E Enif- 672.2 light years

Appendix C: Assessment Chart

Learning Goal	Type of Assessment	Assessment Format
Students will be given a pre and post-test based on their knowledge of math terminology and the Navajo Constellations. <ol style="list-style-type: none">1. Students will demonstrate their knowledge of the standard form of scientific notation and writing the scientific notation for numbers given.2. Students will also be assessed on their knowledge of the Navajo constellations by identifying the constellation that depicts a given description of the constellation.	Formative Assessment	Teacher Created Pre and Post Test
Students will present their knowledge of what they learned based on the following criteria which is scored on a rubric <ol style="list-style-type: none">1. Math Content2. Navajo Constellation3. Presentation Appearance	Summative Assessment	Keynote: Student Created presentation based on a Rubric.
Students will show progress and understanding by scoring 80% or above on assignments given.	Informal Assessments	Student assignments

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