

Patterns, Relations, & Functions....Oh My!

The Function of To' on the Navajo Nation

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Diné Institute for Navajo Educators (DINÉ)

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Author Note:

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## **Introduction**

Ya'at'eeh, my name is Marnita Chischilly from the Bitter Water clan (Tódich'i'nii) born into the Mexican clan (Naakai Dinée), my maternal grandfather's clan is Zuni people (Naasht'ezhi Dinée), and paternal grandfather's clan is Towering House (Kinyaa'aanii). I am a Navajo woman from a small community of Church Rock, New Mexico, which is about 15 miles east of Gallup, New Mexico. I am a proud mother of four children; three girls and a boy. They are all grown up now, with my two eldest girls receiving their Bachelor's degree at UNM, my son serving 10 years in the Army and my youngest daughter pursuing a nursing degree. I am also a proud grandmother of four wonderful grandchildren.

For over 30 years I have been working at Wingate Elementary School, which is under the Bureau of Indian Education (BIE). I started my career at the school as a Special Education secretary for the first 14 years and after receiving my Bachelor of Science degree in Elementary Education at the University of New Mexico, I became a teacher. I also received a Master of Arts degree in Educational Leadership from the University of New Mexico. When I became a teacher I started off teaching 3<sup>rd</sup> grade for 2 years, a 5<sup>th</sup> grade Teacher for 3 years and moved into middle school as a 6<sup>th</sup> grade Math Teacher (10 years), then a 7<sup>th</sup> grade Math Teacher (2 years) and in this coming year I will be in my 3<sup>rd</sup> year as an 8<sup>th</sup> grade Math Teacher.

## **Context**

### *Demographics*

Wingate Elementary School (WES) is under the BIE we serve a 100% population of Native American students. It is currently located a quarter mile from its previous historical site. The new school was built 2005 with facilities to serve residential students and academic programs. The school is more than fifteen years old now with many of the facilities still in fairly good condition. The construction of this campus included the idea of cultivation for a safe environment and providing a setting conducive for learning. The buildings have the capacity for technology in all areas with infrastructure of a school wide operation of a network system. The Library was designed and shaped as a "Hoghan", simulating a traditional Navajo home, and a Culture/Language Classroom designed in the same fashion with color scheme to enhance the simulation for the traditional cultural teachings and activities. The designing of the buildings was collaboratively planned with input from the school administrators, staff, parents and school board. During a typical school year, we usually have an enrollment of about 400 students, 1/4 of our students stay in the dormitory during the school week and 3/4 are day students transported by busses or families, and a few students walk to school from their nearby homes in the community of Ft. Wingate, New Mexico. The small community of Ft. Wingate has a small post office, a one vehicle fire house, government housing for school personnel and a trailer court. Many of the families moved into the community for employment and are now lifetime residents.

The assessment tools used by our school for evaluating math understanding are: teacher developed formative and summative assessments, textbook resource material assessments, daily monitoring techniques, and the Northwest Evaluation Assessment (NWEA) Measures of Academic Progress (MAP). In a "normal" school year, the NWEA assessment would be conducted three times a year to provide our teachers with beginning of the year (BOY), middle of the year (MOY), and end of the year (EOY) student results. The NWEA is also used by our

district as data for our school's Academic Status or Report Card by the Bureau of Indian Education.

### *Covid-19 Challenges*

Covid-19 has been a challenge for our school due to closures and suspension of standardized assessments. Therefore, last year our school did not conduct the end of the year NWEA assessment nor did they conduct the beginning of the year (BOY) NWEA assessment this school year. This was a dilemma for me because I still needed math data to review my students' needs and their math level, as a result, I began by using the most recent NWEA assessment scores which were from school year 2019-2020 NWEA BOY math assessment results for all 8<sup>th</sup> graders (63 total). The results indicated 49% (31 students) of my students were below average in all five areas of the math goal indicators. 45% (28 students) were nearing proficiency and 6% (4 student) were proficient. The nearing proficient students were below average in one or two indicators and two students were average to high average in the five indicators. The results showed most of the students had difficulties in all areas of math. Another factor that added to our students' struggle was having students learn online, which propelled our students to be even more behind. It is a challenging time for our Native students. This school year our school has adopted the hybrid model but we still have restrictions regarding social distancing and covid-19 protocols, so we still have to keep a safe distance from our students. Although we are following these measures as educators, we continue to do our utmost in providing quality education for our students. Using assessment data is only the part of the components in planning for my students. There are other factors that I need to consider in order to plan a productive school year such as my student's family background, culture and other pertinent learning skills and experiences. So providing instruction in ways that connect with students requires understanding of differences that may arise from events, culture, family experiences, assessment data, and academic skills. Over the years I've learned that using the background knowledge of students' is important when planning lessons for my students. In addition, I believe teachers need to be able to inquire sensitively, listen carefully, and look thoughtfully at student work and assessments to determine the level of instruction needed to have them move forward in their learning.

### *Instructional Approach*

I also believe in connecting culturally relevant lessons into my math lessons, which is very important to me as an Indigenous educator. When I began teaching at WES, we were led by an administrator that believed in a more westernized approach to teaching and learning. After my fifth year as a teacher I was more confident as a teacher, so I started self-directed professional development through online research and reading professional literature on instructional methods. During this time, I also took a couple of courses with Diné College in Crownpoint, New Mexico, where I was enlightened with the importance of our cultural teachings and how it was fading from our Diné people. This led me to the realization that implementing culturally responsive pedagogy is an important strategy in our educational system. Therefore, I began transforming my own westernized teaching approach to a more culturally responsive teaching approach. Of course this transformation did not happen overnight, it took several years of practice for me to strengthen my culturally responsive instruction. I know as a teacher I will always be a life-long learner as I continue to improve my content knowledge, search for new instructional strategies/activities, keep abreast of educational policies and search for professional development, thus provide me with the guidance on how to support my Native students' in their holistic development and academic learning.

The search for professional development also brought me to the DINÉ Institute program, where I began to learn how to develop my own culturally responsive curriculum units. The program has provided several elements of professional development such as enhancing content knowledge in seminar sessions with NAU faculty, researching content, augment writing skills, reflections, discussions, planning lessons, learning and/or improving instructional strategies, and other educational topics. One major benefit of this program is collaborating with colleagues that have the same passion for teaching and developing the learning skills of our Native American students. In addition, I enjoy the discourse and collaboration with the fellows in the program about the Diné way of life, traditions and our Navajo language. Another unexpected outcome is finding out that public schools across the reservation are dealing with the same instructional and behavioral issues as we are at our BIE School, which brings me back to the needs of our Native students for culturally relevant teachings. As a teacher, I believe in providing quality, culturally relevant education to all Native students to support their academic achievement. During my research of culturally responsive math instruction I came across Dr. Henry Fowler's statement that he envisions "math education to be engaging, fun, full of exploration, relevant to students' backgrounds and immersed in their native culture" (Brodsky, 2020). I agree with Dr. Fowler's vision, so as an educator, I plan to implement his vision of engaging my math students. The idea of engaging my students will involve my diligence in developing lessons using culturally responsive instruction that will captivate their interest and motivate them to learn. As an Indigenous educator and leader, I believe in the vision and goal that our Native American students can accomplish more achievements in their endeavors by maintaining a positive attitude towards learning, excel in future career(s) for sustaining financial needs, use everyday undertakings in practicing ethical moral ways to help themselves and others, and above all becoming more responsible as productive compassionate individuals. These ideas are the similar to the teachings of our Diné Way of Life that has been passed on from generation to generation and as a Diné educator I plan on using these ideas and teachings in my lessons. There is a Diné saying that has been taught by our elders to our youth, which is to build yourself up to become strong, resourceful, reliable, resilient, dependable, and self-reliant; then come back to your family to help along the way to old age. As Diné people, we need to continue the teachings of our elders and challenge our youth to honor these teachings as they lead us into the future.

## **Rationale**

As an educator, I believe it is important to build new knowledge on the foundation of students' existing knowledge and understanding to solidify the conceptualization of any new concept. For instance, students don't realize that they have many encounters with functional relationships in their everyday lives, and that they can bring a great deal of relevant knowledge to the classroom. This is why tapping into my students' background is an important part of planning for this unit. By having students understand that they have experience using functions in their daily lives is a strategy in motivating students to be more engaged in learning the application of functions. "Motivation to learn the material comes from adults' understanding of what is needed for successful social living and preparation for technical fields, and not the inherent interests of children. In this vain, mathematicians and educators must determine how to conceptualize mathematics, as a set of applied skills to aid in day-to-day living or as a formal academic discipline" (*Teaching Mathematics through Concept Motivation and Action Learning*, 2019). In analyzing my students' previous assessment data, I know most of my 8<sup>th</sup> grade students struggle with mathematical concepts, which points out that a different approach of instruction could be the motivator in their learning. Also by using my students' previous math data I developed this unit in an effort to support their understanding because I know as a math

instructor, that learning functions is part of the basic foundations for developing an understanding of higher level math. This curriculum unit on function is only one part of a complete thematic unit that I will be teaching in my 8<sup>th</sup> grade math class. Before I instruct this unit to my students I will need to reinforce the concepts of how to graph ordered pairs, review ratio and proportions, number patterns, and identifying the math pattern. After I review these concepts with my students, I plan to instruct this particular unit on functions for approximately three weeks. This unit will take longer because I will be embedding cultural relevancy by applying a real world situation pertaining to their family or community. I believe students are more engaged when the math concepts are applied to real world situations and have relevant outcomes to their learning. Thus, my rationale is to develop my unit using the cultural relevancy of “water is life”. They will understand the importance of water conservation in their family or community on the Navajo reservation by relating this concept to math functions with input/output and data analysis.

In middle school we are departmentalized and we have 55 minutes of core instruction in each period. Our core subjects are Math, ELA, Science and Social Studies. Students also have an elective class for 55 minutes. This year our school is planning to implement Math intervention for 55 minutes and ELA intervention for 55 minutes to support students that are falling too far behind in their grade level learning. Since the intervention is strictly for small group instruction, I plan to implement this unit in my core math class.

### **Content Objectives**

When learning math, patterns is a very important concept in building and strengthening students’ understanding of math concepts taught in the middle school. At an early age, students should be encouraged to investigate the patterns they find in numbers, shapes, and even language. They should be provided opportunities to explore, analyze, create, and extend their discoveries in a variety of ways to understand patterns using charts, numbers and shapes. These types of exploration will support the student’s understanding and build their mathematical knowledge in furthering their problem solving skills. As students’ progress to higher levels of math, they will utilize what they learned to deepen their conceptualization in using functions to model relationships between quantities. In 7<sup>th</sup> and 8<sup>th</sup> grade math, pattern-based thinking is generally applied to algebra, in solving problems involving functions. Thus, my unit is developed for my 8<sup>th</sup> grade students in utilizing critical and pattern-based thinking to conceptualize math functions and applying their understanding to solve real world situations. In order to get students motivated in learning this concept I need to give some examples of how functions relate in a person’s life. My curriculum unit objectives are to:

1. Understand the concept of math functions.
2. Have students understand how math functions are used in a real life situation.
3. Relate the cultural relevancy of how precious water is to the Diné Way of Life as they Solve math functions and analyze data.

I’ve been a Middle School Math teacher for over 10 years and one question that students often ask is “How is Math used in the real world?” This is a reasonable question for students to ask because they are wanting to know how the things they learn in school will apply to them in real life. As I contemplate the answer to this question using the concept of functions, I thought of real life scenarios of utilizing math functions. Sometimes, it can be hard to make the connections between the math concept being taught and the real life application of that concept. Lacking these comparisons can often have a negative effect on students and they begin to feel that

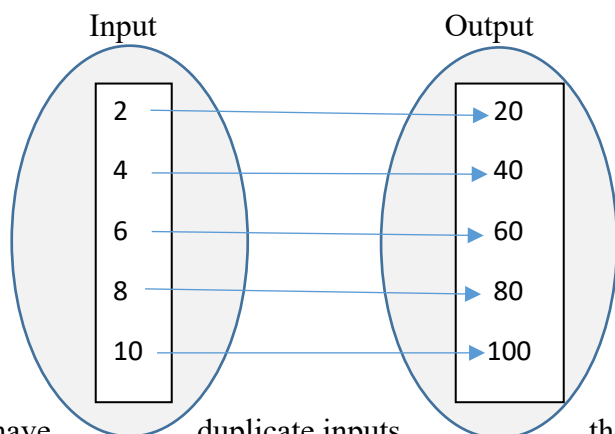
learning the concept is pointless. Even though people say math is important, it becomes less convincing when there is no explanation of why it is important to learn it. This is one reason it is important to make any subject that you are instructing relate to real life situations, which is one of the main focus for this unit.

Basic math concepts are easier in making that everyday life connection because they play an important role in our daily life and it is used more often. For example, calculating the amount of change the cashier owes you or if you want to figure out how much each item in a bulk cost. This type of basic math helps people decide between buying one item or buying in bulk to save them money. When buying in bulk, you would be paying more money, so you want to make sure it is worth it or is it less to buy the item individually. For instance, if a bottle of water costs \$1.00 and a pack of 6 costs \$5.52, you can divide the \$5.52 by 6 to find out that each bottle in the pack would cost \$0.92. You can then be assured that you made the right decision because you saved \$0.48. Sometimes, you find out that bulk is not always a better bargain.

As for middle school concepts such as Algebra, it gets a little more complicated to relate it to everyday life. In Algebra, new concepts such as variables (unknown number) and functions begin to be more complex, but are important concepts for students to learn. These concepts are helpful when we begin to understand how values will change depending on the changes within the math situation or real world problem being solved. Once students understand how different quantities work with one another they will be able to have a better understanding of relating functions in everyday situations because functions have one input and to one output.

When students are introduced to function, teachers usually bring the scenario of a function machine where the students have a numerical expression input and numerical output or answer. This is a good strategy as students begin to learn about functions. So, let's begin by learning what function means, which is having a relation between a set of quantities, where there is one input to exactly one output. This curriculum unit will reinforce student's understanding of this concept at a middle school math level where a function has a rule that assigns to each input to determine only one output. In other words, as stated in the text, Demarais, McGowen, and Whitkanack (1997), "A function is a process that receives input...and returns a value called the output. There is exactly one output for each input (p.149)." The concept of functions in math has a long history, but has only been defined within the past 150 years. The typical definition of function gives us a mental idea what it means, such as mapping.

### A Function

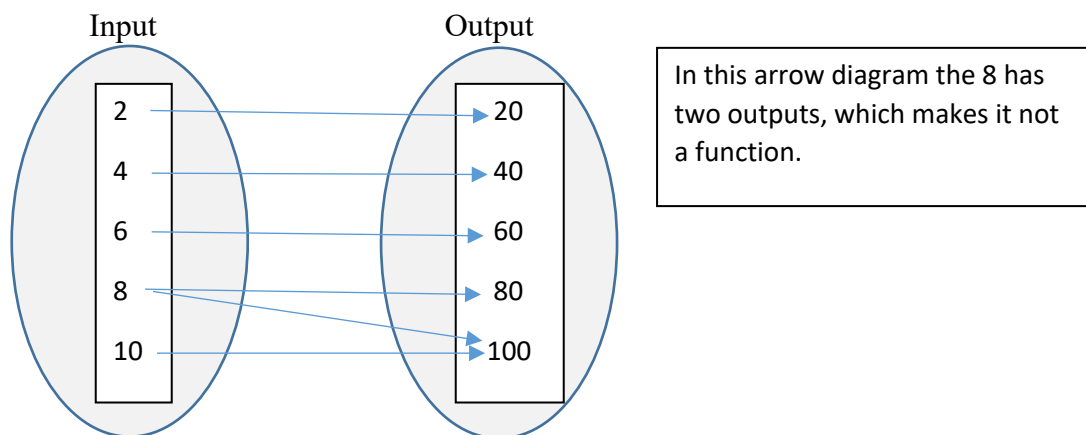


For each input there is exactly one output as illustrated in this arrow mapping diagram.

If you have duplicate inputs they have to correspond with the same output. For example, if this illustration has two 8s then both 8s have to have 80 as their outputs,

which still refers to exactly one output for both 8s. When this occurs it is still considered a function.

### Not a Function



Next, we can illustrate function as a table.

#### Function:

Input (x)	Output (y)
1	20
2	15
3	10
4	25
5	0

#### Not a Function:

Input (x)	Output (y)
1	20
2	15
3	10
3	25
4	0

The first table represents a function since there is exactly one output (y) for each input (x). The second table is not a function since there are two outputs (y) for the input of 3.

Next, students represent functions using graphs, in addition to tables. They will use tables using the x and y as their ordered pairs to graph. For instance, let's use the x and the y from the first table illustrated above. The ordered pairs in this table are (1, 20), (2, 15), (3, 10), (4, 25), and (5, 0). Students will compare functions in different representations by analyzing the properties of functions, using the initial value and constant rate of change, which we sometimes call the math pattern rule. I like to remind my students that there is a pattern in math concepts and it's easier to learn the different math concepts when you understand math patterns because they interrelate. It's important for students to have the foundational skills of understanding patterns as they move into higher math level instruction.

## Rate of Change

Rate is a constant or pattern, which is a type of change represented in the function. When students start understanding what the rule is in the pattern or a table they can associate this with the rate of change. To bring this idea into a real world context, it usually includes hourly wage, gas mileage, profit, water usage, and even the cost of an item such as a carnival ticket per ride. For instance, if you have a constant rate of change in your hourly wage, that means you are being paid a constant wage with no variation. If you calculate a certain amount of hours you work, you can use your constant rate of hourly wage to find out how much you will be paid for the hours you work. This constant rate of change with the hours as the variable can be represented in a table, graph, or as an equation. The rate of change develops into the concept of slope, which is the numeric value that describes the rate of change for a linear function. Therefore, functions will be a fundamental concept in algebra and future high school math courses.

This curriculum unit will focus on the 8<sup>th</sup> grade Common Core Math Standard of understanding relations and functions (8.F.A.1), but the curriculum unit can be adjusted to accommodate other grade levels according to student needs and learning of functions. I plan this unit to take at least three weeks of instructional time with 55 minutes each day. One week to instruct the concept of function and an additional two weeks to complete a performance task applying this concept to a real world application.

## Cultural Relevancy Instruction

Within our Native communities, there is a growing problem of environmental issues regarding water, air, and land. As educators, I believe we are obligated to address these issues that affect people in our communities. Therefore, this unit will support my students in understanding how water conservation affects not just other people's environment but our own community environment as well. I want my students to grasp the understanding that everyone needs to make changes in order to conserve what we have. When students understand the importance of change, maybe they will advocate for this type of change to others in their community.

A school setting is an ideal place to create awareness because it sets up a good way to get students involved in their community and practice what they learned through community service. Students can become advocates and they have more power in their community than they think. This unit also entails encouraging students to cultivate their approach by practicing what they learn by having academic discussions, questioning, sharing of ideas and thoughts, analyzing evidence, and graphing models to represent their findings. Through discussions, students can reflect on their current beliefs and concepts and begin to develop ideas that would support their thoughts on water conservation.

Students will learn or review cultural teachings, to support their understanding of our ancestral heritage and the Diné Way of Life involving the teachings of how precious water is to the Diné people. By including the Diné teachings, student will understand how our ancestors lived in harmony with Mother Earth and her precious resources. In having students learn about their cultural ways, they are more inclined to understand that they need to continue this way of life of respecting their surrounding environment and keep the balance of harmony called, "*Hozho*". It seems we are at a point where our youth are losing their cultural knowledge, language, clan system, and the teachings of the Diné Way of Life. I believe, as educators, we can bring back the teachings of living in the beauty way of (*Hozho*).



## A Need for Instructional Change

There are many educators across the Navajo reservation voicing a need for a different approach in instructing our Navajo students. In my research of culturally relevant instruction I have determined that this is an important strategy in supporting our Navajo youth in their achievement of academic success. Culturally responsive schooling has been a topic of discussion between the Federal, Navajo Tribal, and State Governments for many years. Within these discussions there has yet to be a specific policy or foundation to guide schools in defining a culturally responsive curriculum for the future of our Navajo children. Today, this vision, is still not being fully acknowledged by most school systems serving our Navajo children. Many schools are at the beginning stages of adjusting their curriculum to the meet the needs our Navajo American students. As an Indigenous educator I think we are capable of embedding culturally relevant instruction into our lessons to support our Native students. As a side note, I use Navajo and Diné interchangeably because I grew up knowing our people as Navajo and Diné. As an educator I believe we are Navajo and Diné people, because no matter what we are called, we are proud people and proud of our heritage.

Part of that cultural relevancy is the issues surrounding our environment. Some of our Diné teachings pertain to Mother Earth, which is our environment. If we can address environmental issues in a relevant meaningful way such as analyzing water usage data in their own family, they will likely change some of their habits in the use of water in their home and maybe change their family's usage as well. They need to be aware of the environmental issues in their community as well as global issues. Water conservation is a major environmental issue around the world.

## Water on Earth

Water is a natural resource that covers 71% of the earth's surface. Yet only 3% of the water on earth is freshwater, 2.5% of this freshwater is unavailable. It's unavailable because it is locked up in glaciers, polar ice caps, atmosphere, and soil or it is too far under the earth's surface to be accessible at a reasonable cost. So there is only 0.5% of the earth's water that is available as freshwater and 62% of this freshwater worldwide comes from groundwater. On the Navajo Nation we rely on groundwater.

## Water on the Navajo Nation

### *Navajo Department of Water Resources (NDWR)*

The Navajo Nation Division of Natural Resources established the Navajo Department of Water Resources to protect, manage and oversee water resources on the Navajo Nation. The department is responsible for the long term stewardship of the Nation's water resources and is responsible for the protection of the resources. As you know, the Navajo Nation is sometimes compared to the size of the state of Virginia. The Navajo Nation was established in 1868 and is the largest reservation in the country. The Nation is more than 27,000 square miles located in the southwestern region of the United States. It is situated in the Four Corners Region in parts of Arizona, New Mexico and Utah. It is also characterized as being within the four sacred mountains of Blanca Peak in Colorado, Mount Taylor in New Mexico, San Francisco Peaks in Arizona, and Hesperus Peak in Colorado. Almost all of the land is located within the Colorado Plateau, which is in the high desert. Since the Navajo Nation is located in southwestern part of the United States with a dry climate the Diné people are dependent on their water supply, which

is sometimes limited. For this reason it is important to educate our youth about how important water is to our Diné way of life for survival.

## Groundwater

A majority of the Navajo Nation's water supply are from groundwater. There are approximately 20 groundwater aquifer ranging in sizes by depth and capacity. Some of the aquifers are connected hydrologically and can be grouped into systems. Access to these groundwater systems are valuable during times of extreme drought since most of these deep and larger aquifers are not affected by these droughts. The two larger groundwater resources on the Diné Nation are the San Juan Basin and the Black Mesa Basin. San Juan Basin is located in New Mexico and Black Mesa Basin is located in Arizona. There are additionally other smaller basins that provide water to the Navajo Nation, but the majority of the water come from the two main basins.

## Water Usage by People

According to the most recent data of 2010, there are approximately 173,667 Navajo people living on the reservation and the total population is 332,129 (*Navajo Population Profile 2010 U.S. Census*, n.d.). Recently, people in the United States were astonished of the News on how some of our Navajo people did not have running water in their homes. This news came as a shock to many people in the United States during the Covid-19 pandemic. The Navajo people were hit hard by the pandemic. Water was a necessity for everyone on the Navajo Nation, but some had to make do with what they had. This is when people started to take notice and started non-profit organizations to help the Navajo people. The Navajo Tribal government also started on planning infrastructures for equitable water systems throughout the Navajo Nation. This water system is very much needed for everyone on the Navajo reservation. It is a necessity, but we also need to educate people on using the water wisely and conservatively.

As everyone knows we all need to drink plenty of water each day to stay physically well. Water is necessary for everything your body does. Not drinking enough water can lead to health problems. Brushing your teeth every day is important. Not only does brushing affect your dental health, it can also affect your overall health. There are many other ways we need to use water in our daily activities including cooking, so we cannot go without water for the sake of our health and survival. Since we need to use water daily we can think about ways we can do it conservatively. While brushing their teeth, some people let the water run from the faucet. Other people shut off the faucet to save water. Did you ever wonder how much water people waste brushing their teeth? These are some things we need to think about when we are using precious water and this is what I want our students to understand. Water is a good natural resource that does not come easily, nor abundantly, so whenever we use water, find ways in which to use water conservatively.

## Teaching Strategies

### Classroom Instruction using Zoom

Our school year schedule is hybrid learning, so some students will be in person and some students will be online learners. It is difficult to plan for this type of learning and it will be our first time with this type of instruction delivery. It will definitely entail the usage of technology in every aspect of our instruction. For now, our school is using zoom for our classroom instruction,

while our district gathers information on other learning management systems. Instructing on zoom was not too difficult to learn, if you practice. I learned how to navigate the system by practicing with a partner which made it easier. Zoom can be used to teach whole group instruction by sharing your visuals online, having whole group discussions, and having questioning/answering sessions. It allows you to have small group breakout rooms for group activities, peer tutoring sessions, or small group discussions. The breakout rooms can also be used for individualized sessions with the instructor for one on one conferencing. The zoom chat option can be used to post questions to the whole group or to an individual. This platform has enlightened me on the importance of incorporating technology into the classroom as a teaching tool in today's society. It also provides students an opportunity to learn online and have interaction with others without being in a classroom setting.

In today's society, technology is everywhere in almost every part of our daily lives and community. It affects how we live, work, play, and most importantly learn, so it only makes sense that we incorporate technology into our daily lessons. Combining new technology with traditional classroom instruction is one example of how the introduction of new technology can enhance the learning experience and create new opportunities for our students. When technology is readily available and used as an instructional tool, students have a better understanding of concepts learned.

A quick internet search helped me identify ways to supplement my lessons with interesting new material. I make it a habit of searching before I begin a new unit so I would be prepared and have a smooth transition from my instruction into a supplemental lesson using technology. I found plenty of supplemental lesson using video clips, tutorials and more, that brought my lessons to life. So, integrating technology into my zoom classroom instruction offers the opportunity to increase student interest and teach valuable skills, plus get them engaged. I try to make lessons engaging as much as possible so students are motivated in learning each new concept.

### Guided Instruction and Modeling using Technology

One of my primary goal is teaching for understanding to help my students develop a rational understanding of the mathematical concepts being taught. This understanding develops over time and becomes more complex as they move into higher level math. As an educator I support my students in understanding math concepts through daily instruction and scaffolding. Guided instruction is different than telling students to solve using only the method that is demonstrated, but to have students understand the problem and demonstrating the outcome. When guiding students as they learn remember to use questioning, prompts, and cues to engage students into interactive learning. Questioning students during the guided instruction helps students to focus their attention on the lesson and to be engaged, so they can participate in the conversation when prompted. Prompting students into math discussions also helps them focus on the math lesson and the vocabulary used during the discussion. When guiding my students in math lessons I will use videos, visual demonstration of a problem displayed on the zoom whiteboard or use the interactive textbook from our Savvas Math program. It's important to provide step by step instruction when I am demonstrating and modeling math concepts. This visual demonstration supports students in learning and understanding the concept. In addition, a routine in my math class is to incorporate modeling and reviewing in our daily lesson to support long term memory of the concept being taught. I know my students need plenty of visual instruction for them to comprehend middle school math concepts.

Sometimes students need step by step instructions or re-teaching to help them understand the concepts being taught. Instructing in ways that connect with students requires understanding of differences that may arise from culture, family experiences, assessment data, and academic skills. As a teacher, I need to be able to instruct using strategic, well planned lessons, listen carefully during discussions, and look thoughtfully at student work and assessments to determine their next level of instruction. It's also important to teach students how to write math notes, so they have examples to follow when they complete their independent practice. My students get frustrated very easily when they are struggling, so it's important to monitor their progress through questioning and discussions. It takes time for students to become confident in their math ability, so it's important to make students feel safe as they answer questions and praise them for learning. As students become more independent they assume more responsibility in completing their assignments and tasks, moving them from being participants in the modeled lessons, to helpers in the guided instruction and collaborating more with their peers. These helpers then become my peer tutors in our small group discussions or learning task. Once my students have a better understanding of the concepts learned, they can then be challenged using a performance task activity, such as incorporating the cultural relevancy of this math unit in a real life scenario. This math task is explained in the activity section.

### Tutorial Videos

To further engage students in learning concepts I plan to use math videos as a supplemental learning tool. Videos provides a means of interactive instruction and is a very flexible medium. Having the ability to stop, start and rewind which is absolutely imperative for me during my math instruction. It provides the option to stop each video and challenge students to predict the outcome of a demonstration, elaborate on the math procedure and integrate a short questioning/answering strategy. I also have the option to rewind a section of the video to review a segment to ensure that my students understand the key concept. Using videos is a good strategy but I know it's important to select the right video for each lesson to align with your instructional outcome. I will be using the videos from our Savvas Math (formerly known as Envision) program aligned with this particular unit. Other videos include [virtualnerd.com](http://virtualnerd.com), and youtube math antics. I will also use YouTube math videos aligned with this concept, which are listed in the teaching resource.

The tutorial video I am also planning to use are the teachings of our Navajo culture. In researching for this unit I've noticed there are many videos being produced by Navajo individuals that have good cultural teachings and one of those individuals is Wally Brown. I've been using his videos to supplement my instructions on our Navajo culture.

### Hands on Activities using Technology

By using hands on activities, it is my intention to support my students in recognizing, generalizing, and using patterns and functions that exist in society to further develop their understanding of real world mathematical problems and to enhance their skills for problem solving. One of the online programs that provide students with hands on activity is [whiteboardfi.com](http://whiteboardfi.com), which is a free online whiteboard for classroom work. I set up the whiteboard program and it generates a class access code for students to join. When they join, they each have their own whiteboard to use in solving a problem that I want them to do. As a teacher I can see each student's whiteboard as they write or type their steps in solving the problem. Another program that provides hands on activities is the Desmos program, which is an online program

that is a teaching tool for students to use as they learn graphing concepts. This tool lets students set the input values for x and the output values for y to generate a graph of the values. As students use this online program, students are actively engaged in the generating math functions of input/output and how the values form a straight line if the function has a constant rate of change. I also use the Teacher Pay Teacher resource to generate paper/pencil hands on activities for students that are online and for students that don't have internet access. There are a variety of resources on this site for all subjects, so I have to research which activity will support my students in learning the concept. It takes time to research and it does have a fee for each resource you want to use, therefore I usually make sure the resource is well worth the cost. Once all students have a copy of the activity I use an Elmo to project the activity on my share screen in zoom. The Elmo is a useful tool for instructing online or in person, because students can have a visual aid of how to complete the activity as you instruct it online. I can also use the Elmo to project other tangible resources that are not online to instruct students in learning their math concept.

## **Classroom Activities**

### Guided Instruction

Guided learning activity- Have students make two columns, title one-side water usage and the other side title it estimation in cups/gallons. Then have students work with a partner to list how they use water on a daily basis. Next, have them estimate how much water they use for each item they listed. With a partner, have students record their initial thoughts about how much water is being used on a daily basis if everyone in the classroom does these same routine on a daily basis. After they record their answers, the students will discuss their finding as a class. Explain to the class that over the next few weeks, they will be discussing ways to conserve water.

### Reading and Research

Reading and Researching Activity– Students will be expected to read books, articles and other material from the internet or in libraries to enhance their understanding of water resources and water conservation. These reading strategies are important for students to master as they move higher in grade level. Students will spend time:

- Looking for information
- Selecting information
- Noting and recording information
- Interpreting information
- Organizing information
- Referring to information in assignments

### Analyze Data Activity

Students will analyze data from the research of their choice. Data analysis is the process of interpreting the meaning of the data students have collected. Data study is a valuable tool for students to learn, especially considering that so much data is now being generated. This is an important learning experience for students as they prepare for High School level math and science courses.

I also included a list of non-profit organizations and other resources regarding water programs on the reservation. This list is on Appendix B.

### Infographic Activity – Performance Task

Infographics are graphic visual representations of information, data, or knowledge intended to present information quickly and clearly. Students will organize a collection of math functions and graph they feel is important in representing what they learned in their analysis, which will demonstrate their understanding of how to represent math functions using data displays. By completing this type of assignment my students will improve their reasoning by utilizing graphics to enhance the human visual system's ability to see patterns and trends. Having students share their findings supports their understanding that each individual has a role in conserving our natural resources.

Another use of infographics will be to show an example of an infographic from the internet then ask students, where they have seen an infographic? Maybe articles, newspaper, advertisement, textbooks, etc. Students will use the information they gathered to create an infographic using the following criteria: 1) title 2) at least four pieces of evidence 3) use images or data more than text 4) citation of where they gathered the information. They will present their completed project. (a suggested rubric is included in figure 1)

Once they have explored infographics, students will create one of their own. Instructions will be as follows:

- 1) Instruct students that based on what they learned, they will create infographics that representing math functions to illustrate their data analysis of water usage. In this curriculum I want students to do a performance task in which they observe and complete a data chart on how much water they use when they shower. The reason I chose this task is to give them an understanding that everyone uses different amounts of water, according to how long they take in the shower and how many showers they take in a week.
- 2) The student will focus on one specific water usage task (you can also have students analyze other water uses that illustrate water usage.
- 3) Students will find solutions to the problem by finding ways to conserve water for each task. They will use this as part of their infographic data collection and their presentations.

### **Student Assessment**

Assessments are a fundamental tool in measuring academic growth for students in any subject. It plays a critical role in teaching because it helps teachers determine the extent in which students have mastered a specific concept. It gives teachers guidance in determining the next step of instruction or if re-teaching is necessary before moving on. Assessments is a very useful tool for instruction when it is implemented correctly and strategically for the purpose of gathering information of each student's progress and understanding. Sometimes, students fall through the cracks when teachers are not analyzing data results from assessments. This can cause students to fall further behind in grade level learning.

In analyzing my students' previous assessment results and conducting the pre-assessment at the beginning of the year, I am well informed of where I need to start in this unit. A pre-assessment at the beginning of the year informs me of each student's strength and weaknesses in math. In analyzing the results of the pre-assessment I was able to determine my students' weaknesses in

the number systems and algebraic reasoning, therefore, before I start this unit I need to reinforce these concepts, so they will be prepared in learning the concept of math functions.

During the learning phase of the unit, I will be conducting formative assessments, which are also important components of a unit and in our daily lessons. I will incorporate formative assessments using the questioning strategy as mentioned, observations as students use independent practice on their whiteboards and class discussions during zoom lessons. Students will also be observed in breakout rooms as they complete small group task and discussions. By conducting these formative assessments, I will know what students understand and/or if I need to use a different approach in clarifying what is being taught.

At the end of this curriculum unit students will demonstrate their understanding by completing a summative assessment in the form of a performance task. I started the process in designing this summative assessment which I feel would benefit my student’s educational growth in conjunction with their learning styles. I design the assessment according to my students’ learning style and background knowledge. This process of designing assessment is time consuming, but I believe it will support my students’ learning as well as benefitting my professional development as a teacher. The performance task assessment is a project based learning task that can be completed as a pair or individually. In this unit students will complete a performance task that will entail their learning of the objectives as presented for this unit.

Infographic Rubric (example)	minimal	moderate	achieve
Has an appropriate title	1	2	3
Contains at four pieces of evidence	1	2	3
Organization of the project	1	2	3
Data shares focused information	1	2	3
All citations are included	1	2	3
Total points possible 15			

Figure 1 is a suggested simple rubric

## Alignment with Standards

### *Common Core Standards*

The Common Core State Standard (CCSS) is a research-based set of learning progressions detailing how students’ mathematical knowledge, skill, and understanding develop over time. The standards support the development of knowledge and skills students need in order to prepare for mathematics in college, career, and in life. These standards define what students should understand and be able to do at each grade level, but at our school, most students are behind in their grade level. The standards encourage students to solve real-world problems using the components of mathematical practices. This curriculum unit is aligned with the 8<sup>th</sup> grade common core state math standards of understanding relations and functions (8.F.A.1). It is also aligned with the 7th-8th Diné Culture Standards: Dinek’ehji na’nitin silahigii gohoosh’aahgo ei bee siih dinisdzin dooleel (I will apply and practice the Diné way of life with confidence, PO2, To’ daholoogoo binanise’ shil beehozing dooleel (I will identify different water sources and their purpose of usage).

I also included a list of teaching resources for math instruction to use as supplemental tools in supporting students in their learning of math concepts. Online instructional tools are beneficial to enhance student learning and have students have access to visual learning. I included this list in Appendix C.

## Resources

*Envision 2.0 Math 8th Grade: Vol. Volume 1* (Envision 2.0 8th Grade ed.). (2014). Pearson Education.

Fisher & Frey. (2010). *Guided Instruction: How to Develop Confident and Successful Learners*. Ascd.

<https://books.google.com/books?hl=en&lr=&id=bVx7Z5HPJG8C&oi=fnd&pg=PR7&dq=guided+instruction+and+modeling+in+teaching+math&ots=y61dMBIM0p&sig=YGPyzKzID7dgDJyire3bhUsh1c#v=onepage&q=guided%20instruction%20and%20modeling%20in%20teaching%20math&f=false>

*How Much Water does a Shower Use?* (2006). Pbs.

<https://nm.pbslearningmedia.org/resource/ess05.sci.ess.earthsys.showermath/shower-estimation/>

*How Much water is there on Earth?* (2021). Usgs. [https://www.usgs.gov/special-topic/water-science-school/science/how-much-water-there-earth?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/special-topic/water-science-school/science/how-much-water-there-earth?qt-science_center_objects=0#qt-science_center_objects)

*How the Navajo Nation is Transforming Math Education.* (2021). Forbes.

<https://www.forbes.com/sites/juliabrodsky/2020/12/19/how-the-navajo-nation-is-transforming--math-education/?sh=1b713afd4c96>

*Navajo Current-Future Water Use.* (2018). Usbr.

<https://usbr.gov/lc/region/programs/crbstudy/tws..>

*Navajo Population Profile 2010 U.S. Census.* (n.d.). Navajo-Nsn.Gov. Retrieved October 10, 2021, from <https://www.nec.navajo-nsn.gov/Reports/NN2010PopulationProfile.pdf>

*Reclaiming Dine History: The Legacies of Navajo Chief Manuelito.* (2006). University of Arizona Press.

*Research Sampler 9: Key Aspects of Knowing and Learning the Concept of Function.* (2021).

Mathematical Association of America. <https://www.maa.org/programs/faculty-and-departments/curriculum-department-guidelines-recommendations/teaching-and-learning/9-key-aspects-of-knowing-and-learning-the-concept-of-function>

*Teaching Mathematics through Concept Motivation and Action Learning.* (2019). Hindawi.

<https://www.naeyc.org/sites/default/files/globally-shared/downloads/PDFs/resources/position-statements/psmath>

*Water Facts - Worldwide Water Supply.* (2021). Bureau of Reclamation.

<https://www.usbr.gov/mp/arwec/water-facts-ww-water-sup.html>



*Water is life is this still true?* (2021). Youtube.

<https://www.youtube.com/watch?v=agKyHA78T6c>

## Appendix A

### Water Project Research

Name: \_\_\_\_\_

Most of the Earth is covered by water, but only a small portion of that water is fresh water that is usable for people to survive. Use this page to explore fresh water on Earth.

#### Research different types of water sources.

Sources: List the different types of sources of each type of water.

Salt Water	Fresh Water

What are the fresh water sources on the Navajo Nation?

Research some concerns regarding these fresh water sources on the Navajo Nation? (Findings)

Does your family or community have concerns regarding their fresh water sources?

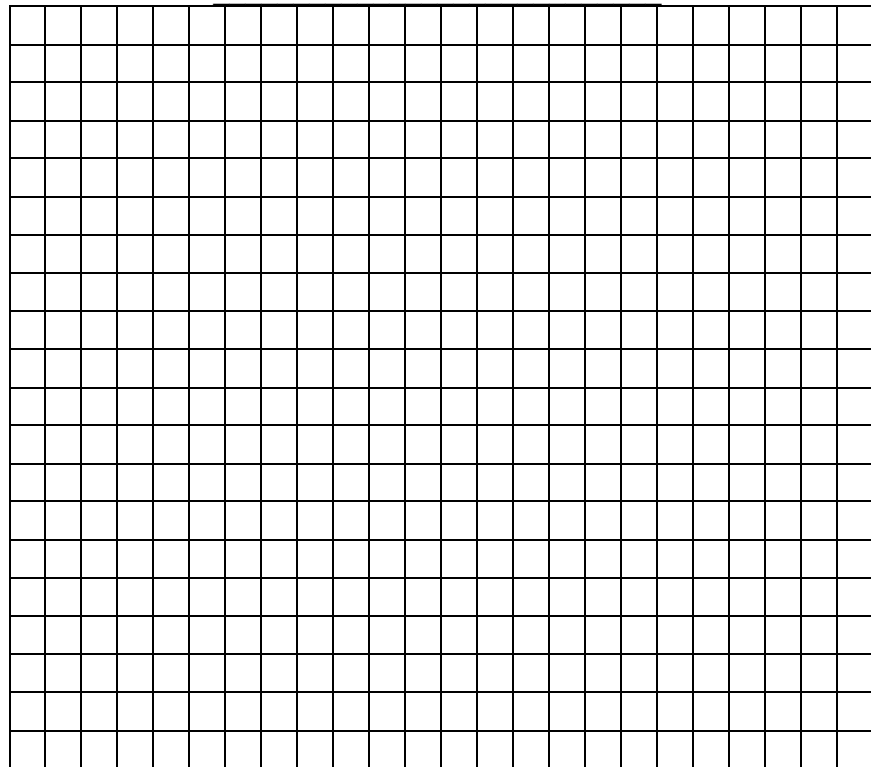
**Part of Infographic Data Results**  
**Relating Math to Real World Problem Solving**

**Name:**

Create an input/output table using proportional relationships in estimating how much water your family will use in one year (by days or months). Use this table to graph your results.

Create a graph to show your family's estimated water usage in a year. (Remember the subtitles for x and y)

Title:



Describe at least 4 ways your family can reduce the amount of water used in the year.

**Cultural Aspects of Water to the Diné People**

**Name:**

---

Do you think our Diné way of life teachings help us? Why?

How has our Diné way of life teachings contributed to today's society regarding water usage?

Do you feel motivated to learn our Diné way of life teachings? Why?

Do you feel motivated to learn the Navajo Language? Why?

Who can you ask in your family to learn more about the Diné way of life teachings or the Navajo language? Will you ask them to teach you? Why or why not?

## Appendix B

### List of online resources regarding water programs on the Navajo Nation:

- Navajo Nation Department of Water Resources <https://www.nndwr.navajo-nsn.gov/>
- Water Equity Clearinghouse <https://uswateralliance.org/organization/navajo-water-project>
- Tracking Water for the Navajo Nation  
<https://earthobservatory.nasa.gov/images/146565/tracking-water-for-the-navajo-nation#:~:text=Carlee%20McClellan%20has%20a%20mission,local%20communities%20C%20particularly%20underserved%20communities.>

## Appendix C

### Teaching Resources:

*How Much Water does a Shower Use?* (2006). Pbs.

<https://nm.pbslearningmedia.org/resource/ess05.sci.ess.earthsys.showermath/shower-estimation/>

This is a video published by PBS, that gives students an idea on how to collect data on water usage as they shower. It gives them an idea on how calculate amounts of water used.

*Water is life is this still true?* (2021). Youtube.

<https://www.youtube.com/watch?v=agKyHA78T6c>

This is a video by Wally Brown on how water is important to the Diné people.

The following list is online supplemental resources to support math instruction:

Desmos.com

Virtualnerd.com

Mathplayground.com

Mathanticsyoutube

Envision 2.0 (8<sup>th</sup> Grade)

Eureka Math (8<sup>th</sup> Grade)

## **Synopsis: The Function of To' on the Navajo Nation**

Connecting math with real world context is more meaningful to students than traditional textbook exercises and it helps them develop a sense of how number patterns and functions are used in everyday life. Frequent practice and use of the concepts learned is important in the development of math skills, as are regular opportunities for student communication. Discussion of their learning and problem solving helps students strengthen their intuitive understanding of math patterns and functions. In this curriculum unit students learn math function by applying it into a real world situation of water conservation. Students represent functions in a table and a graph to present their data analysis of daily water usage. Students will create an infographic presentation as their performance task, using their data results. Cultural relevancy is also important in this unit as students conduct their water usage research to include research on the importance of water to the Diné Way of Life. Water is precious, so students should be aware that water conservation is important to our future generations.