Clean Air and Water: Keeping the Navajo Nation Safe through A Clean Environment

Water on the Colorado Plateau

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Introduction

Water is everywhere. Above, below, and even in our bodies. The same water we are drinking now is the same the dinosaurs have been drinking and swimming in millions of years ago. Water is very important and scarce in the southwest United States and on some parts of the Colorado Plateau, which encompasses the Navajo Reservation. We know water is recyclable. That is, it goes through the water cycle process that allows all living beings to consume clean water to sustain them. In the water cycle, water in the liquid state forms rivers, streams, tributaries, and lakes as surface water. Some water will seep into the porous rock and soil and become underground water. The goal is to inform my students about why clean water is important. My integrated curriculum unit will inform students and teachers about clean water. My curriculum unit embeds the Diné culture and language, the state social studies and science, and the language arts standards while illuminating and teaching the content to my students.

Context

Kayenta Middle School is one of four schools with the Kayenta Unified School District. Kayenta is located in the northeast region of the Navajo Reservation. The rural town is 22 miles south from the Utah border. According to the National Center for Education Statistics: 93% of students are Native American Indian (Navajo), 3% White, 1% Hispanic, 1% Hawaiian/Pacific Island, and 2% two or more race (National Center for Education Statistics). Within the four schools (ABC preschool, Kayenta Elementary, Kayenta Middle and Monument Valley High School there are about 1,700 students. Many of the students lived within the surrounding areas of Kayenta about fifty to sixty miles radius. Students ride busses from these areas. The District is a feeder school for students who have completed the BIE, grant, tribal or charter k-8 schools. The surrounding schools are Chilchinbeto, Dennehotso, Rough Rock, Shonto, and Black Mesa Community School. Students from these nearby schools prefer KUSD because of the sports program, the swimming pool, and the GATES Millennium scholar program. The community provides the fast food chains at the junction (McDonalds, Taco Bell, Burger King, Sonic, Subway, Churches, and Pizza Edge) which most students prefer to eat. In addition, there is our famous Wednesday Flea Market. Many vendors from around the reservation and border towns come to Kayenta to sell their products.

The Middle School encompasses grades 5th through 8th with an estimate of 530 students. I am one of six fifth grade teachers and the upper grade sixth through eighth have about six teachers within each grade level. The average classroom size is about 25 to 30 students per class. I teach at the Middle School as a fifth grade teacher in a general education classroom. My students are a mixture of general education, special education, and English Language Learner students. Our district utilizes the inclusion model for special education students to attend in the general education classroom as much as possible based on their functional level of their Individualized Education Plan (IEP).

Most students have the basic understanding of carrying a water bottle to stay hydrated, but they need to know more about the policies and politics of water and how it will influence their lives today and for their future. They do not realize how important water is in the Southwest and on

the reservation. Most students have running water and electricity in their homes, but there are very few of them who actually haul water for human consumption. Those who have livestock usually haul water for their horses, cows, and sheep. The Navajo Tribal Utility Authority (NTUA) in Kayenta has a well in front of their office building and many of the residents in Kayenta and the surrounding area haul water from the well. Although, there are windmills for livestock, many still come to Kayenta for water.

Rationale

When the recent Gold King Mine spill in 2015, many small towns and rural communities panicked. The chemical waste from the mine poured into the rivers from Colorado and into New Mexico, and Utah. The rivers turned yellow and effected the water usage with the three states. People depended on the San Juan river for their livestock and their fields for irrigation. Individuals from the northern outlying areas came to Kayenta to obtain water. The small towns from Utah would come to Kayenta with large water trucks to haul water back their residents. Monument Valley/Gouldings, Mexican Hat, and Bluff would drive to Kayenta to get their water. I recalled seeing a long line of trucks parked at the well to get water. They would come during the early mornings or late evenings. The Kayenta residents began to worry about the water because others started coming to get water. I want my students to learn about the water process (water cycle), how to conserve water with their homes and to teach their families about what is happening to water within their area. My students need to know and understand why and how water is very important because in our Diné culture, the common phrase heard is, Tó Bee Iíná meaning, "Water is Life". What will their future will be like when they begin to raise their own families in thirty to forty years from now. Will there be clean water in twenty years? Will ground water and aquifers be able to provide clean water for the community?

Objectives

My objectives are to know the future state of water; my students will need to know the geography of the water system on the Colorado Plateau from the smallest streams to the large Colorado River flowing into the Gulf of California. They need to know the specific components of the water cycle along with the Black Mesa Water table's surface and groundwater, which hits home within the town of Kayenta. This content includes relevant factors that our Diné students need to know their future needs, especially to know the Clean Water Act's (CWA) purpose and regulation when accessing water for public and personal use. In addition to the aquifers, the Gold King Mine spill (2015) explains the details and information on the point of origins of the spill of the toxic chemical into the tributaries, streams, and rivers. The Diné culture and language stories about water are additional information students need to know because these stories have a theme and lessons about how water is sacred and have a ceremonial purpose.

Content

Colorado Plateau

The Colorado Plateau currently covers portions of Utah, Colorado, Arizona, and New Mexico, which is 130,000 miles. The Colorado Plateau is a land with colorful sedimentary strata that has been uplifted and dissected into deep canyons by a few large rivers and their tributaries, with extensive between-canyon landscapes in a mostly arid climate. (Plateau, p. 9, 2009). The colorful horizontal strata layers of deposition rocks show what has happened since the rocks formed layer by layer. These rocks record what, when, and how it used to look before the uplift of the plateau. Millions of years before the uplift, there were shifting dunes, rivers, and areas with blue seas. The time era of the plateau was about 450 million years ago and the area was below sea level. Geologists used the rocks, plants, and animals evidence to determine an approximation of when the uplift happened. They estimated the uplift happened 70 million years ago, which recent when compare earth time, but other geologists have other theories. As the uplift of the plateau formed, the area of the Basin and Range began to take its modern form and segregate itself from the Plateau beginning about 17 million years ago and begin to visibly show the outline of the uplift. (Plateau, page 10, 2009). We know the tectonic plates are constantly shifting and moving the Earth's crust. They believe the Plateau is thick dense crust than the regions that surround the tableland. A cross-section of the earth's crusts from California to Colorado through the Colorado Plateau, there are different disturbed rocks on the west and east of the Plateau. The young pointy mountains in California, Nevada, and Colorado formations by the convergence of the subduction (Farallon Plate) and uplift of North American plate. (Plateau, page 10, 2009)

An estimated five to ten million years ago, raging rivers, streams, tributaries and lakes begin to carve into the landscape of the Plateau (Durrenberger, 1972). The landscape begins to show the many beautiful canyons in which the rivers journey through to make their way to the larger lakes then into the Colorado River. Geologists theorized based on evidence of the stratification layers show how the canyons became very deep and wide. As the Plateau slowly uplift the rivers and streams continually flow through creating deeper chasms on their way toward the sea. These sandstone chasms carved easily because of their sedimentary structure. Although, there are numerous streams and rivers most of the Plateau receives about 15% of rainfall. A relatively large portion of the precipitation is from thunderstorms which occur mainly in July and August when rates of evapotranspiration are highest. (Durrenberger, page 5, 1972) These quick downpours of rain result in rapid runoff and less saturation of groundwater. Most of the moisture coming from the winter and snow from the mountain caps, which trickles slowly in the subsoil, in turn, provide water stored in the reservoirs within the southern and western portion of the Plateau. On the eastern and northern parts of the Plateau, the Colorado, San Juan, and Green rivers provide water for the agriculture. These rivers and tributaries have variable flows; they can become raging rapid floods to small trickle flows and dry riverbeds. Drought and flood fluctuate with the rivers and stream on the Plateau.

Along with the many land formations structures of buttes, canyons, mesas, and mountains on the Colorado Plateau, these formations contain out/under/surface flow, evapotranspiration (the process where moisture is evaporated from land and plants and taken up into the atmosphere) and seepage of water from various aquifers to sustain life (Durrenberger, 1972). The Black Mesa aquifers are one of the major natural aqueducts that have provided clean confine and unconfined water to all beings within the surrounding areas of the mesa.

Black Mesa Aquifer

Black Mesa is located in the northeastern region of the state of Arizona. The mesa's diverse topography includes flat plains, smaller mesas, and deep ravines. The northern and northeastern sides have high cliffs, whereas the south and southwest region of the mesa gradually slopes down. Water availability is very important because this region has an arid to semiarid climate with low precipitation (Eychaner 1981). The groundwater availability is from the different aquifer between the different sandstones under the mesa. Below the mesa's numerous sandstones, are layered aquifers, which provide clean water to all beings living on the surface of the land.

In the Black Mesa region, there are four main aquifers, each with its geological formation of sandstone. In ascending order, the aquifers are the C aquifer, N aquifer, D aquifer, and the Wepo and Toreva Formations of Cretaceous age. (Eychaner 1981) The Navajo (N) aquifer is the major source of water for industrial and municipal uses in the Black Mesa area. The N aquifer is composed of three hydraulically connected formations—the Navajo Sandstone, the Kayenta Formation, and the Lukachukai Member of the Wingate Sandstone—that function as a single aquifer. (Macy and Mason 2013-2015). The N aquifer is about 1,000 feet deep and above it, is the Dakota Sandstone aquifer (D). The D aquifer is composed of Dakota Sandstone, Entrada sandstone, and the Carmel sandstone. (Macy and Mason 2013-2015) The Carmel sandstone divides the N and D aquifer. The Carmel sandstone contains red and white shale siltstones and massive mudstone. The N aquifer is the lowest unit considered because it is generally the lowermost aquifer tapped by wells in the area and no significant amount of water movers between the N and C aquifers. (Eychaner 1981) The D aquifer is about 600 feet above the N aquifer and has a greater concentration of chemical within the water. The concentration of chloride ions is 11 times greater, and sulfate ions are 30 times greater. The shale, claystone, and mudstone prevent the vertical movements of water. (Eychaner 1981).

The sandstone stratification below the mesa is a confined aquifer in most of Black Mesa, whereas as the N aquifer surrounding mesa and the most recharge to the aquifer are at the surface where the sandstone is exposed. The primary inflow to the aquifer is a recharge of rainfall and snowmelt on the ridges, which is near Shonto. Shonto produces about 15 percent of the outcrop areas estimated to produce more than one-third of the recharge. Shonto recharge moves rapidly to the southeast towards Tuba City and the south towards the Hopi Reservation. The same recharge divides and moves east towards Rough Rock and Dennehotso. This flow divides under the mesa, moving to the south, north, and east. These directions of ground-water movement indicate areas of inflow to outflow from the aquifer. These underflow, outflow, surface flow, and seepage documented yearly to track the number of water movements to and from the aquifers. The chemical composition of water purity documented for human consumption because of the location of D aquifer and its high chemical substance within the water.

A small amount of inflow most likely occurs from upper stratification beds as leakage into the lower confining beds. The geologic description of the confining beds indicates that some flow in same amounts does occur. However, the concentrations of chemicals (sulfate, chloride, and other solvents) in the D aquifer is more evident than the N aquifer. The drill for wells into the N aquifer may also have contributed to a small number of leakages from the N aquifer but the percent of chemicals are very small. The N aquifer flows tested in the surround mesa areas like

the Moenkopi Wash, Dinnebito Wash near Sand Springs, Polacca Wash near Second Mesa, Pasture Canyon Springs, Laguna Creek, Chinle Creek near Mexican Water, the unnamed creek near Dennehotso. These areas have a streamflow-gaging station.

Today, local towns like Kayenta, Tuba City, and Chinle have grown and so has the demand for water usage. More wells drilled for more windmills to provide water to livestock on and surrounding the mesa. A major corporation (Peabody Western Coal Company) was the major industrial water user. The PWCC mine corporation established their company on the top northern part of Black Mesa. The company demands vast about of water from the N aquifer withdrew more than the inflow from the surrounding streams, creeks, and wash. PWCC's mining operation consisted of two mines on Black Mesa—the Kayenta mine, which transported coal to the Navajo Generating Station by train, and the Black Mesa Mine, which transported coal 275 miles to the Mohave Generating Station by a coal slurry pipeline. (Macy and Mason 2013-2015) In 1982, the PWCC sold the largest amount of moisture-adjusted tons of coal to the Mohave Generating Station and the quantity of water pumped by the PWCC increased from about 100 acre-feet (ft) in 1968 to a maximum of 4,740 acre-ft. in 1982. (Macy and Mason 2013-2015) The PWCC demands for water lowered the aquifer, which also plummeted the water in many wells. The long term on continuous use of water withdrawn from the D aquifer used with caution, because of the stress of the aquifer effects the flow and containment of water in the D aquifer.

The Clean Water Act (CWA)

All capillaries of our river system and small streams are very important in relation to clean water because they feed into the larger water system such as lakes and rivers. The capillaries of streams are critical in protecting the flow of clean water downstream. (epa.gov/wqs-tech/). Although small, these streams are very vulnerable and need protection under the CWA regulations and guidelines.

The Clean Water Act (CWA) is the basis of protecting surface water quality in the United States. Growing public awareness and concern for controlling water pollution led to the enactment of the Federal Water Pollution Control Act Amendments of 1972 (Clean Water Act. Laws and Regulations). Amended in 1977, the law is known as the Clean Water Act (CWA). The Act has structured regulations to inform and monitor the discharges of pollutants into the water systems across the nation. The Clean Water Act gave the Environmental Protection Agency (EPA) the authority to implement guidelines to set water quality standards to control pollution for industry and all surface water contaminants. The act forbid any person to release any poison or toxins from its origins (point source) into moving waters unless an PA official approved a permit to release the contaminated waters. The EPA funded even the sewage treatment plants constructed. It addressed the nonpoint source pollution--meaning the origins of contaminants are unknown.

Throughout the years after the Act's establishment, it has gone through some revisions and changes with the laws and regulation, because funding and grant programs were improving programs like construction a new facility, renovating sites, or connecting with partners who are stakeholders with the CWA and the EPA. An example of partnership is the Clean Water State and the EPA-State partnerships. Even our nation's president contributed and finalized regulations to the CWA. In 2015, the Obama Administration finalized the Clean Water Rule to clarify which

water was protected under the act and restore protections for many of the two million streams miles that have been at-risk (rivernetwork.org date needed or indicate no date). The public from communities around country-influenced Obama's involvement. The EPA and Obama's administration adjusted the regulations to make it clear and concise as possible. As the original regulations in the CWA did not protect as many waters originally covered. Although EPA is a national entity and makes every effort to address water issues the governmental body need assistance. The EPA has compiled state, territorial, and authorized tribal water quality standards that agency has approved or are otherwise in effect for Clean Water Act purposes. (epa.gov/wqs-tech/). In instances when state-specific water quality standards have not been developed or approved by EPA, the Agency will propose and/or promulgate standards for a state until the state submits and EPA approves their standards (epa.gov/wqs-tech).

The EPA has provided grants known as Section 106 under the Clean Water Act. Section 106 of the Clean Water authorize EPA to provide financial assistance to states and eligible interstate agencies to establish and administer programs for the prevention, reduction, and elimination of water pollution (epa.gov/wqs-tech). In 1978, Congress amended section 518e of the CWA to include provisions that allow EPA to treat an Indian tribe like a state (i.e., treatment like a state, or TAS) to provide Section 106 funding (epa.gov/wqs-tech date or no date).

Section 106 is a program, which provided technical assistance and funding known as the Section 106 program. The program assists tribes and intertribal group to understand, assess, and preserve water resources on their lands. Section 106 grants provide important funding sources to assist in developing, maintaining, and expand water quality programs. The programs provide tribes with a structured and systematic plan designed to control, prevent, and eliminate water pollution and to train and educate tribal members. These federally recognized tribes reside on tribal lands covering scattered Reservations across the United States. More than 110,000 square miles of land are claimed land sustained by more 566 distinct Indigenous tribes. The individual tribes have their unique way of using and respecting the water resources. The many use the tribe utilizes water is for recreation, transportation, fishing, aquaculture, ceremonial purposes, and more. Each tribe has unique challenges in protecting and restoring thousands and thousands of rivers, streams, lakes, and groundwater. Many tribes across the country are using Section 106 grants to address water quality and concerns.

For these tribes to be eligible to receive the 106 grants they need to abide by specific guidelines and requirements. Of the 573 federally recognized tribes, approximately 330 meet the five requirements for TAS (epa.gov/wqs-tech). Since 1987, the annual Section 106 tribal set-aside has grown from less than $1 million to more than $25 million (epas.gov/wqs-tech). About 75 percent of these tribes have applied for and received Treatment As States to receive Section 106 grants (epa.gov/wqs-tech). One of these tribes is the Navajo Nation, who has their own Navajo Nation EPA. The Navajo Nation has an established environmental policy act, known as the Navajo Nation Clean Water Act. The 57-page outline with ten subchapters of about general provisions, Navajo water quality standards and planning, surface water discharges, and pretreatment requirements, sewage sludge, permits and other authorizations, nonpoint source management program, watershed protection programs, enforcement, and rulemaking and judicial review. The Navajo Nation Director enforces the ten subchapter regulations along with the US EPA.

Gold King Mine Spill – Yellow Water

On Wednesday, August 5, 2015, during a United States Environmental Protection Agency (US EPA) mine site investigation of the abandoned Gold King Mine near Silverton, Colorado, heavy equipment disturbed loose material around a soil "plug" at the mine entrance. (Understanding the Gold King Mine spill, rev. 2016) This accident resulted in the release of approximately 3 million gallons of acid mine drainage into Cement Creek, a tributary of the Animas River, which in turn flows into the San Juan River and ultimately into the Colorado River. (Understanding the Gold King Mine spill, rev. 2016) The Gold Mine spill is an excellent example of point source release water pollution and the federal EPA and the state that had been regulating the mine. The main point where the toxic chemicals from the abandoned mine gave way from the acid build up behind the plug.

There are numerous mines in Colorado created during the early 1800s when gold and silver ore discovered. Today many of these mines left abandon and became acid mines. The mine became acid because deep tunnels dug below the water table to get to the ore. Eventually, the empty tunnels filled with water. When the ore in the tunnels are expose to water and air, acid is generated and metals from the rock seep into the water. (Understanding the Gold King Mine spill, rev. 2016) This creates a thick, metal-filled mixture called "acid mine drainage." (Understanding the Gold King Mine spill, rev. 2016) The acid mine drainage becomes a rusty red to orange color forms due to a high concentration of iron. The point source of the acid mine drainage spill released a very high concentration of iron (248,582 lbs), calcium (23,657 lbs), magnesium (6,984 lbs), potassium (5,307 lbs), lead (4,481 lbs), manganese (1,953 lbs), zinc (1,101 lbs) and other toxic minerals like arsenic, mercury, and cadmium. The weight of metals (in pounds) released in 3,034,067 gallons of acid mine drainage from Gold King Mind: estimated by the University of Arizona from US EPA measurements at the Cement Creek 14th St. Bridge on August 5, 2015 16:00 (US EPAb, Preliminary Analytical Data, 2015) (Understanding the Gold King Mine spill, rev. 2016). These solids mixed in 3,043,067 gallons of water. The volume of water release was approximately 9.3 acre-feet, or 9 football fields spread out at one foot deep. (Understanding the Gold King Mine spill, rev. 2016)

As the toxic spill flowed in the Cement Creek tributary, the spill mixed with freshwater and the red-orange concentration began to dilute and became less acidic. The color of the drainage changed because iron and other metals interacted with running water and other solids within the water, which turned it yellow. As the drainage moved into running streams and rivers, the drainage became more and more diluted. The iron and other metals stuck to solids, and settled into the river sediments, eventually the water color returned to normal.(Citation needed here) This watershed includes six US states (Colorado, Utah, New Mexico, Arizona, Nevada, and California) and 12 Native American tribes live along the tributaries. (Understanding the Gold King Mine spill, rev. 2016). The Southern Ute Indian Tribe, the Navajo Nation, and the Ute Mountain Ute Indian Tribe are the tribes nearest to the spill. (Understanding the Gold King Mine spill, rev. 2016)

The EPA and state agencies traced the drainage flow beginning at the point source from the Upper Colorado River Basin to Colorado River after the Lake Powell Dam. Officials traced the

drainage spill into Cement Creek the flow south into the Animas River through Durango, Colorado. Residents and tours in the Durango area rely on the river for recreation, agriculture, and drinking water, and the drainage metal level had significantly decreased. This means that within the day, the 9.3 acre-feet of acid mine drainage would have been further diluted by 1:150, or one-part acid mine drainage to 150 parts of river water. (Understanding the Gold King Mine spill, rev. 2016) As the drainage flow kept moving, the Animas River flows south and converges with the San Juan River, which flows through Farmington, New Mexico. The San Juan River winds its way west through the Four Corner area from Southern Colorado, northeastern New Mexico, and Southern Utah and finally into the Colorado River. The river is a major source for the local tribe's agriculture and small farms for families who rely on their harvest as their main source of income. When water from the spill reached the San Juan River at Four Corners, it would have been further diluted by 1:550, or one-part acid mine drainage to 550 parts of river water. (Understanding the Gold King Mine spill, rev. 2016) As the river flows east the San Juan confluence with the Colorado River. The Colorado River flows south into northeastern Arizona and moving into Lake Powell. The lake is a popular area for recreation and tourism, for agriculture, and drinking water. The leading edge of the plume (no longer visible) likely entered Lake Powell on August 12, 2015. (Understanding the Gold King Mine spill, rev. 2016) This would have further diluted the 9.3 acre-feet of acid mine drainage released in the Gold King Mine spill by 1:1,2000,000, or 1 part acid mine drainage to more than a million parts of last water. (Understanding the Gold King Mine spill, rev. 2016) Thus, if all the sediments from the Gold King Mine spill were to reach Glen Canyon Dam, would dilute more than 600 times in one day by 121 thousand tons of erosion sediment that enter the lake each day. (Understanding the Gold King Mine spill, rev. 2016) After Lake Powell, the Colorado River flows through Lee's Ferry and southwards towards Lake Mead and Hoover Dam which borders Arizona and Nevada and finally into Mexico.

Will there be more spills? With the thousands of inactive and abandoned mines in the southwest, on federal, state, tribal and private lands, increase the probabilities of more spills in the future. These mines need constant regulations to protect human and environmental health. The EPA is the agency in charged to oversee the abandon mines. It is a large problem for the EPA to oversee. There are approximately 5,105 abandoned mines in Colorado, 3,989 in New Mexico, 10,697 in Utah, and 24.183 in Arizona (Bureau of Land Management, 2015). (Understanding the Gold King Mine spill, rev. 2016) It will cost the EPA more than 12 times their annual budget for reclamation of mines. The reclamation takes a long time and is very costly. It is possible to for the mines to reach their pre-mining state. In the meantime, EPA, state, and tribal agencies will continue to track the impacts of the spill by sampling drinking water, surface water, fish tissue within the tributaries, streams, and rivers, the soil and plants along the waterways. Sampling from the point source to Glen Canyon Dam. Testing is being done to determine the concentration of metals typically found in acid mine drainage, as well as to determine water quality factors as hardness and acidity (Understanding the Gold King Mine spill, rev. 2016) As the officials continue to test the water, plants, land, and animals there are no short-term effect. Nevertheless, the long-term effect will not be evident for the time needed and depending on the metal deposited in the sediments whether it will be disturbed or used to grow or feed animals. Many factors considered when loose metals are concentrated.

Language and Culture Connection

Snail Girl Brings the Water A Navajo Story

Long ago, there was a great flood and the people had to leave the Fourth World and enter into the First World. They found themselves along the shore of a great ocean. They scattered into small bands and went on their way. On the fourth day, they return to their place at the shore.

The people stated there was no fresh water to drink. They were facing the vast ocean water that was salty and they could not drink. First Woman stood up and spoke. She said, “Someone will need to go back to the Fourth World to find some freshwater. Just a small amount and I can sing my water song and many streams and rivers will form and grow.”

First Woman was the first human female being. Her persona showed wisdom and strength. She looked at all the people and she saw the Water Clan people. She said, “One of you should go.” Then First Woman created a beautiful water container out of seashells with a red coral as the cork to keep the freshwater in. The strap was a beautiful rainbow color tie to the neck of the container. Then she asked again, “Who will go.”

From the water clan, two animal people stepped forward to agree to go. They were the Otter and the Beaver. The ancient ones said, long, long ago before the world was completed the animal people walked upright and talked like people. They were great warriors. Otter said, “We are excellent swimmers and we will journey to the Fourth World to get the water.”

When Otter and Beaver prepare for their journey First Woman gave the water container to the two travels who were about to begin their journey into the Fourth World to find freshwater. As they swam into the ocean to find the area that seeped fresh water, the two distracted by the beautiful thick green seaweed leaves and began to wrap themselves with the leaves. Enchanted by the leaves they forgot the water bottle and returned to the surface of the Fifth World. First Woman asked for thef freshwater and the two travelers began to look for the container. They realized they had forgotten the freshwater. First Woman was not happy and told them to leave for now. This is why Otter and Beaver always covered with seaweed and sea plants. Then she asked, is there anyone who wants to volunteer to retrieve the water bottle and get fresh water.

Suddenly the turtle appeared and stated he will swim and travel to get the water bottle. The turtle swam into the Fourth World. While swimming, he saw beautiful shells on the seafloor and collecting the shells. He collected so many and began putting the shells onto his body. He remembered the water bottle, saw the colorful strap, and hung it around his neck. Then return to the surface to show off his beautiful shells. Turtle gave First Woman the container. She opened the container and discovered it was empty, she was not happy. First Woman said to go away for now. This is why Turtle has a shell covering.

First Woman announced again, who will volunteer to get the water bottle with fresh water. Amazingly, little Snail Girl squeaked and said, “I will.” First Woman looked down at her and began to tie the empty water bottle around her neck. Snail Girl slowly swam into the ocean. Everyone was waiting for her return. They waited and waited; soon they began to tire and left for their homes. Snail Girl finally reached the place where fresh water seeped from the crevice. She

had a difficult time opening the red shell cork lid. She twisted and panted and twisted and finally the cork lid loosened free. Snail Girl quickly filled the container with fresh water and put on the stopper, then slowly traveled to the surface. The bottle was heavier than her small body, so she struggled with the weight and kept swimming to the surface. After a long, long time, Snail Girl finally reached the surface.

When she got to the surface, no one was there to greet her. She thought about where everybody went. Weary from a long and heavy swim, she dragged herself and the bottle to a nearby rock to rest. She fell asleep, not knowing the side of the bottle had broken and freshwater had seeped out. While she slept, the First Woman and the animals returned to the shore and found Snail Girl asleep. Someone yell, "She brought the water bottle!" The excitement had awoken and started her. First Woman grabbed the container and discovered it had a hole on the side of the bottle and most of the water was lost, but a very small amount was still at the bottom of the container. Snail Girl saw the broken bottle and began to cry because she had failed to bring fresh water. First Woman stated the small amount is enough. I can use it to sing my water song and bring fresh water.

First Woman walked down to the dry rocky valley with a small amount of water in her hand. She began to sing and soon the freshwater began to grow and filled the dry valley. Everyone cheered and Snail Girl sat up and amazed by the amount of freshwater in the valley. First Woman thanked and blessed Snail Girl for bringing water; then she gave her the beautiful water bottle and fitted it onto her back. First Woman said, "This you will carry this beautiful shell with and it will be your home and you will always leave a small amount of water." Everyone will know that you brought the pure precious water and we must take care of it.

Strategies

These strategies are from Marcia Brectal's Guided Language Acquisition Design (GLAD) book, *Keep It Together*. She is the founder of these strategies.

Interactive Map of the Colorado Plateau

An interactive map is similar to a pictorial input chart but focuses on details of a map. A pencil sketch of the Colorado Plateau with the waterways of tributaries, streams, rivers, and lakes detailed with word labels. The teacher uses colored markers to chunk the information about the map, using key content and key vocabulary words. Daily addition onto the map like photographs or picture sketch of towns, the American Indian tribes, recreation areas, and key waterways. During the three-week unit, the map will have student input of vocabulary words and pictures in connection to the map. Every other day the map will be review for content and vocabulary.

Pictorial Input of the Water Cycle with the layers of the Black Mesa Aquifer

A pictorial Input Chart used for all content areas. This strategy takes the place of real things. A facsimile lightly sketched in pencil of the water cycle and the Black Mesa Aquifer outlined and labeled with key content and key vocabulary words to show the diagramed picture. Then, the

teacher marks the sketch with different color markers in front of the students, known as imprinting. This gives the students an advantage of comprehensibility to brain imprinting. The colored markers model the chunking of information and using the 10/2 after each chunking of information. The 10/2 is when the teacher talks/lecture for ten minutes, then students retell what they have learned from the pictorial. This strategy is motivating, give brain-compatible teaching, and more retention over time as the teacher review the chart. The pictorial chart displayed during the duration of the unit, which is about three weeks. The pictorial usually have a song or chant connected to the content and key vocabulary words.

Narrative Input of the story, Snail Girl Brings Water

The narrative input is a colored coded chart that focuses on the content, vocabulary, author's point of view, sequence, and story elements for a narrative story. The story about, Snail Girl Brings the Water. The narrative background chart is a picture of the book cover and the story summarized onto picture cards with highlighted key vocabulary words on the back of the cards. The story read orally on the first day to the students. Then read again on the second day, this time key vocabulary word strips distributed to the students to listen for while the teacher reads the story again. After each card read orally, the student will tape the vocabulary word strip next to the picture card. After all the vocabulary words are completed, the teacher and students review the vocabulary words again. The third day, the story is read again and speech bubbles are given to the students. While the teacher reads the story, students will listen to who is speaking in the story. Then, the speech bubble taped next to the picture card. The fourth day is working with the sequence of the story, what happened first, second, third and so on. The story pictures are not in order and students need to sequence the picture cards and need to retell what event is happening in each sequence. The fifth day is to analyze the characters' action, attitudes, and personalities. Why do the characters act the way they act. After these conducted strategies, the actual literature book given to students, to read independently. Additional, strategies taught using the book, like the author's point of view, text to self, text to world, text to text. By the end of the second week of the narrative input, students can comprehend the literature and can complete activities independently.

Exploration Report

An exploration report is for students to make observations of the picture or photograph then to make predictions about the picture. Students write their observations and what they are wondering then answer their predictions. Questions asked, "What did your team observe? What is your team wondering? What does your team predict? This whole class strategy addressed each table team to report their observations. The teacher record each team's- observation, wondering, and prediction to the wondering in their team color; the process continues. This later moves to a (team task) in which students have another topic category to investigate and discussed on their exploration report. Then to student independent task.

Classroom Activities

Grandparent Book

Students interview with their grandparent(s) and asked them how they survived during the early 50 and 60 with water and what was it like to obtained clean water into their homes. They will make comparisons of clean water today, clean water in the past and predictions of clean water in the future, fifty years from now. An interview sheet with questions produced for the students to converse with their grandparent(s). Connecting to grandparents is a good interaction between home and school, known as home/school connections. Students will create a booklet about a grandparent when they were young. This project will be an ongoing home school activity because constant communication, photographs, and family timeline involves family member participations.

The classroom activity is from the book Arizona Conserve Water, Educators' Guide

Ins and Outs of Water Conservation

Students utilize concept maps and other assessment tools to determine their interests, ideas, experiences, and knowledge related to water conservation concepts before, during, and following participation in the activities. Students will conduct water surveys of their attitude toward water conservation after participating in a mind map activity. Index cards given to students to write the keyword connected water conservation and to explain what it means to them. Then, collect the cards and group the cards into common clusters. The most common topic written on the cards is the theme and students write about the theme selected.

A Hydrologic Primer

Students will explore the properties of water by building a water cycle model in a cup, observing transpiration, and experimenting with adhesion and cohesion. They then apply their knowledge of basic water science to read the word conservation problem. They will model the state of water and the principle of hydrogen bonding. They will design experiments to demonstrate water science principles to address water conservation challenges and create a poster to display their water conservation solutions and present them in a class poster session.

For students to comprehend water conservation and related issues, they will need to have a background understanding of the basic properties of water. The hydrologic topics beginning with water molecules, state of matter, hydrogen bonding, density, then evaporation, condensation, precipitation, and transpiration: the water cycle.

Assessments

Students will create a similar narrative input chart about Ch'ał Tó Yinílo' (Frog Brings Rain). Pictures from the book and summaries of the literature created to make their narrative input story. All materials of color cardstock papers, photos of the book, highlight, Chromebook to type, and markers provided to make the chart. Students present their created narrative to the whole class and graded on a class created the rubric.

Water Conservation

Students present what they know about water conservation in the form of a concept map, before, during, and after instruction to show their acquisition of knowledge and change in attitude and behavior in their experience with water conservation. Students complete a water survey before and after instructions to assess changes in attitude and behavior related to conservation of water resources, the record their questions and knowledge in a journal and share their observations with the class.

Hydrologic Primer

Students model the states of water and the principle of hydrogen bonding and conduct experiments to demonstrate water science principles including transpiration, evaporation, condensation, adhesion, and cohesion. Students identify water science principles used to address water conservation challenges and to present a poster to display their water conservation solutions in a class poster session.

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Appendix

Social Study Standards - Geography

5.G2.1 Describe how natural and human-caused changes to habitats or climate can impact our world. 5.G3.1 Use key historical events with geographic tools to analyze the causes and effects of environmental and technological events on human settlements and migration. 5G4.1 Describe how economic activities, natural phenomena, and human-made events in one place or region are impacted by interactions with nearby and distant places or regions

Science Standards – Physical Science

5.P1U1.1 Analyze and interpret data to explain that matter of any type can be subdivided into particles too small to see and, in a closed system, if properties change or chemical reactions occur, the amount of matter stays the same.

5.P1U1.2 Plan and carry out investigations to demonstrate that some substances combine to form new substances with different properties and others can be mixed without taking on new properties. Other substances simply **mix** without changing permanently and can often be separated again. At room temperature, some substances are in the **solid** state, some in the **liquid** state and some in the **gas** state. The state of many substances can be changed by **heating** or **cooling** them. The amount of matter does not change when a solid **melts** or a liquid **evaporates**.

5.P4U1.6 Analyze and interpret data to determine how and where energy is transferred when objects move. The currents may have been produced to begin with by transforming the energy of motion into electrical energy (e.g., moving water driving a spinning turbine, which generates electric currents).

Dine Standards

K'e doo nitsahakees doo nahat'a naasgoo iina bee siih hasingo adoolniil. (I will develop an understanding of Dine way of life.)
Concept 2 – Nahat'a

Nahat'a bits'aadoo anootiligii bik'ehgo anisht'ee dooleel. (I will apply and practice the dine way of life through planning.)
PO 3. Nilch'i al'aan anaa'niligii baa hane; yiisinists'aa'go shil behozon dooleel. (I will listen to and retell stories related to elements of nature.)

Concept 3 – Iina
Bits'aadoo bee da'iinaanii baa akonisin dooleel. (I will implement and recognize the Din'e lifestyle.)
PO 2. Shinnago keyah doo naaldooshii doo To adaat'ehigii beehozin dooleel. (I will classify the Land and Water Beings in my environment.)

Concept 4 – Siihasin
Dinek'ehji na'nitin silahigii bohoosh'aahgo ei bee siih dinisdzin dooleel. (I will apply and practice the Dine way of life with confidence.)
PO 2. To daholoogoo shil beehozin dooleel. (I will locate the different water sources.)