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Náhasdzáán Níłchi Binaadohígíí - Carbon Dioxide

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Introduction

The emission of carbon dioxide (CO_2)in coal-burning power plants has been a dominant topic internationally. It is an important environmental issue and yet, controversial too. Many industries and manufacturing plants produce massive amounts of CO_2 by burning coal. Carbon dioxide is a main greenhouse gas that leads to air pollution.

Air pollution causes great harm to human life and our environment. It is obvious that a large portion of pollution is caused by human activities and thus continues to rapidly change the environment. The emission causes the planet to encounter different types of disasters, including climate change. It has become a major challenge of the world today because the air we breathe is contaminated. This pollution creates so many health problems and diseases which are affecting people at an alarming rate. As for scientists making noise about climate change, the better the adult discussion and concern, the quicker the children can grasp the problem, and the more likely we are able to find a solution in the future.

The goal of this unit is to inspire students by empowering them to be contributors to society on a large scale. Students are eager to be self-directed learners when they are actively engaged in real-world learning. They are able to embrace the bigger issues with confidence and communication. It enhances their development as leaders in taking action at every stage of their life.

Rationale

The Kayenta Unified School District's science curriculum is not as high a priority as it should be. Science content only becomes embedded if time allows. Many students fall far below grade level in reading and math. Because of this, these foundation skills supersede science. Research states, hands-on activities stimulate students' brains and they absorb learning based on these experiences.[1] Demanding a child to read out of a book is not the same as hands-on learning; this also applies to math rote drilling. For a successful classroom experience to take place, students need to experience in-depth study of content exploration over a wide

range of subjects.

One such activity is teaching students about the land and understanding respect for it, because it affects their livelihood. Diné students are adept in bridging science education when they are grounded in their own "cultural knowledge." They are then capable of acquiring and understanding science concepts much more easily.[2]

I teach fifth grade students at Kayenta Middle School. Our school district serves a little over 1,800 students in kindergarten through twelfth grade. The majority of the students are Diné with a few other ethnicities. Most students come from low-income homes, where maternal grandparents are typically the care takers. Many students come from single parent homes or have a parent who is employed in a job outside of the home town. Over the past two decades, I have had a diverse group of students; out of all my classes only one student would fluently speak and understand the Diné language. Although most students have little knowledge or are non-Diné language speakers, most do still participate in traditional teachings and events.

Integrating Diné Culture and History is important to this unit. With a majority of students being of the Diné Nation, orienting students to their cultural knowledge basis connects them through Navajo thought content with Mother Nature. Our Navajo elders strongly emphasize respect and knowledge for Mother Earth and Father Sky because of their sacredness. Oral traditional teachings are the way to make meaning out of one's own identity and a balanced connection with our environment, when we make sacred offering for continued existence. Times have changed tremendously from the time our ancestors lived without electrical power.

Our ancestors lived off Mother Nature without endangering the environment. Today, Western Philosophy of education has opened our minds to a convenient way of getting energy. For future generations, people need to regulate their activities in a conservative manner to restore and maintain respect for the land. Such Diné teachings say living in disharmony with the universe develops an imbalance and may cause major health issues.

This unit will take place over four weeks. It will begin with building background key concepts of air pollution. Visual representations will be used to convey their understanding of the topic and are excellent tools for students to think with pictures and encourage elaborate responses.

By including an introduction to the teachings of Diné Culture and History, I hope to elevate students' minds to make a connection with the kinds of effects we are having on Earth. In this way, students are establishing a relationship with Mother Earth (Nahasdzáán) and Father Sky (Yádiłhił). My goal is to focus on the impact of human activities putting stress on the planet.

Throughout the activities, students will be constructing their thinking and communication skills to understand their responsibility in the world. Science experiments are excellent ways of teaching and molding the thoughts of students to form their own hypotheses.[3] The unit will encourage students to think in a proactive mode. Then, they will understand the need to protect the environment and to prevent further damage.

The study will look to determine how an increased level of CO_2effects the environment, humans, plants, and animals. The experiment will teach how the increased level of CO_2can trap the sun's warmth in the lower atmosphere. A diagram of a "Carbon Dioxide and Oxygen Cycle" will be utilized to demonstrate how the greenhouse effect works. The Diné and Hopi reservations entered a lease contract with Peabody Coal Company for coal. An enormous amount of mineral stored beneath Mother Earth was stripped and N-Aquifers

were used to slurry coal 300 miles. This process produces carbon dioxide, mercury oxide and sulfuric oxide that get trapped in the atmosphere. This affects global climate change and is a growing threat to society.[4]

As a Diné educator, I know I must do my job, like the government and state entities, to educate people to be mindful of the health of the ecosystems because all living species are dependent on it. I have been taught the harmonious traditional teachings of the Diné Way of Life and with the universe by my elders.

Content Objectives

For years, I have read and observed quarreling within my community due to an uproar about the effect coal mining is having on the community. The Diné have a high percentage of people with respiratory diseases, such as asthma and black lungs disease. Some feel it is directly related to the pollution of the coal mining industry. While growing up, I witnessed many protests in the surrounding communities over coal mining. I only gave it a tiny speck of concern, and thought the Western scientists would quickly fix the problem, as though someone would say “Poof” and it will dissipate and life would be jolly again. Well, it is not that simple, but, slowly as I made sense of this issue, it evolved into a monstrous thing called – Global Warming. The greenhouse effect results from carbon dioxide trapping heat. Carbon dioxide is a gas considered good for some living organisms and bad for other living species in the environment. This mysterious gas was revealed to be not only a problem in my small community, but is a global issue. It’s in the atmosphere. So invisible! It took me by surprise. The problem was real and I did not know how to comfort my people. Now I recognized the issue very well and I know the need for education.

Why did I struggle with this mysterious concept? Since most gases are colorless and odorless, the hole in the ozone cannot be seen by looking into the sky. Therefore, I did not realize how the atmosphere was being harmed. It’s a surprising concept and as a result I thought I would make it real for my students.

According to Arizona 5th Grade Science Standards and Arizona College and Career Ready Standards, students will be using the inquiry process to establish the basis for students learning about science. Students will use the following scientific processes: questioning, planning and conducting investigations, using appropriate tools and techniques to gather data, thinking critically and logically about relationships between evidence and explanations, and communicating results. Both Navajo Culture and history standards and also State of Arizona Science standards indicate Navajo students will be able to build on the knowledge and skills from local and cultural communities as a foundation from which to achieve personal and academic success throughout life.

Comparing and contrasting strategies will be utilized to learn about the current uses of the natural resources and minerals by Native American and western cultures. In this unit, the carbon cycle and understanding how concentrations of carbon dioxide in the Earth’s atmosphere fluctuate as the seasons transform.[5] Even with these seasonal changes, the overall vastness of CO2 is increasing in the atmosphere as a result of people’s activities, which are altering the natural carbon cycle.[6] Furthermore, students will learn to formulate and test the level of $CO_2$and communicate a comparison to other groups, and then compare and contrast to the historical significance of scientific discoveries. Last, students will demonstrate understanding of how scientific knowledge, skills, and technological capabilities are important to a variety of careers.

Content Background

Coal formation

Carbon is a chemical element that is found all over the world and in every living thing. Carbon can change into a solid, gas, or liquid. Oxygen is another element that is found in the air we breathe. Oxygen is invisible! Air is twenty-one percentage of oxygen in the atmosphere. Oxygen forms into oxides, silicates, and carbonates. Eventually carbon and oxygen bond together and form a colorless, odorless gas called CO_2. In Earth's atmosphere, CO_2 is a greenhouse gas, which means it traps the heat. This "greenhouse effect" naturally helps to keep the Earth's temperature at a level that can support life on the planet.7

Fossil fuels are remains of plant and animals. In the carboniferous period, about 300 million years ago, the chemical element in coal and other fossil fuels, carbon, was trapped inside the earth. When trees and plants die and descend into the lower part of land covered with swamps or oceans they form layers of spongy material called peat. Since the peat is contained in sand or other minerals, it transforms into sedimentary rock. Over time as more heavy rocks pile on top, heat and pressure squeeze the water out of the peat. Eventually this process, over hundreds of millions of years, transforms the peat into coal, oil, and natural gas. These fossil fuels provide us with a source of nonrenewable energy.8

Coal Characteristics

Coal is a fossil fuel. The content of coal is composed mostly of carbon and other elements such as sulfur, nitrogen, hydrogen and oxygen. Coal develops its high sulfur content from its combination of what organic matter was present, the duration of the burial, and what temperature and pressure conditions were present. Formation of coal is a geological process; pressure on peat creates lignite first. Lignite coal is brown coal. It is very soft and carries water weight of about 70%. Its emission level of CO_2 is higher. Next, lignite transforms into sub-bituminous. At this stage, the carbon content is still low, and it still contains water. Sub-bituminous is not efficient as a source of energy. Then sub-bituminous transforms to bituminous. Bituminous coal is soft coal. It contains more carbon by weight than sub-bituminous coal and has a higher heating value. It is mined mostly in the Midwest and Appalachia. Another type of coal is Anthracite coal, a hard, black coal with a metallic luster producing very little smoke and burns slowly. The carbon content is higher than any other type of coal such the coal from the mountain ranges of the Appalachian region of Pennsylvania. It has the highest energy content of all coals.9

Coal contains 65% to 95% carbon. Carbon is an important chemical element. Carbon is atomic mass 12 and atomic number 6. It is a nonmetal element. Carbon exists all over the universe and is important to living things. All living things on earth are composed of carbon, along with hydrogen, oxygen, and nitrogen, sulfur and phosphorus. Carbon atoms link easily to hydrogen and carbon is one of the only elements that can create chain-shaped molecules. Carbon has the ability to form a chemical bond with many other elements. If iron is heated up with carbon, it will make strong steel. Most of the coal on earth is carbon.10

Sulfur's atomic number is 16. It is a nonmetal, the tenth most abundant element in the universe. It is a pale yellow solid, soft and odorless. Sulfur does not dissolve in water. It works mostly as a good electrical insulator. When burned, it emits a blue flame and melts into a molten red liquid. It binds to coal and when coal is burned it can create a toxic gas called sulfur dioxide.10 Sulfur is mined from underground deposits. It can be recovered as a byproduct from various industrial processes such as refining of petroleum. Coal

contains a mixture of carbon, hydrogen, and sulfur atoms. Sulfur can be transformed into sulfuric acid, a popular chemical in industries. Sulfur is used in batteries, fertilizer, to refine oil, to process water, and to extract minerals.[11]

Coal extraction

Coal can be mined on the ground and underground, and from the mountaintop. Underground mining is considered most dangerous and was very popular in the earliest times. Surface mining is easiest and mountaintop removal creates a lot of damage to the ecosystem. Once coal is mined, it is pulverized and transported to a power plant for production of energy. When coal is burnt, it emits a mixture of sulfur dioxide, nitrogen oxide, mercury, and microscopic particulate matter. The release of these elements impacts our environment.[12]

Coals Effects on Air, Water, and Health

Air Pollution

Carbon dioxide is a key pollutant warming the Earth. There are good and bad effects of carbon dioxide. Cars, planes, power plants and other human activities are associated with emitting higher levels of pollution because they involve burning of fossil fuels. In recent times, such activities have forced massive amounts of carbon dioxide into the atmosphere.[13]

The United States continues to see a rapid population and economic growth, new technologies, and seasonal temperatures in the last couple of decades, which corresponds with increased energy use. Although China's population is controlled, there seems to be creation of more fossil fuel plants there than in any of the other countries. The demand for more energy will drive up the rate of CO_2 emissions. The world has become industrialized and an emission from industries and manufacturing activities has become a major cause for air pollution. Research shows CO_2 emission internationally and depicts the United States and China to have led other countries in emission of highly concentrated CO_2 into the atmosphere. Furthermore, most underdeveloped countries have been catching up rather quickly and the burden on these underdeveloped countries will suffer the effect of increased emissions the most.

Carbon dioxide in the atmosphere is threatening the environment. Society's basic needs, air to breathe, water and food are contaminated. This pollution creates so many health diseases and other dangerous problems which can affect people for a long time. Although the Environmental Protection Agency (EPA) regulations set constraints at the federal, state, and local governments to rely on low-carbon emission, the efforts seems sluggish. The controversy involves national consistency, accountability, and the flexibility of the type of fossil fuel produced.[14]

Economic of Coal

Fossil fuels are a nearly unlimited source of energy. Therefore, fossil fuels are being extracted on a daily basis. Geologists are always looking for massive mines of coal. This is even stressing because population is increasing at an uncontrollable rate annually. Science and technology have now advanced tools for extraction procedures and this makes it a lot easier to extract massive amounts. Fossil fuel is a popular source of energy because it burns so easily. It is considered as a portable form of energy. Industrial machines, devices, and vehicles require only fossil fuel for power. Meanwhile, sustainable fuel sources have become a complex

process. Fossil fuels have the most effective calorific value. This is one reason it's preferable over renewable sources of energy. Fossil fuels contain very stable molecules of carbon and hydrogen. The biggest advantage of fossil fuel is it can be stored for a long time and can be transported rather easily. Fossil fuels are not expensive to extract and are most economically produced. Fossil fuels are widely available and can be extracted in large amount in one single location.[15]

Water Pollution

Ash produced from coal plants and waste water are dumped into rivers and streams. Waste water contains arsenic, boron, cadmium, lead, mercury, and selenium. Coal fired power plants are the biggest source of water pollution in the United States. Cancer risk can reduce a person's IQ from the contamination of Lead (Pb) considered one of the health effects.[16]

Health Effects

Air pollution primarily affects the respiratory and immune systems. It can lead to additional severe symptoms and conditions such as heart disease and cancer. A more common symptom is asthma. Asthma is a disease that affects your lungs. It causes repeated episodes of wheezing, breathlessness, chest tightness, and nighttime or early morning coughing. Asthma can be controlled by taking medicine to avoid the triggers that cause an attack. You must also remove the triggers in your environment that can make your asthma worse.

Long-term exposure to polluted air can have permanent health effects such as loss of lung capacity, shortened life span, development of bronchitis, and decreased lung function. Ground level ozone is highest in the afternoon and evening hours. It can cause constriction of the airways, forcing the respiratory system to work harder in order to provide oxygen, increased fatigue, wheezing, chest pain, dry throat, headache or nausea.[17]

Coal and Climate Change

Climate change is a global process. The world's climate has changed enormously and has affected many living and non-living things. Some places where it is warmer are now getting colder, and where it's colder now is becoming warmer. This is a consequence of the "greenhouse effect." This happens when the sunlight enters the atmosphere, passes through the blanket of greenhouse gases and it reaches land surface, which absorbs the energy. The energy is then directed back into the atmosphere in the form of infra-red rays. Some of the energy passes back into space, while much of it will get trapped in the atmosphere by greenhouse gases, causing the Earth to warm up. This process is called the "greenhouse effect," which causes problems for humans, plants, and animals.[18]

On a positive note, most recent EPA controls have some power companies eager to cut CO_2 emissions and are taking actions to rely on low-carbon technology such as hydropower, wind, solar, and nuclear to alleviate climate change-related liabilities.However, as the U.S. fossil fuel consumption increases, the nation needs to make a sound decision. First, we need to look at how the human greenhouse effect can be reduced. Our technology has substantially advanced compared to other countries. This can drive the emission reduction with strong but achievable standards for power plants. States can cut the carbon pollution given the flexibility of an affordable supply of electricity for human activities. It also shows the world that the United States is committed to leading global efforts to address climate change. Fossil fuels will continue to be an important component for America's future energy source simply making fossil fuel-fired power plants operate more cleanly and efficiently, while zero- and low-emitting power sources are consumed.[19]

Clean Energy

Energy sources are produced from renewable and non-renewable resources. Renewable energy can be refilled in a short period of time. Non-renewable energy takes millions of years to form. Even though it makes sense to consider our needs, the non-renewable fuel causes pollution and contaminates the air. The air we breathe and need to survive every day is contaminated. This pollution creates so many health diseases and other dangerous problems which can affect people for a long time.

Renewable energy technologies are clean and safe for the environment. They do not pollute. Renewable energy is energy developed from Earth and that can be replaced. The only problem is we can't store the resource and use it later. Renewable energy is costly and requires a lot of maintenance and care. Most solar energy is noise free. It requires a lot of land and space to be efficient, but has good tax incentives. Despite the cost, solar technology can provide power to remote places.[20]

Solar Energy

Sunlight transmits massive amounts of energy. You can sense the Sun's energy when sunlight warms your skin on a summer day. To capture the Sun's energy, scientists have developed solar cells, called photovoltaic cells. These cells transform sunlight into electricity. When sunlight hits a solar cell, the cell soaks up some of the light energy. Particles in the solar cell move a lot quicker and the movement of these particles creates electricity. In some areas of the country, like the southwestern United States, there are many sunny days. In such places, solar cells and solar panels can make a lot of electricity and heat. Experts state that vast installations of solar panels in sunny parts of the regions could produce enough electricity to supply an entire country. New ways to capture this energy are being established all the time to maximize efficiency.[21]

Scientists have also continued to research other ways to produce energy, such as wind turbines or geothermal energy. Wind turbines create electricity when their blades turn in the wind. The turbines do not use fuel and do not create pollution. However, the machines are huge and can kill local birds. Geothermal energy is drilled underground and energy is sucked out where the Earth is very hot. Water is often channeled through the pipes to absorb that heat. This type of energy can be expensive and difficult to reach the heat.[22]

Nuclear power can produce tremendous amounts of energy almost twice as much as coal could produce. The energy from the uranium does not pollute or add to global warming. Although uranium is highly efficient, the waste material nuclear power plants produce is quite hazardous. Nuclear power is risky because of the danger of the possibility of having an accident makes it hazardous. It could explode and spew out if the core gets overheated. Another danger is the spent uranium is highly radioactive even though it is no longer useful.[23]

Activities

Students will have a science journal to keep a record of all vocabulary, models, and general notes of ideas, questions and sketches. They will utilize Cornell notes format for note-taking strategies. The two-column layout will contain the main ideas/headings along with vocabulary in the left column and notes, sketches, questions, and definitions in the right-hand column. This science journal will be used for reflection on weekly assessments and the final assessment.

Week 1 Activities: Students will build a content background of key concepts and ideas essential to developing the understanding of academic words. A photograph of a city with polluted air will be projected along with a short passage of key words. This image will help shape and guide the learning of air pollution. Students will be asked what causes the city sky to look the way it is. From this image, students will brainstorm in small groups and record their ideas on a chart. A timer will be used to create a sense of urgency. Once time expires, another photograph of a clear sky in the city will be projected. The discussion will be of how clean air is good for the ecosystem unlike what dirty air does to our environment. Here I like to focus on a discussion geared towards the direction of students' thinking processes to embrace empathy. Empathy is feeling what others feel, not just understanding what they feel. I want students to understand the needs beyond themselves and appreciate the world from someone else's perspective. For the unit to be meaningful, connecting students thinking with content background terms such as air pollution, climate change, ecosystems, energy (fossil fuels), health (asthma and various respiratory problems), waste, and water pollution. The brainstorming charts will be kept visible throughout the unit where students can refer back to them as the unit progresses. They will be allowed to include their input and other facts to it.

During the next lessons, students will be immersed into Diné Culture and History through traditional storytelling and folktales. The first story shared will be the Navajo Clan story. The purpose is to establish self-identity and one's kinship with others, nature, and become aware that we respect the Earth as "Our Mother." The activity will begin with students' self-introduction. This is an important part of Navajo custom. Students will introduce themselves with clans, where one is taught at an early age of their matrilineal lineage. The clans identify an individual of whom they are and where they come from. K'e is the strength of the family and holds the family together. With their introduction, they have established respect and acknowledgement of each other just as they do to Mother Earth and Father Sky. The Diné language is eloquently spoken and represents their footprint as being a part of the environment.

Finishing up the week's last activity is the Navajo Creation Story, which will focus on oral mythology storytelling, allowing students to understand the origin of Diné. These oral traditions and philosophies will clarify the journey and struggles of the people from the emergence to present day. It provides direction and strength to challenge the future. Most students are familiar with storytelling. It's a teaching tool used by parents and grandparents at home and through community events for all ages. This technique is passed on from generation to generation. For example, storytelling teaches students how to live off the land and how to survive in the natural environment where it is strongly emphasized to the younger generation. Students will be introduced to the shorter version of the Navajo creation story, which describes the prehistoric beginning of the Diné people and settling in the sacred Dinétah, the traditional homeland of the Diné. The purpose is to understand that they have an immense responsibility in this world. They need to acknowledge earth and sky as significant beings. A timeline integrated with art and writing activities will enhance the learning. This is an organizational method I often use when I teach a timeline activity. The timeline fold is a four-part creased layout. This allows students' minds to think in sequential manner. It is also a way for students to use their creativity while reinforcing important thinking and communication skills. The activity will reemphasize "Walk in Beauty." "Walk in Beauty" is a terminology that we use in our spiritual prayers to connect to our holistic being in the universe. In traditional teachings, the number four has a symbolic meaning tying them to Navajo history and belief. It represents our cardinal directions, sacred mountains, clans, color of natural elements, components of Navajo Philosophy and our traditional songs and prayers which are chanted in a count of four. Students will be given a few minutes to brainstorm with their small group on their interpretation before beginning their timeline. Finally they will summarize each part of the timeline. Students will share the story with their parents as a home-to-school connection assignment.

Week 2 Activities: I will read aloud “The Air We Breathe” as a preview reading to assist students’ learning about the concept “Air.” The book explains what atmosphere is and why it is important to life on earth. Students will then discuss questions pertaining to the atmosphere so they can understand that only some pollution is visible. They will be given time to take notes in their science journal of their understanding.

Another reading will be assigned as a home-to-school connection homework activity. Students will explore “How Do Your Lungs Work?” The book focuses on how air feels going through their respiratory system. Some physical activities will be done by students and parents to test their breathing rate and take note of changes in their body system. The following day, a discussion will take place on asthma and other health-related effects. Students will reflect on their notes as they present a drawing of their upper body with each part of the respiratory system colored and labelled. Students will include a cause and effect in their presentation.

The first experiment is to understand why air is invisible, colorless, and tasteless. We will discuss the impact of air in the environment. In this experiment, students will understand that air has mass, although they can’t feel it, and recognize that air takes up space, even though they can’t see it. Students will make a hypothesis if air exists. Students will investigate “Does Air have Volume?” In the experiment students will crumble up a sheet of paper into a ball and firmly push to the bottom of the cup. Next they will turn the cup upside down and lower it into the water for a few seconds. They take the cup out of the water and will notice the paper is still dry. It is dry because air does have volume. As the cup is placed upside down it fills with air. The air inside the cup submerges putting pressure against the water; therefore, it did not fill the cup with water. As a result the paper is dry meaning air takes up space. As they observe and describe what is happening to air in a cup. They will conclude by describing air, how it behaves in water, how they recognize they found air, and tell where they also can find air.

Next, they will see what carbon dioxide is like by experimenting with “Soda Fizz.” Students will hypothesize the process through the scientific methods of observing and describing what is happening when they drop mentos candy into soda. Initially, I want the students to gain knowledge that this same reaction occurs when a power plant burns coal. Only the toxic CO_2 cannot be seen emitted into the atmosphere. Over time, CO_2 gets trapped in the atmosphere and affects the ecosystem. They will determine the level of concentration being emitted which affects our health, plants, animals, and everything in the environment.

The second experiment will be the introduction and exploration of “The Carbon Dioxide – Oxygen Cycle.” Students will compare and contrast related reading material from the previous activity. Here students will understand the big picture of what carbon dioxide is and how it affects global warming. They will use a compare and contrast Venn diagram to process their thinking and communication skills.

Week 3 Activities: Students will begin this experiment by conducting a survey to collect data. First, they will design the survey with it geared toward 5th and 6th grade students. Questions will be simple, asking students if coal is burned in their household or other family members’ households and if any family members or extended family members have asthma or any respiratory problems. Students will conduct the survey, total the results of the survey, and create a large bar graph. Of course, due to privacy concerns, the survey will be kept anonymous.

Second, students will reflect on notes from the previous weeks’ lessons and describe what they find interesting and include any new information about air pollution. They will then be introduced to a video on YouTube: “Air Pollution – Enough is Enough.” The information in the presentation touches on most background content and key concepts as well as a review of causes and effects, and solutions to air pollution. After this

presentation, students should be able to identify one cause and effect, and come up with how they can be contributors by preventing further damage to our planet.

Third, students will participate in a scientific inquiry activity. Students will hypothesize what properties make CO_2 hazardous to our health. CO_2 is heavier than air; therefore, it can accumulate in the environment and lack proper circulation. This atmospheric carbon dioxide is a greenhouse gas serving to trap heat from the planet's surface that would otherwise radiate back into space. The gas can pose an asphyxiation hazard to those who are working with it in large quantities.[23]Students will then conduct a simple investigation through observation and record keeping to interpret the survey data and draw a conclusion from the results. The grouped students will receive prepared water samples from various locations: a reservoir with soot (burnt coal), a creek sample, and tap water. The aim is to measure how acidic or basic the various solutions are. Students will dip pH paper to test each sample of water. The measure of pH is on a scale of 0 to 14. Acidic water has pH values between 0 and 7, zero being the most acidic. Basic water has pH values between 7 and 14, 14 being the most basic.[24]

An informational text pertaining to solutions for air pollution for kids will be assigned and discussed. The reading assignment will be from the internet “Doing Your Bit.” (“Clean Air Kids”). From the completion of the reading, students will brainstorm on these ideas and add additional ideas to our charts from the first week’s activity. The groups will then select one solution and write their action on it.

In the final week, students will take part in an educational field trip to bring awareness of the effects from the coal mining industry and to address the cause and effect of air pollution. The trip to Peabody Coal Mine located on Black Mesa will include a tour of the surface mining operation. On another day, we will take a trip to the Navajo Generating Station in Page, Arizona for a visit to an educational facility to learn about the emission from fossil fuel burning and learn about the company’s plan to innovate clean air and energy.

The final assessment of this unit will be writing an opinion essay entitled “How Energy Impacts our Environment.” An opinion writing rubric will be used for grading. Finally, students will present their writing project during Earth Week. During Earth Week, students will celebrate by participating in career development opportunities as future scientists, educators, leaders, and artists.

Strategies

This curriculum unit will engage and educate students using a number of instructional strategies. My focus is at the fifth grade level. The methods I chose for teaching the unit allow for scaffolding for English Language Learners and inclusion students. Differentiated instruction will be applied so all students will be able to access the unit activities. Differentiated instructions will assist the different styles of learning techniques on assessment and reassessment. The structure will allow grouping and regrouping strategies for the purpose of engagement and learning styles.

This unit commences the introduction of academic words to build background knowledge of the concept and displaying an image will hook students’ prior knowledge to the concept. A number of strategies are utilized, including brainstorming for one in cooperative groups because it encourages students to think critically without relying on the teacher. Further, students have an opportunity to do a preview reading along with the image so they can make their connection to key words and topic of the unit. They will also be highlighting

vocabulary words and entering side bar notes.

Oral teaching is an element of Diné cultural history and language at its core in this unit. Storytelling accentuates maintaining a balanced connection with our environment, when we make sacred offerings for continued existence. I use this strategy to demonstrate understanding of how telling stories and story structure enables expression of themselves more clearly. Most students are very familiar with storytelling. For example, storytelling of how to live off the land and how to survive in the natural environment were strongly emphasized to the young generation just as we continue to learn about the use of natural resources.

The unit also uses hands-on inquiry experiments using the language learning approach. The student thinking and engagement happens spontaneously. Dissecting the unit activities will be successful for ELL and special education students. Students process the information better as it relates to the bigger concept. First, informational text is used to continue to build background to the key words and the main topic. Concepts are broken down to help students internalize the scientific words better. A close reading strategy is emphasized with students highlighting and taking notes on the sideline. Reading skills and cause and effect are touched upon to back up opinions using evidence and examples from the text. Students continue with the processing of the scientific methods for conducting surveys and developing a hypothesis, and use observation, predicting, describing, and theorizing what they are doing. They will move from simple experiments to complex projects. The simpler experiment is modified and does not involve all parts of the scientific methods because learning concepts from the hands-on experiment is crucial. Small heterogeneous groups will be utilized for discussion and brainstorming. Furthermore, students will be expected to stretch their thinking to interpret, analyze, and comprehend their solutions with mathematic concepts, if necessary. More importantly, the unit will strongly touch on Diné students' traditional cultural and history where it is relevant to the topic.

In the final week, students will take an educational field trip to bring awareness about addressing the land and environmental issues related to their local surface mining and an affiliated Power Plant Company. The educational field trip is a way to bring first-hand information that is helpful in discussion and explanation of mining operations history. This activity will end with opinion writing. Students use their journal and sketches to assist in performing an opinion writing project and presenting their writings in conjunction with the school's annual Earth Week festivities.

Appendix

Inquiry Process

Inquiry Process establishes the basis for students' learning in science. Students use scientific processes: questioning, planning and conducting investigations, using appropriate tools and techniques to gather data, thinking critically and logically about relationships between evidence and explanations, and communicating results.

Observations, Questions, and Hypotheses

Formulate a relevant question through observations that can be tested by an investigation.

A. Formulate a relevant question through observations that can be tested by an investigation.

B. Formulate predictions in the realm of science based on observed cause and effect relationships.

C. Locate information related to an investigation.

Scientific Testing (Investigating and Modeling)

Design and conduct controlled investigations

A. Demonstrate safe behavior and appropriate procedures in all science inquiry.

B. Conduct simple investigations based on student-developed questions in life, physical, and Earth and space science.

C. Measure using appropriate tool and units of measure.

D. Record data in an organized and appropriate format.

Analysis and Conclusions

Analyze and interpret data to explain correlations and results; formulate new questions.

A. Analyze data obtained in a scientific investigation to identify trends and form conclusions.

Communication

Communicate results of investigations.

A. Communicate verbally or in writing the results of an inquiry.

B. Choose an appropriate graphic representation for collected data.

C. Communicate with other groups or individuals to compare the results of a common investigation.

History and Nature of Science

Scientific investigation grows from the contributions of many people. History and Nature of Science emphasizes the importance of the inclusion of historical perspectives and the advances that each new development brings to technology and human knowledge. This strand focuses on the human aspects of science and the role that scientists play in the development of various cultures.

History of Science as Human Endeavor

Identify individual, cultural, and technological contributions to scientific knowledge.

A. Identify how diverse people and/or cultures, past and present, have made important contributions to scientific innovations.

Science in Personal and Social Perspectives

Science in Personal and Social Perspectives emphasizes developing the ability to design a solution to a problem, to understand the relationship between science and technology, and the ways people are involved in

both. Students understand the impact of science and technology on human activity and the environment. This strand affords students the opportunity to understand their place in the

Changes in Environments

A. Explain the impacts of natural hazards on habitats.

B. Propose a solution, resource, or product that addresses a specific human, animal, habitat need.

Science and Technology in Society

Develop viable solutions to a need or problem.

A. Describe the relationship between science and technology.

Teacher Resources

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