Institute for Native-serving Educators

Exploring Water Management and Conservation Through Historic and Current Precipitation Levels and Traditional Indigenous Land Usage

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Culturally Sustaining Investigative STEM (CSIS)

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Topic and Context

Throughout the world, the concepts of water preservation and conservation are becoming more and more prevalent. While modern humans (Homo sapiens) have lived on this planet for around 300,000 years (Smithsonian National Museum of Natural History, 2024), it has only been in the last few thousand years that our water resources are becoming polluted or are disappearing altogether. According to Vuorinen, Juuti, & Katko, (2007), ancient Egyptians had wells and toilets with pipes were used in the early Bronze Age city of Mohenjo-Daro, in modern day Pakistan. They also note that ancient Greeks and Romans were aware of the dangers of drinking water that flowed down from hills and mountains that were being used for mines.

For time immemorial, Indigenous peoples, such as the Hopi and Navajo, have learned how to live in harsh environments with very little water. Farming has occurred on the Hopi Mesas for hundreds of years, even though the average yearly rainfall was much less than what most farmers need to grow their crops (Bernardini et al., 2021). In fact, Bernardini et al. (2021) state that stability in a population over such an extended period of time is considered unusual, not only in the American Southwest, but also around the world. Many Indigenous communities see water as sacred and are seen as water protectors, spreading the message that water is life (Native Women's Association of Canada, 2025). Primary and secondary schools, universities, environmental groups, and government agencies have joined in, creating learning opportunities for the masses or policies to preserve and conserve. This plan combines some of those resources while also teaching fourth grade students about the history, culture, and techniques of Indigenous groups, like the Hopi and Navajo.

This lesson is part of a bigger unit used to teach the fourth grade Arizona Science Standards on the importance of water. Currently, my school, Kinsey Elementary, has a three-way team for fourth grade. One educator teaches ELA, one teaches math, and I teach science and social studies. I have created units to teach these subjects, and I work with my coworkers to embed concepts being taught in my room in their units/plans as well. I begin teaching my Water unit towards the beginning of September to coincide with Flagstaff's annual festival held toward the end of September. The "backbone" of the unit is called, "The Arizona Water Festival," (University of Arizona, 2025; Arizona Project WET, 2025), which was created by the University of Arizona's Cooperative Extension and Project WET. This program has lessons created for teachers to use prior to and immediately after their water festival. These lessons investigate the water cycle, watersheds, groundwater and water management practices. The plans provided below are designed to enrich The Arizona Water Festival unit, involve students in more real-world problems with math, while also bringing more Indigenous teachings into the classroom through presenters and place-based learning. Honoring the Indigenous communities

Rationale

This lesson was designed to give students space to learn from tribal experts while also learning the required standards for 4th grade. Kinsey Inquiry and Discovery School is an elementary school located in Flagstaff, Arizona and serves students from many different backgrounds. Currently, the Native population at Kinsey is around 55% and being culturally responsive is very

important to the teachers and staff at the school. The school celebrates and honors many cultures and our Indigenous communities with special events both during and after school and teachers incorporate ways our Indigenous students can show and celebrate their heritage, such as Winter Stories night, Native American Spirit Week, the annual Miss/Mr. Kinsey Pageant, Discovery Days, art pieces done in art class and plans to accommodate our Indigenous students during ceremonies, etc.

Kinsey is a place-based, project-based magnet school, where students learn through inquiry. Due to place-based learning, we go on many excursions to learn about the land, its history, habitats and more. Within my own classroom, I foster an environment of openness and community, and I ask my students for constructive feedback on the units I teach. One of my Navajo students asked to have more Indigenous presenters come throughout the year. With all this in mind, I wanted to explore ways I could organically interweave Indigenous history and teachings into more of the units I teach, while also exploring more locations around us that could also add depth to the lessons.

Kinsey Elementary participates in the Arizona Water Festival every year. It is a fun way for students to learn about water, water conservation, and management. Due to the winter weather in our city, the water festival, which is held outdoors, is planned early in the school year. Due to this, this program is the second unit I teach, and it is a perfect opportunity to learn about how communities like the Hopi and Navajo use water today and how their ancestors survived and thrived in environments with very little water. With this knowledge, students will be able to survey their actions and lifestyles and see how they can improve everyday activities to conserve and preserve water for themselves and future generations.

Incorporating more Indigenous teachings has been a process for me. I am Latina, born in New York City and raised in urban Florida. I moved to the Flagstaff area about ten years ago, with some knowledge of the Navajo Nation, all of which was learned via documentaries and some texts. I had very little knowledge of cultural norms for the Navajo and none for the Hopi and, needless to say, made many mistakes in my first year teaching here when it came to things I could or could not show in my classroom, etc. In my own life, I have been subjected to many stereotypes, and I understand how uncomfortable and disheartening it is. In the school I taught at in Florida, there were many students from all over the world and, as an English Language Learner Specialist, I actively worked to highlight and teach about their cultures and traditions throughout the year and within all grade levels. I brought that work ethic to my classroom here in Flagstaff and I have learned many things from my students, their families, and the community. I believe we must learn who our students are and teach them, not just the curriculum the state mandates, but about the world around them. The “real” world does not work in isolation, people and communities are not isolated in a global economy, so our students need to learn how to communicate and work with people from different backgrounds. It is my hope that this unit will allow my Indigenous students to grow and strengthen their ties to their communities while also teaching them and my other students how we can work together and improve our local communities- our school, our city and beyond.

Instructional Guide

Students will, through the Arizona Water Festival, learn about the water cycle, water conservation and water management. Once the students have this knowledge, students will explore parts of the Flagstaff area that have environmental and cultural significance to the area. Students will also learn about how ancient Puebloans lived in the area and how they managed their water resources in order to survive and thrive in this landscape from leaders of tribal communities. Students will also learn ways these communities currently use water and will take all this information and apply it to predicted weather and climate patterns to see how they can help conserve and preserve water.

To help ensure this plan is meeting the expectations of the state, I have included the Arizona science (Arizona Department of Education, 2022) and mathematics standards (Arizona Department of Education, 2025) for fourth grade. To help establish cultural responsiveness in schools, Castagno et al., (2021) created the Culturally Responsive Assessment of Indigenous Schooling (CRAIS) tool. This document allows teachers to design lessons that are culturally responsive in multiple categories, thereby assisting teachers in creating meaningful plans. Embedded in this unit are areas within the CRAIS I felt most resonated with what students would be working on. Specifically, students will understand where they are within different communities. They will be encouraged to think critically and ask higher level questions in order to understand historical and current events. Through the place-based excursions, presenters and data presented to them, students will hear different perspectives and will understand different Indigenous traditions, cultures, way of life and important events of regional Indigenous communities. It is important they understand how Native Nations function as government agencies that work with the national government and that they have their own laws and regulations that help their communities. These points will help guide the students' learning and will deepen the connection between the past and the present, allowing the students to truly own their learning.

One of the activities that is mentioned in this unit is something I call 6 Hats. Each hat represents a perspective. This activity, if used, should be done prior to this plan so that students feel comfortable and confident with the process. I added the documents I created to help my students and there are three separate items needed. First, there is a one-page document that lists all 6 hats and what they mean. This document is for the teacher to help explain each hat and as a reference. There are small, quarter-sized hats; these can be laminated. The final part are larger descriptions of each hat. I laminate these and attach them to chart paper for the students to reference. To complete the activity, pass out the mixed hats to students. When everyone has a hat, have them take a pen or pencil (or supply them with markers) and stand next to the chart paper with their colored hat. Groups should be 3-5 students. Display a picture, document or other talking point and give about five minutes for groups to write down what they think of from their hat's perspective. Each child should write/draw their thoughts and group members should talk about what they are thinking. Students should only write about what they are seeing, they should not use background knowledge (if they know any about the text or object). After the allotted time finishes, have students rotate to another chart, given the same amount of time, students who write/draw about what they see from that hat's perspective view. Keep doing this until the students have visited each chart. The final hat, the blue "summarizer" is the more difficult hat, as

it requires the students to view the text or item from all other perspectives before writing their summarizing view. This hat can be left out til a later time or not used if it is not warranted.

The data sets and graphs from NOAA can be altered to other cities or counties via the website. For the purposes of this unit, I am using data on Flagstaff. If a different location is desired, the following directions will assist you. For monthly or annual precipitation levels, click on the link for the NOWData site (National Weather Service, 2025). Choose your location and select "Monthly Summarized Data" and choose a starting year, then click "Go." For the climate projections, click on the link to the Climate Resilience Toolkit's Climate Explorer (National Weather Service, 2025). Input your city and click on the search button. The data will pull up to the nearest month from when you access the data.

Teaching Plan

Topic: Exploring Cultures through Precipitation and Land Usage/ Science
Subject Matters: Science & Math
Grade Level(s): 4
Learning Objectives-

- Carry out investigations about the water cycle and analyze the importance of water to the city of Flagstaff, as well as the Native communities in the surrounding areas (Hopi, Navajo, Yavapai/ Apache).
- Using information from Project WET/ the Arizona Water Festival and from Indigenous teachings, determine methods we can do in our daily lives to be more responsible with our water resources.

Arizona State Standards

Science

- **4.E1U1.8** Collect, analyze, and interpret data to explain weather and climate patterns.
- **4.E1U3.9** Construct and support an evidence-based argument about the availability of water and its impact on life.

Math

- **4.MP.4** Model with mathematics Mathematically proficient students apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. When given a problem in a contextual situation, they identify the mathematical elements of a situation and create a mathematical model that represents those mathematical elements and the relationships among them. Mathematically proficient students use their model to analyze the relationships and draw conclusions. They interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.
- **4.MP5** Use appropriate tools strategically Mathematically proficient students consider available tools when solving a mathematical problem. They choose tools that are relevant and useful to the problem at hand. Proficient students are sufficiently familiar with tools

appropriate for their grade or course to make sound decisions about when each of these tools might be helpful; recognizing both the insight to be gained and their limitations. Students deepen their understanding of mathematical concepts when using tools to visualize, explore, compare, communicate, make and test predictions, and understand the thinking of others.

CRAIS Tool Principles

- Relationality, relationships, and communities
    - Encourages students to understand themselves within broader communities
- Indigenous knowledge systems and language
    - Traditional and/or cultural knowledge is included
    - Norms, values, traditions, interests of local/regional Indigenous community are leveraged for learning opportunities
- Sociopolitical context and concepts, and specifically sovereignty, self-determination, and nation-hood
    - Recognition of Native Nations as governmental agencies
    - Recognition of treaty rights and/or federal Indian law
- Representation of Indigenous peoples
    - Indigenous people are represented as contemporary (not only historical)
    - Local/regional Indigenous community is reflected
- Critical understandings of diversity, and specifically race
    - Models critical thinking about historical narratives and contemporary status quo
    - Encourages asking critically-oriented questions about historical narratives and contemporary status quo
    - Diverse narratives and perspectives are integrated

Instructional Strategies

Engage

(1 day)
Read "The Water Lady," McGinty, A. B. (2021) to the class. Break students up into equal groups and assign them to a chart paper with a hat label and description. Display the page with the picture of Cody and Darlene holding the bucket together. Give the groups about 4 minutes to write their thoughts on that particular hat's perspective. Rotate groups every 4 minutes until they have gone through all the hats **except** the blue one, Summarizing Thinker (this hat will be used at the end of lesson, during the "Evaluate" stage). Share out some of the thoughts the students had on each chart.

Explore

Part 1 (3 days)
Day 1: Introduce NOAA precipitation data from 2024-25 and discuss with the class. What is the data showing us? How would we graph this data? Graph data from Jan- April 2025 with class as a line plot and a bar graph, with each month being its own bar. Pass out historical precipitation levels document and have students discuss the data in small groups. Groups will share their findings with the class.

Day 2: Have students graph the annual data from the following years: 1899, 1909, 1919, 1929, 1939, 1949, 1959, 1969, 1979, 1989, 1999, 2009, 2019 (have students highlight these years). Students will graph the precipitation levels for these years, using the precipitation graph document. Have students complete the questions from this data set.

Day 3: Present graphic on annual temperatures in Flagstaff and have students discuss in small groups. As a class, discuss if there are any correlations between this data and the data on precipitation levels. Present students with predicted precipitation levels data, have students graph years: 2025, 2035, 2045, 2055, 2065, 2075, 2085, 2095. Have students complete the questions from this data set.

Part 2 (1 day)
Class will go on an excursion to Viet Springs on the San Francisco Peaks. Students will hike the trail, stopping along the way to investigate the watershed and drainage flow down the mountain. Students will also hear about the importance of the mountain to the Navajo and Hopi and how the mountain helped bring water to ancient communities. Students will answer the questions for this excursion.

Explain

Part 1 (1-2 day(s))
Students will listen to a presenter or presenters from different tribes in this region. Presenters will discuss their tribes' history in terms of the relationship with water and survival in their homelands. They will also discuss what their tribes are doing currently to ensure the survival of their people through oral stories/histories, tribal laws, community projects, etc.

Part 2 (1 day)
Students will go on an excursion to the Flagstaff Water Treatment plant and tour the facility. After the tour, students will hike the Trail around Picture Canyon. During the hike, stop along the trail to talk about the effluent flow out of the treatment plant that recharges the Rio de Flag that runs through the canyon. Also discuss the Ancient Puebloans who lived in the area, cultivating herb gardens, walnut trees and more. Discuss the connection between the water in the area and the ancient people, as well as the importance of the water way today.

Part 3
Display the same picture from "The Water Lady," along with the description of the blue hat "summarizing thinker." Students will answer the question for the exit ticket.

Elaborate

Students will review the graphs they created. Display these questions: How can the historical data we have graphed help give a clearer picture of how the ancient people of this land lived? In looking at predicted precipitation levels, how can we use the teachings of the Indigenous communities in our water management plans? Have students work in groups to answer the questions. Groups will present their answers to the class.

There are several children's books from different tribes on the importance of water and protecting it. These can be read aloud (please see Learning Resources for some suggestions).

Evaluate

Finished graph, Slide show, blue hat exit ticket, questions on historical data and predicted precipitation levels

Formative Monitoring (Questioning / Discussion): Students will be monitored for comprehension during whole class and small group discussions. Students will submit both graphs, along with their answers to the questions for each data set. Exit tickets will also be graded.

Summative Assessment (Quiz / Project / Report): Student group presentations will be graded using the rubric in the resources.

Learning Resources

1. Historical and Predicted Precipitation Graph Questions
2. Bar Graph student sheet (print a double-sided copy for each student to use)
3. 6 Hats Different Perspectives Teacher Reference Sheet
4. 6 Hats Different Perspectives Sorting Cards
5. 6 Hats Different Perspectives Chart Labels
6. Presentation Rubric
7. Blue Hat Exit Ticket

Flagstaff Precipitation Level Questions Name: _____

Historical precipitation levels of Flagstaff

1. Which year had the least amount of precipitation? Which one had the highest? Use the **R.A.C**. parts of the R.A.C.E. method to answer the question.

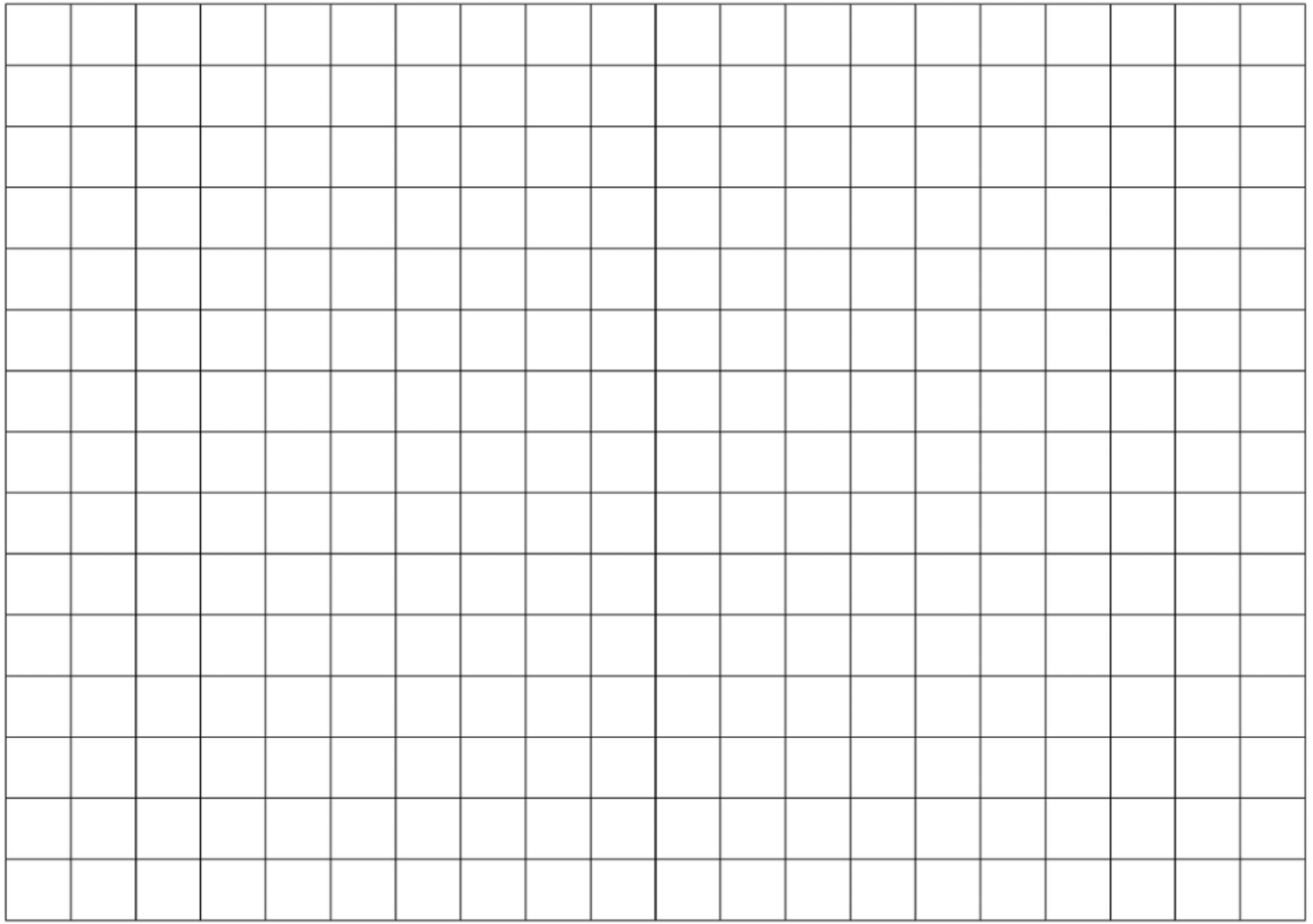
2. When looking at the whole data set, what trend do you see happening with the precipitation levels? Why do you think that trend is happening? Use the R.A.C.E. method to answer the question.

Predicted precipitation levels of Flagstaff

1. When looking at the whole data set, what trend do you see happening with the predicted precipitation levels? Use the R.A.C.E. method to answer the question.

2. What possible environmental events could cause this kind of trend? Use the R.A.C.E. method to answer the question.

Historic and Present-Day Precipitation Data Graph Name: _____



	The Objective Thinker You focus on the specific, available data in a situation	• Here are the facts… • What do I know about…? • What is happening…? ❖ "Let's look at the facts…"
	The Emotional Thinker You consider the emotions in a situation	• How do I feel about…? • What is my opinion of…? • How might other people feel? ❖ "What I feel is this…"
	The Negative Thinker You see all the bad things in a situation	• What is wrong with…? • What are the weaknesses? • What might not work? • What are the challenges? ❖ "No, this isn't going to work…"
	The Positive Thinker You see all the good things in a situation	• What are the positives with…? • What are the strengths of…? • What are the benefits of…? ❖ "Let's look at all the positive things…"
	The Creative Thinker You come up with creative solutions in a situation	• What other alternatives are there? • How can I improve…? • What are the possibilities? ❖ "I've got an idea…"
	The Summarizing Thinker You summarize the most important information in a situation	• What was most valuable? • Here is a summary of… • How can I apply what I have learned? ❖ "All of this means…"

	**The Objective Thinker** You focus on the specific, available data in a situation	• Here are the facts… • What do I know about…? • What is happening…? “Let’s look at the facts…”
	**The Emotional Thinker** You consider the emotions in a situation	• How do I feel about…? • What is my opinion of…? • How might other people feel? “What I feel is this…”

	# The Negative Thinker You see all the bad things in a situation	• What is wrong with…? • What are the weaknesses? • What might not work? • What are the challenges? "No, this isn't going to work…"

	# The Positive Thinker You see all the good things in a situation	• What are the positives with…? • What are the strengths of…? • What are the benefits of…? "Let's look at all the positive things…"

	**The Creative Thinker** You come up with creative solutions in a situation	• What other alternatives are there? • How can I improve…? • What are the possibilities? “I’ve got an idea…”

	**The Wrap-up Thinker** You summarize the most important information in a situation	• What was most valuable? • Here is a summary of… • How can I apply what I have learned? “All of this means…”

Speaking Presentation Rubric: Flagstaff Precipitation & Indigenous Teachings

Student Name: _____
Date: _____
Total Score: _____ / 20
Directions: For each category, circle the score that best describes the student's performance.

Category	4 - Distinguished	☆ 3 - Proficient ☆	2 - Developing	1 - Emerging	Score
1. Content & Depth	• Fully answers both questions with excellent detail and clear connections. • Includes a lot of historical and current precipitation data. •Explains in detail specific Indigenous teachings for water preservation and how they apply today. • Shows a deep understanding of the topic.	• Answers both questions with good detail and some clear connections. • Includes important historical and current precipitation data. • Explains Indigenous teachings for water preservation and how they apply today. • Shows a good understanding of the topic.	• Answers the questions, but with limited detail or connections. • Includes some precipitation data, but it may be incomplete. • Briefly mentions Indigenous teachings, but connections to today's practices are vague. • Shows some understanding of the topic.	• Does not clearly answer the questions. • Lacks relevant precipitation data. • Does not include or poorly explains Indigenous teachings on water. • Shows limited or no understanding of the topic.	
2. Organization	• Presentation is very well-organized with a clear, engaging introduction, logical flow of ideas, and a strong conclusion that summarizes key points.	• Presentation is well-organized with a clear introduction, logical flow, and a conclusion that summarizes key points.	• Presentation has an introduction and conclusion, but the flow of ideas may be disconnected or hard to follow.	• Presentation lacks clear organization; ideas are scattered, and there is no clear introduction or conclusion.	
3. Delivery	• Speaks clearly and confidently with excellent volume and pacing. • Makes consistent eye contact with the audience. • Uses visuals effectively to enhance the presentation (if applicable). • Engages the audience.	• Speaks clearly with good volume and appropriate pacing. • Makes eye contact most of the time. • Uses visuals to support the presentation (if applicable). • Generally engages the audience.	• Speech may be too quiet or too fast or slow, making it difficult to understand. • Makes limited eye contact. • Visuals are used but may not be effective or well-integrated. • Audience engagement is inconsistent.	• Speech is unclear, too quiet, or too fast or slow. • Avoids eye contact. • Does not use visuals or uses them ineffectively. • Does not engage the audience.	
4. Language Use	• Uses precise, age-appropriate vocabulary. • Explains complex ideas clearly and simply. • Speaks grammatically correct sentences. • No reliance on notes.	• Uses appropriate vocabulary. • Explains most ideas clearly. • Speaks with minor grammatical errors. • Occasional reliance on notes.	• Vocabulary may be limited or unclear in places. • Explanations are sometimes confusing. • Noticeable grammatical errors. • Frequent reliance on notes.	• Vocabulary is very limited or inappropriate. • Explanations are consistently unclear. • Numerous grammatical errors. • Reads directly from notes.	
5. Research & Sources	• Clearly references multiple, credible sources throughout the presentation (e.g., "Our graph shows..." or "The Hopi tribe teaches..."). • Demonstrates independent research	• References sources during the presentation (e.g., "The data from the chart shows..." or "Indigenous stories tell us..."). • Uses provided materials effectively.	• Mentions sources vaguely or not at all. • Primarily relies on provided materials without much additional research evident.	• Does not reference any sources. • Shows no evidence of research.	

	beyond provided materials.				

Exit Ticket- Blue Summarizer Hat for "The Water Lady"

Name:

Now that you have learned some more information about precipitation levels in Flagstaff, and how the Indigenous communities (both past and present) lived in this area, summarize what this picture means to you. What is most valuable? Is there anything you have learned that can be applied to this picture? Use complete sentences and remember to use correct capitalization and punctuation.

Exit Ticket- Blue Summarizer Hat for "The Water Lady"

Name:

Now that you have learned some more information about precipitation levels in Flagstaff, and how the Indigenous communities (both past and present) lived in this area, summarize what this picture means to you. What is most valuable? Is there anything you have learned that can be applied to this picture? Use complete sentences and remember to use correct capitalization and punctuation.

_____ _____	_____ _____

References

Arizona Department of Education. (2025, January 29). Arizona Mathematics Standards, 4th Grade. https://www.azed.gov/sites/default/files/2025/03/Math%20Grade%204%20Final%202025.pdf.

Arizona Department of Education. (2022, November 3). Arizona Science Standards- 4th Grade. *https://www.azed.gov/sites/default/files/2022/11/Fourth%20Grade%20Science%20Standards%20Placemat.pdf*.

Bernardini, W., Koyiyumptewa, S. B., Schachner, G., & Kuwanwisiwma, L. J. (Eds.). (2021). Becoming Hopi : a history. The University of Arizona Press.

Castagno, A. E., Joseph, D. H., Kretzmann, H., & Dass, P. M. (2021). Developing and piloting a tool to assess culturally responsive principles in schools serving Indigenous students. *Diaspora, Indigenous, and Minority Education, 16(2),* 133–147. https://doi.org/10.1080/15595692.2021.1956455

McGinty, A. B. (2021). The water lady: How Darlene Arviso helps a thirsty Navajo Nation. Schwartz & Wade Books.

National Weather Service (2025, June 19). Climate explorer. Climate Resilience Toolkit https://toolkit.climate.gov/tool/climate-explorer

National Weather Service (2025, June 19). Coconino County. Climate Resilience Toolkit's climate explorer. https://crt-climate-explorer.nemac.org/cards_home/?city=Flagstaff%2C+AZ&county=Coconino%2BCounty&area-id=04005&fips=04005&zoom=7&lat=35.1982836&lon=-111.651302.

National Weather Service (2025, June 19). Monthly total precipitation for Flagstaff area, AZ. NOWData NOAA Online Weather Data. https://www.weather.gov/wrh/climate?wfo=fgz.

Native Women's Association of Canada (2025, June 18). Water is a source of life. https://nwac.ca/policy/water-is-a-source-of-life.

Robertson, J. (2017). The water walker. Second Story Press.

Smithsonian National Museum of Natural History (2024, January 3). Homo sapiens. What does it mean to be human? https://humanorigins.si.edu/evidence/human-fossils/species/homo-sapiens.

Tenasco, S. (2021). Nibi's water song. Lee & Low Books.

University of Arizona (2025, June 18). Arizona Water Festival. Teacher Resources. *https://projectwet.arizona.edu/arizona-water-festival/teacher-resources*.

Vuorinen, H. S., Juuti, P. S., & Katko, T. S. (2007). History of water and health from ancient civilizations to modern times. *Water Science & Technology: Water Supply, 7(1),* 49–57.