10 Water Lessons for Tucson

This unit teaches students about the water cycle with a focus on how Tucson benefits from the Colorado River and CAP (Central Arizona Project Aqueduct). Students learn about the Hohokam people and the importance water to their community. Students then learn about the Agua Nueva Reclamation Facility and how the reclaimed water is bringing back the Santa Cruz River. Students also do a water quality lab where they test their own tap water from home. Each lesson in the unit can be taught alone or alongside other lessons.

Science Standard:

7.E1U1.5 Construct a *model* that shows the cycling of matter and flow of energy in the atmosphere, **hydrosphere**, and geosphere.

Lesson 1

Learning Target:

I am learning where water can be found on Earth.

Success Criteria:

-I can explain how water droplets move from place to place on Earth.

-I can make a bar graph displaying where I have been as a water droplet.

-I can gather class data and graph to determine where the class has traveled the most as a water droplet.

-I can write a conclusion based on my data.

Where water can be found?

Soil

Lake

Ocean

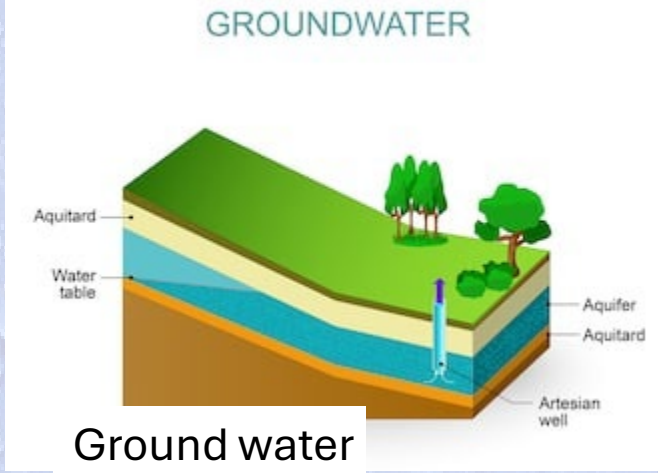
Atmosphere

Glacier

Animals

Plant

River



Ground water

Instructions

Materials

- 1 dice per group
- 1 plate per group
- Groups of 3 students (one rolls the dice, one records, one holds the plate)

Procedures:

1. Each group decides the location they want to begin (if too many in one section, teacher decides where they should begin). There are a total of 9 water locations.
2. Each group rolls the dice and follows the handout as to where they go next. Each group tallies and keeps track where they go each time.
3. Teacher allows students to do this activity for 10 minutes so each group can gather data.
4. When done, students will make a bar graph with the group data and write a conclusion.
5. When done, each group will then share their data with the class and teacher collects data.
6. Students make another bar graph on Excel, using the class data as well as write a conclusion.

Water-Location Poster

PLANT

WHAT YOU ROLL	WHAT HAPPENS TO YOU	WHERE YOU GO
1, 2, 3, or 4	Water leaves a plant through the process of transpiration.	Atmosphere
5 or 6	Water is used by a plant and stays in cells. Roll again.	Plant

Investigation 7: The Water Planet

FOSS Kit

Water-Location Poster

GROUNDWATER

Special Master—No. 5

WHAT YOU ROLL	WHAT HAPPENS TO YOU	WHERE YOU GO
1	Water filters into a river.	River
2 or 3	Water filters into a lake.	Lake
4, 5, or 6	Water stays underground in an aquifer. Roll again.	Groundwater

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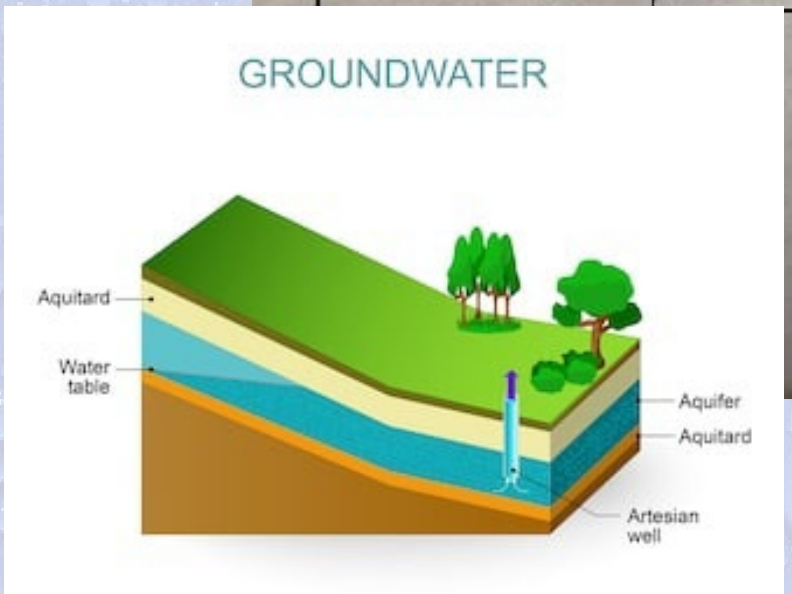

FOSS Kit

Water-Location Poster

GLACIER

WHAT YOU ROLL	WHAT HAPPENS TO YOU	WHERE YOU GO
1	Ice melts and water filters into the ground.	Groundwater
2	Ice sublimates (turns directly from ice into water vapor) and goes into the atmosphere.	Atmosphere
3	Ice melts and water flows into a river.	River
4	Ice melts and water flows into the ocean.	Ocean
5 or 6	Ice stays frozen in the glacier. Roll again.	Glacier

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FOSS Kit

Water-Location Poster

LAKE

WHAT YOU ROLL	WHAT HAPPENS TO YOU	WHERE YOU GO
1	Water filters into the soil.	Soil
2	An animal drinks water.	Animal
3	Water flows into a river.	River
4	Water heats up and evaporates.	Atmosphere
5 or 6	Water remains within a lake or estuary. Roll again.	Lake

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Water-Location Poster

ATMOSPHERE

Special Master—No. 3

WHAT YOU ROLL	WHAT HAPPENS TO YOU	WHERE YOU GO
1	Water condenses and falls on soil.	Soil
2	Water condenses and falls as snow on a glacier.	Glacier
3	Water condenses and falls on a lake.	Lake
4 or 5	Water condenses and falls on an ocean.	Ocean
6	Water remains as vapor in the atmosphere. Roll again.	Atmosphere

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FOSS Kit

Water-Location Poster

ANIMAL

WHAT YOU ROLL	WHAT HAPPENS TO YOU	WHERE YOU GO
1 or 2	Water is excreted through feces and urine.	Soil
3, 4, or 5	Water is respired or evaporated from the body.	Atmosphere
6	Water is incorporated into the body. Roll again.	Animal

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FOSS Kit

Water-Location Poster

OCEAN

Special Master—No. 7

WHAT YOU ROLL	WHAT HAPPENS TO YOU	WHERE YOU GO
1 or 2	Water heats up and evaporates.	Atmosphere
3, 4, 5, or 6	Water remains in the ocean. Roll again.	Ocean

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FOSS Kit

Water-Location Poster

RIVER

WHAT YOU ROLL	WHAT HAPPENS TO YOU	WHERE YOU GO
1	Water flows into a lake.	Lake
2	Water filters into the soil.	Soil
3	Water flows into the ocean.	Ocean
4	An animal drinks water.	Animal
5	Water heats up and evaporates.	Atmosphere
6	Water remains in the river. Roll again.	River

Special Master—No. 9

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Investigation 7: The Water Planet

FOSS Kit

Water-Location Poster

SOIL

WHAT YOU ROLL	WHAT HAPPENS TO YOU	WHERE YOU GO
1	Water is absorbed by plant roots.	Plant
2	Soil is saturated, so water runs into a river.	River
3	Water filters into the soil.	Soil
4 or 5	Heat evaporates the water.	Atmosphere
6	Water remains on the surface, in a puddle, or on a soil particle. Roll again.	Soil

Investigation 7: The Water Planet

FOSS Kit

I am a water droplet. Where will I go?

Hypothesis

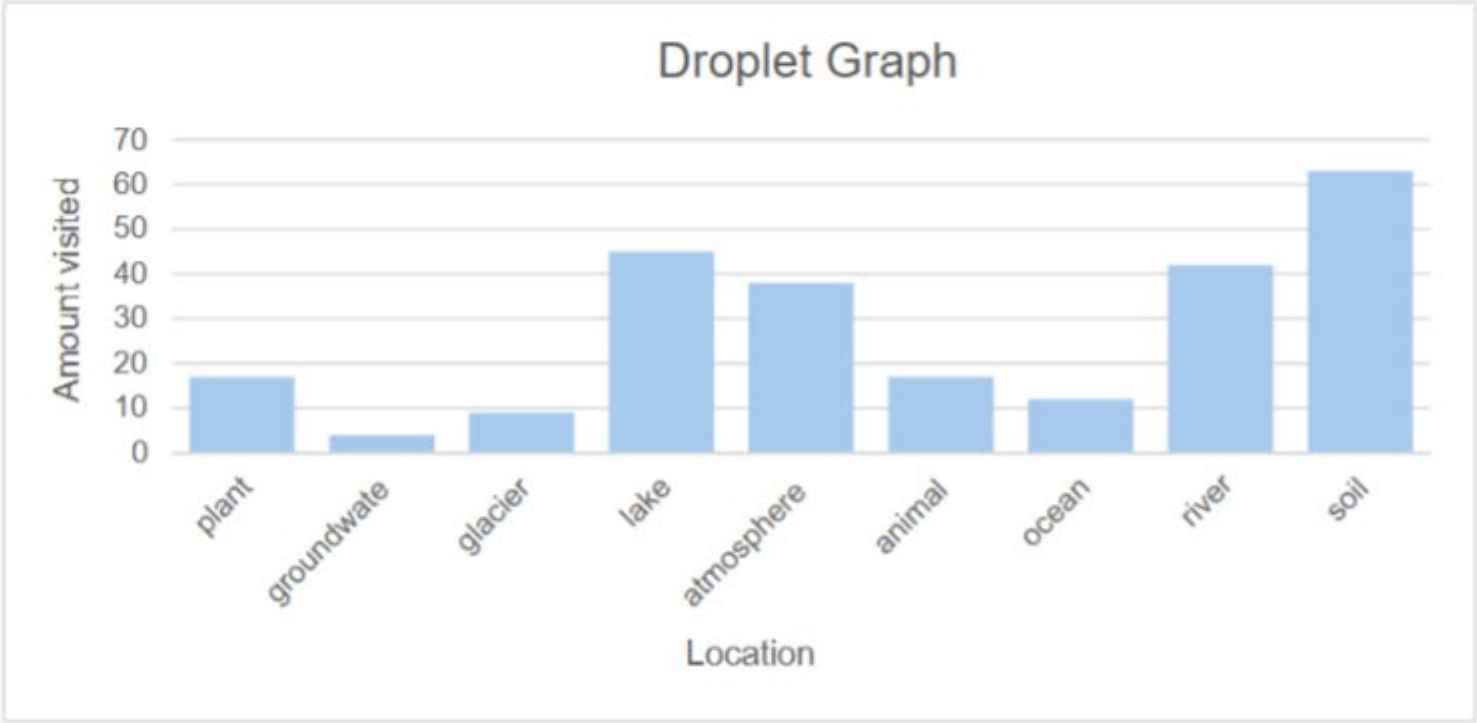
The Water Droplet	How many times do I go there? (tally)
Plant	
Groundwater	
Soil	
Ocean	
River	
Lake	
Animal	
Atmosphere	
Glacier	

Class Data Table:

Water Droplet	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Total
Plant									
Groundwater									
Soil									
Ocean									
River									
Lake									
Animals									
Atmosphere									
Glacier									

Student Work: Class Data

plant	**17**
groundwater	**4**
glacier	**9**
lake	45
atmosphere	38
animal	17
ocean	12
river	42
soil	63



Students used Excel when graphing the class data.

Lesson 2

Learning Target:

I am learning about the water cycle and its importance for all living things.

Success Criteria:

-I can explain what is evaporation, condensation, precipitation, transpiration, groundwater, and aquifers are to a peer.

-I can explain the importance of the Sun in the water cycle.

-I can create a model that illustrates the water cycle in Tucson, Az.

The Water Cycle Assignment

1. **Draw** the setting in Tucson, AZ (examples “A” mountain, saguaros, the University of Arizona etc).
2. **Draw and label** the 3 ways water enters the atmosphere and label them (evaporation, organisms breathing out and, transpiration).

3. Draw the water cycle and **label** evaporation, condensation, precipitation, and collection.

4. Draw and label the source and that makes evaporation possible (the Sun).

5. **Draw and label** groundwater and an aquifer.

6. Writing: Explain how water enters the atmosphere (#2). Explain what is the water cycle (#3). Explain the importance of the Sun (#4). Explain what is groundwater and an aquifer (#5). Explain where your drawing is located (#1). Finally, explain why water is important.

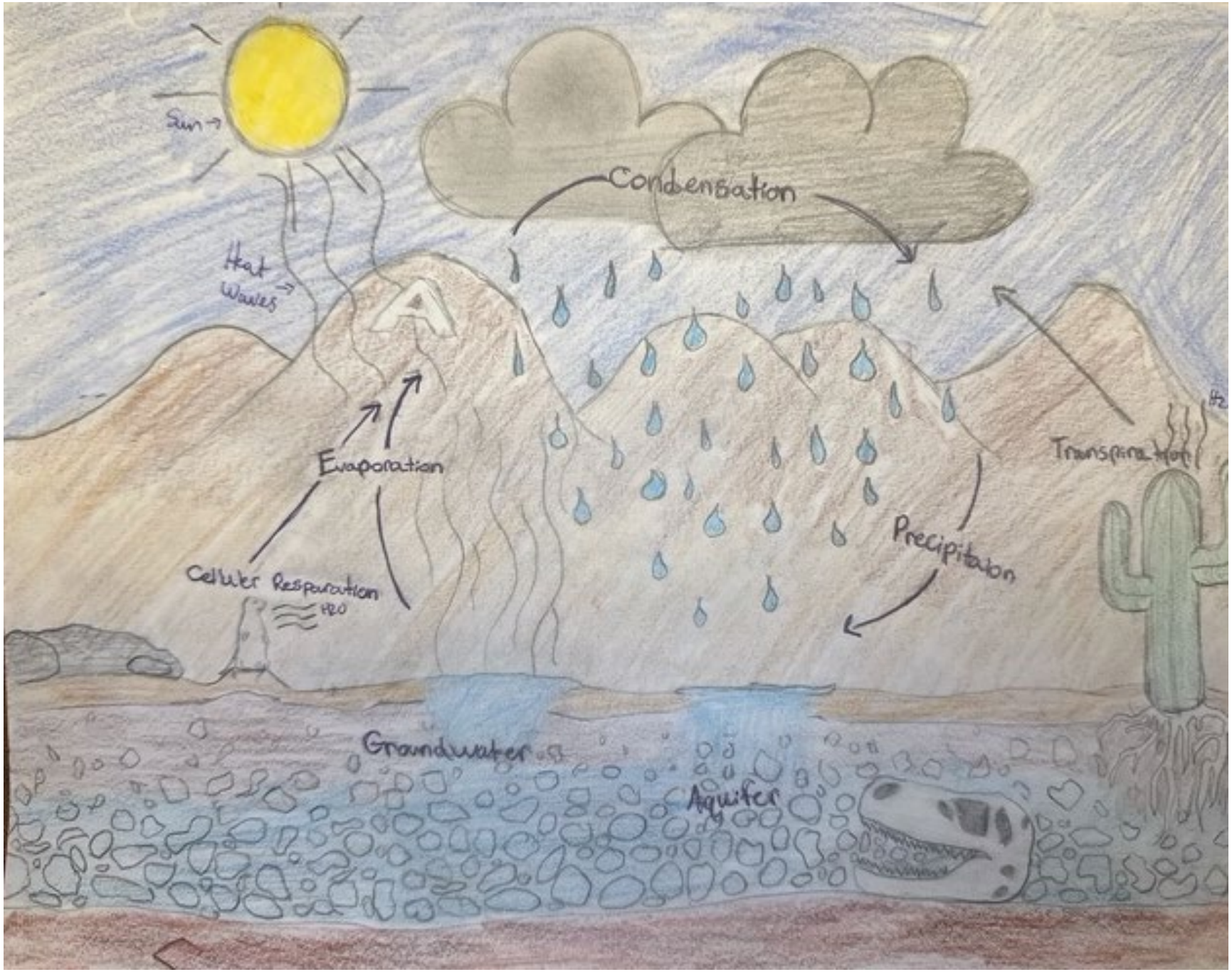
(Write at least 2 paragraphs. Writing needs to be in complete sentences, check grammar, spelling, and capitalization.)

7. **Color and hand-in**. Must be neat and presentable. See Rubric.

Rubric

Rubric	4	3	2	1
Neatness	The **model** and **writing is very neat and legible. Color is present.** The setting is in Tucson, AZ.	The model and writing is **presentable. Color is present.** The setting is in Tucson, AZ.	The model is somewhat neat but needs attention. The setting is in Tucson, AZ.	The poster is not neat. The setting is not in Tucson, AZ.
Water entering the Atmosphere	**Evaporation, Organisms breathing out, and Transpiration are drawn, labeled and discussed in the writing section in great detail.**	2 out the 3 are drawn, labeled and discussed in the writing.	1 out of 3 are drawn, labeled and discussed in the writing.	Neither is drawn or discussed in the model.
Water Cycle	**1.evaporation, 2.condensation, 3.precipitation, 4. collection are labeled, drawn** and **discussed in the writing.**	3 out of 4 words within the water cycle are drawn, labeled, and discussed in the writing.	2 out of 4 words within the water cycle are drawn, labeled and are discussed in the writing.	1 out of 4 words within the water cycle are drawn, labeled, and discussed in the writing.
Aquifer, groundwater, and Sun.	**Aquifer, groundwater, and sun are drawn, labeled, and discussed in the writing section.**	2 out of 3 words are drawn in the model and are discussed in the writing.	1 out of 3 words are drawn, labeled in the model and are discussed in the writing.	Neither is drawn or discussed in the model.
Writing	**Complete sentences are present.** **All** sentences begin with a capital letter and end with a period. No grammar errors or misspelled words are present. **See #6 (back) for questions that need to be answered.** **Two paragraphs are present.**	Complete sentences are present. **Most** sentences begin with a capital letter and end with a period. Some grammar errors or misspelled words are present. **Two paragraphs are present.**	Sentences are not in complete sentences. Several sentences have grammatical errors or misspelled words.	There is no organization in the writing. Many sentences are not in complete sentences. Many misspelled words with grammatical errors.

Student Work:



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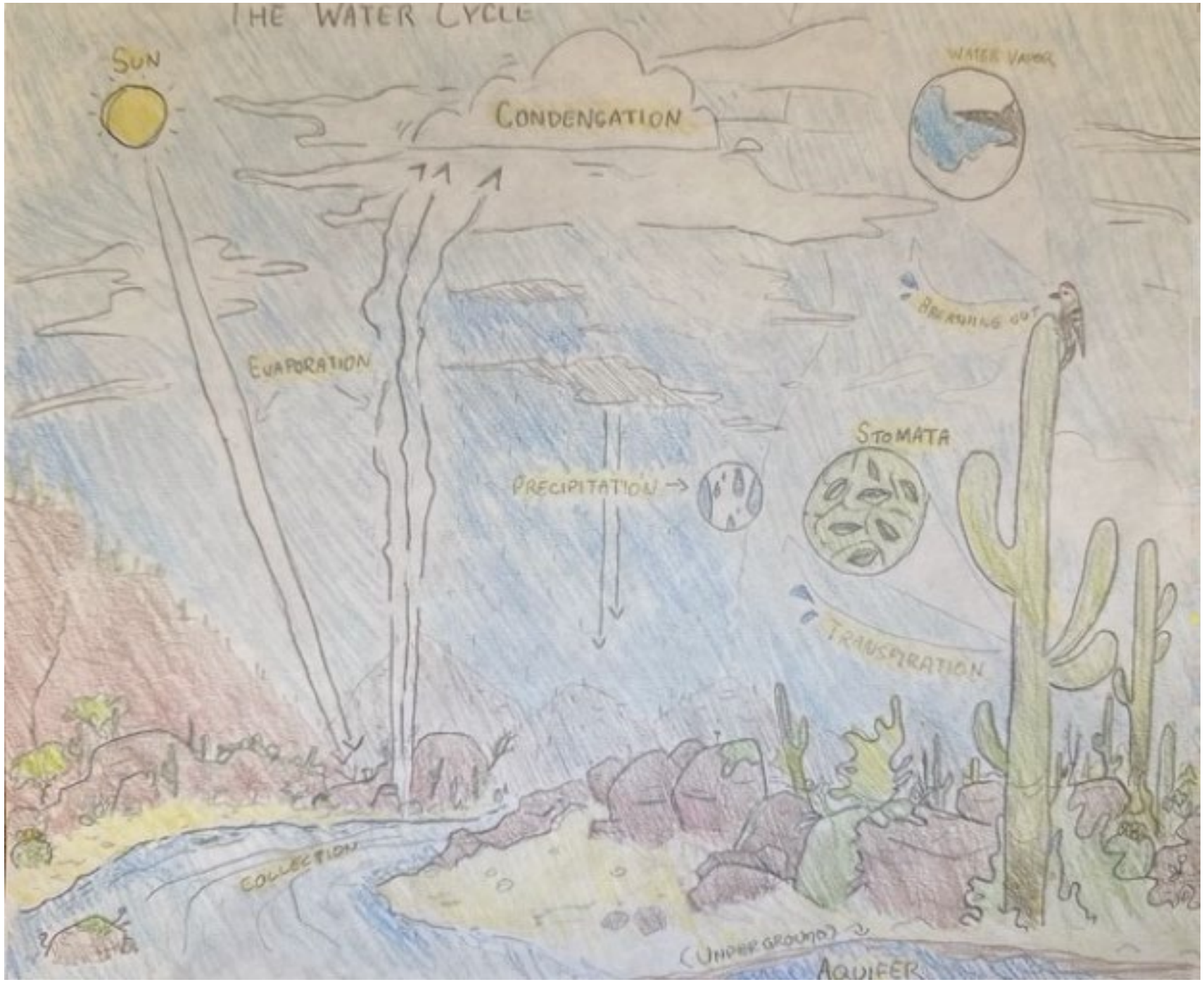

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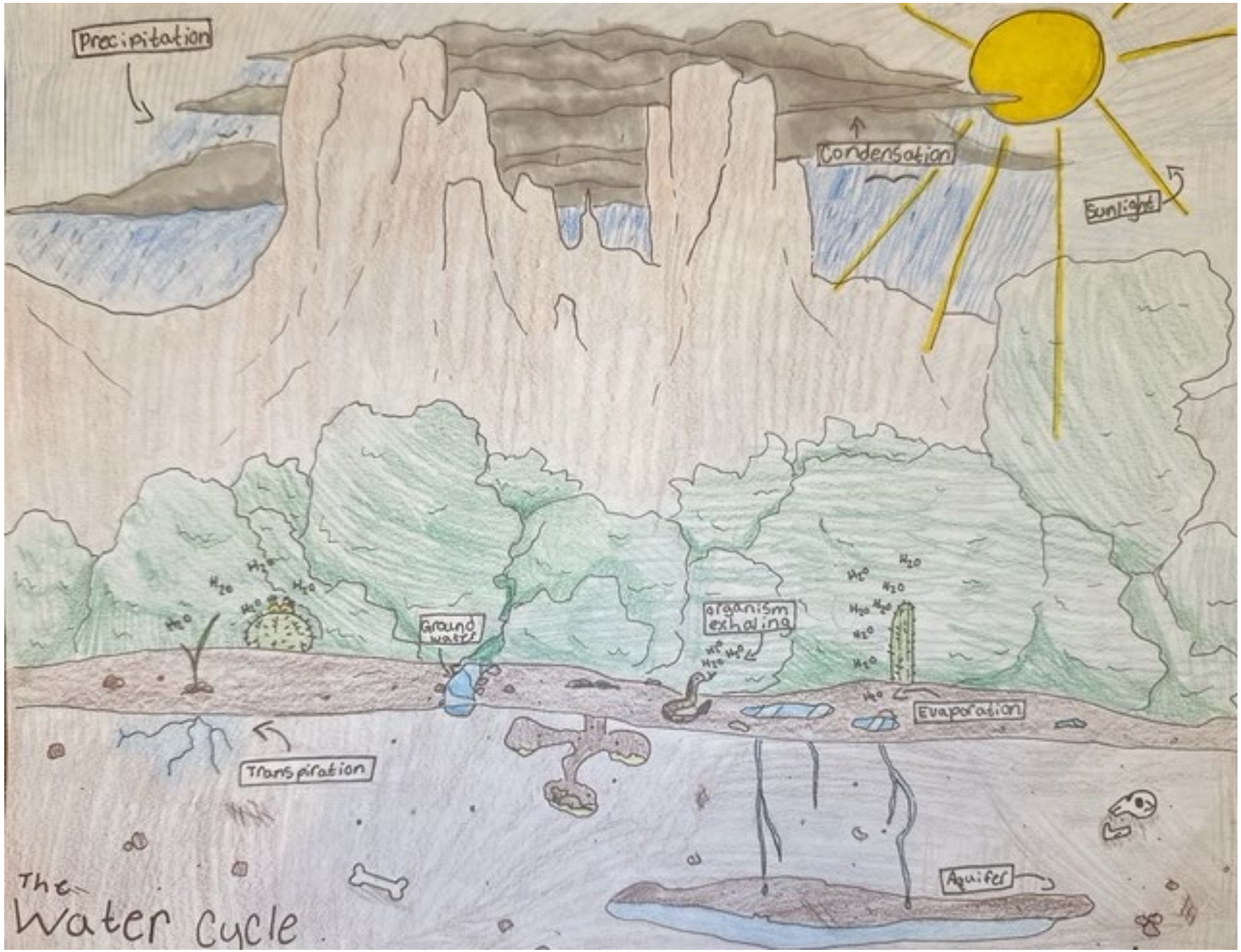

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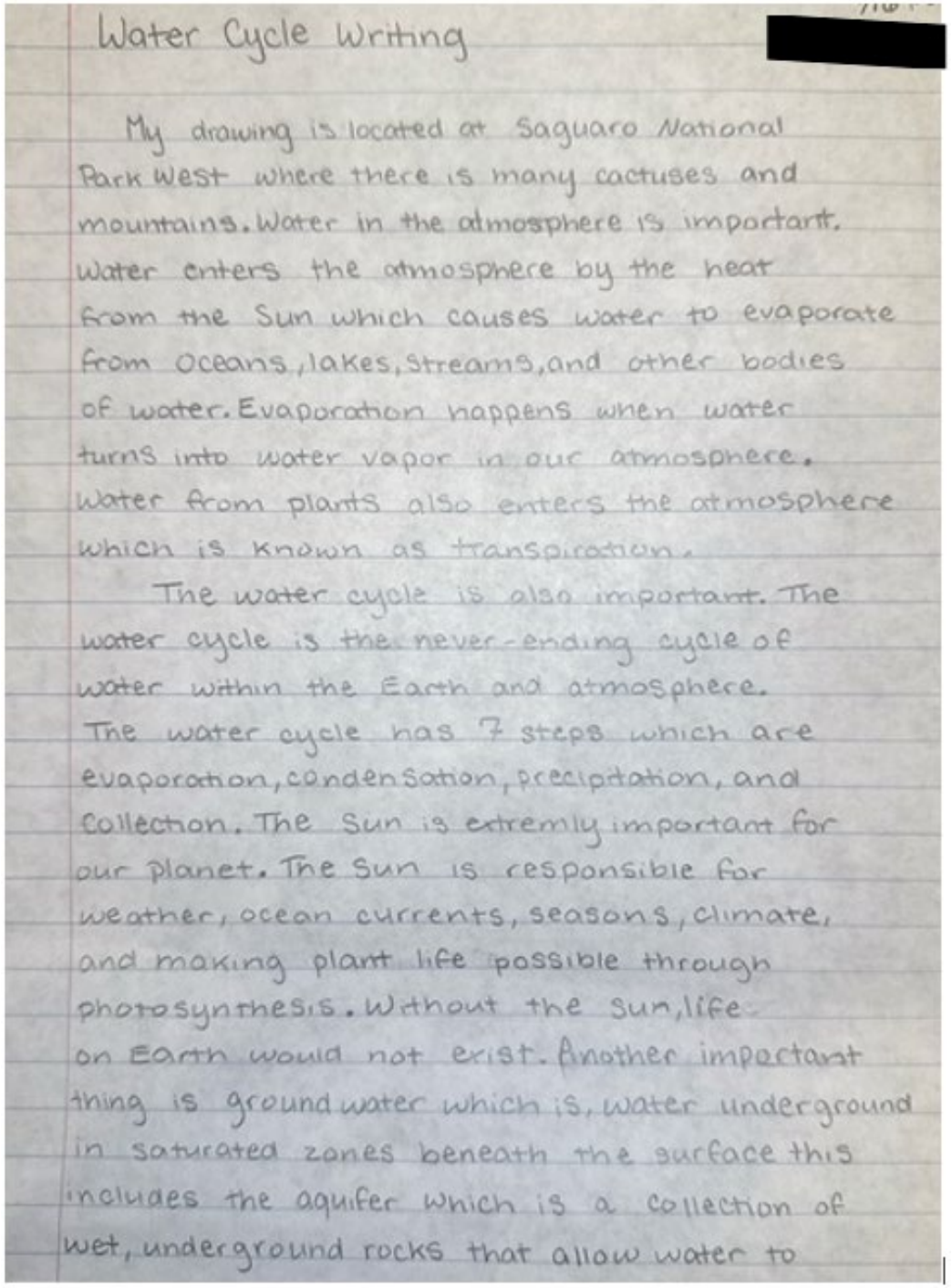
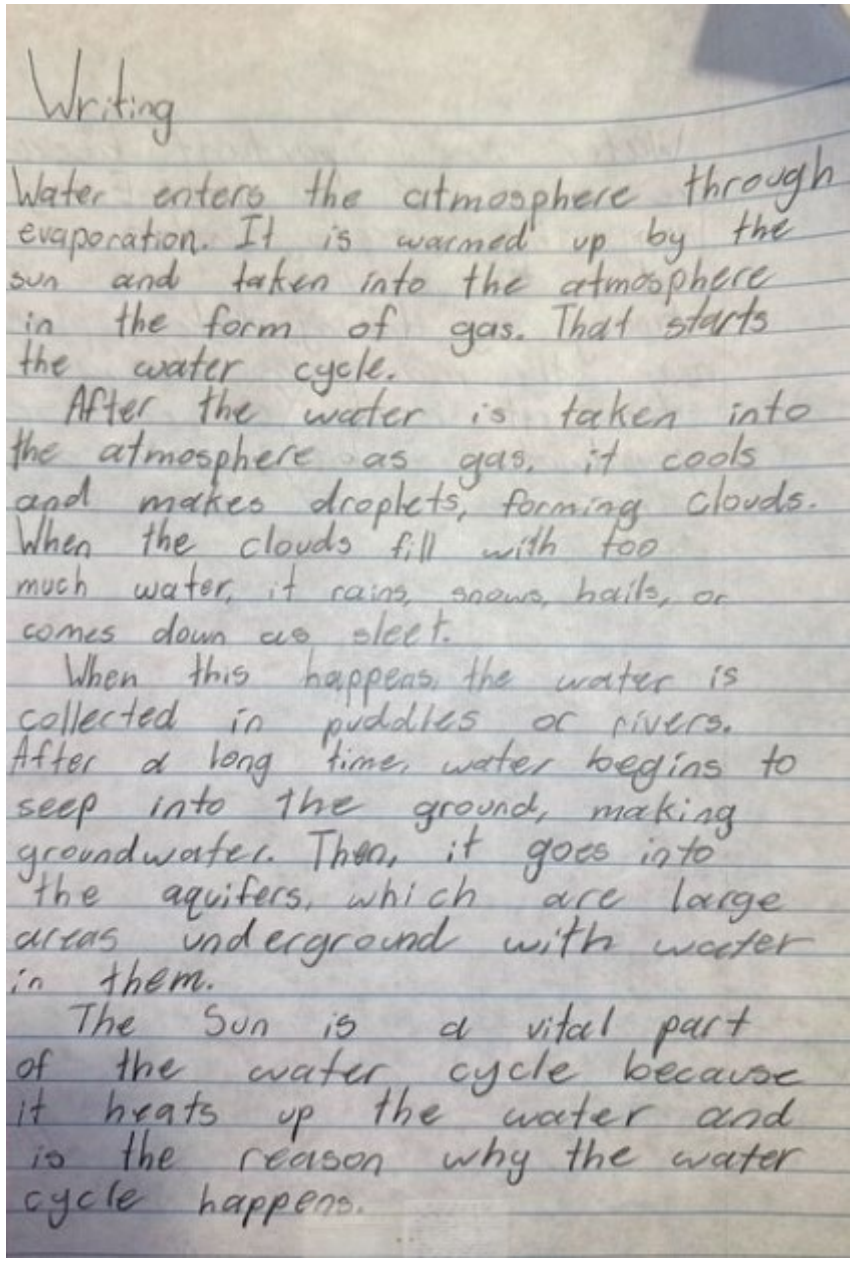


Water Cycle Writing [redacted]

My drawing is located at Saguaro National Park West where there is many cactuses and mountains. Water in the atmosphere is importart. Water enters the atmosphere by the heat from the Sun which causes water to evaporate from Oceans, lakes, streams, and other bodies of water. Evaporation happens when water turns into water vapor in our atmosphere. Water from plants also enters the atmosphere which is known as transpiration.

The water cycle is also important. The water cycle is the never-ending cycle of water within the Earth and atmosphere. The water cycle has 7 steps which are evaporation, condensation, precipitation, and collection. The Sun is extremly important for our planet. The Sun is responsible for weather, ocean currents, seasons, climate, and making plant life possible through photosynthesis. Without the Sun, life on Earth would not exist. Another important thing is ground water which is, water underground in saturated zones beneath the surface this includes the aquifer which is a collection of wet, underground rocks that allow water to pass through it slowly. All these important things include water, one of the most important characteristics of life. Water is important because without it you will be extremly dehydrated and will probably die. Also, everybody is made of about 55-60% of water. Water is extremly crucial to life and that is why.

Student work:



Writing

Water enters the atmosphere through evaporation. It is warmed up by the sun and taken into the atmosphere in the form of gas. That starts the water cycle.

After the water is taken into the atmosphere as gas, it cools and makes droplets, forming clouds. When the clouds fill with too much water, it rains, snows, hails, or comes down as sleet.

When this happens the water is collected in puddles or rivers. After a long time, water begins to seep into the ground, making groundwater. Then, it goes into the aquifers, which are large areas underground with water in them.

The Sun is a vital part of the water cycle because it heats up the water and is the reason why the water cycle happens.

Lesson 3

Learning Target:

I am learning about the Grand Canyon and its importance to Tucson.

Success Criteria:

-I can explain the history of the Grand Canyon and the importance of the Colorado River that runs through it to a peer.

Tucson’s Water

https://santacruz.arizona.edu/sites/default/files/2025-04/Tucson-Water-Unit-Side-26-Video.mp4

GRAND CANYON NATIONAL PARK

Location : Arizona

Established : 1919

Area : 1,877.5 Square Miles

Annual Visitors : 6,254,238

HISTORY

The first humans arrived in the area of the Grand Canyon around 10,500 years ago. However, the first permanent settlements only date from around 4,000 years ago. These early settlers, known as Pueblo people, built their homes in the many caves and overhangs of the canyon's walls. A long drought caused many ancient peoples to leave but other groups, most famously the Navajo, re-settled the canyon around 500 years ago. During the 1500s the Spanish sighted the canyon for the first time during an expedition led by Francisco Coronado. The arrival of American settlers during the 1800s led to conflicts over land with the Navajo and other Native Americans eventually forced onto reservations.

In 1869 an expedition led by John Wesley Powell managed to raft through the entire canyon but they had no artist with them to record what they saw. Powell began another journey in 1872, this time with a photographer and painter. Their works helped to spread word of the canyon throughout the Untied States. Starting in the 1880s, several groups began lobbying the government to turn the canyon into a National Monument. However, they were opposed by ranchers and miners who wanted to use the land for their businesses. In 1908 President Roosevelt created the Grand Canyon National Monument, saying that it was "the one great sight that every American should see." Railroads began transporting large numbers of people to the canyon where they stayed in several large lodges and hotels built near the rim. Farming and mining still continued in and around the canyon, causing huge damage to the land as well as pollution.

Stephen Mather wanted to turn the canyon into a National Park but his efforts were blocked by Ralph Henry Cameron, a wealthy Arizona landowner who had managed to get elected to the U.S. Senate. Cameron had set up several lodges and controlled access to trails – charging high fees for entrance and water. In 1919, Congress created Grant Canyon National Park and in 1920 the Supreme Court ordered Cameron to give up his land and mining claims but he simply ignored them. He then made plans to build two huge dams in the canyon as well as a huge platinum mine. Mather and his allies managed to get newspapers to report on how Cameron was using his position in the Senate to enrich himself. In 1926 the people of Arizona refused to re-elect him, finally forcing Cameron to give in.

GEOGRAPHY

The rocks which can be seen at the Grand Canyon date from between 1.7 billion and 230 million years ago. Most of these rock layers were laid down in shallow seas and swamps which once existed over what is now the western United States.

Around 75 million years ago, the lands in and around the Canyon began to slowly rise up – eventually reaching a height of 2 miles above sea level. This process also led to the creation of the Colorado River which began to cut its way through the rock down to sea level. A change in the climate around 6 million years ago led to much greater rainfall in the region, increasing the speed and size of the river and also its power.

As the river cut its way down its course was continually changing, creating a deep and wide canyon. The canyon walls were then further eroded by rain and ice which weakened and then cracked the rock. Today the Grand Canyon has an average width of 10 miles and an average depth of just over 1 mile. From east to west the canyon stretches for 277 miles making it the longest of Earth.

WILDLIFE

Differences in elevation have created several different climate zones in and around the Grand Canyon. Large mammals in the park include deer, sheep, black bears, and elk. Smaller mammals include squirrels, raccoons, and beavers.

The Grand Canyon is home to many different species of snakes and lizards. There are also large populations of scorpions and insects. Many birds make their homes on the canyon's walls, including condors, owls, hawks, falcons, and vultures.

Areas of the canyon near the river are dominated by small plants such as willow and acacia. The canyon walls are populated by small plants whose roots are dug into the rock. Higher areas of the park are covered with spruce and fir trees along with various shrubs and cacti.

GRAND CANYON NATIONAL PARK

Location : Arizona

Established : 1919

Area : 1,877.5 Square Miles

Annual Visitors : 6,254,238

History

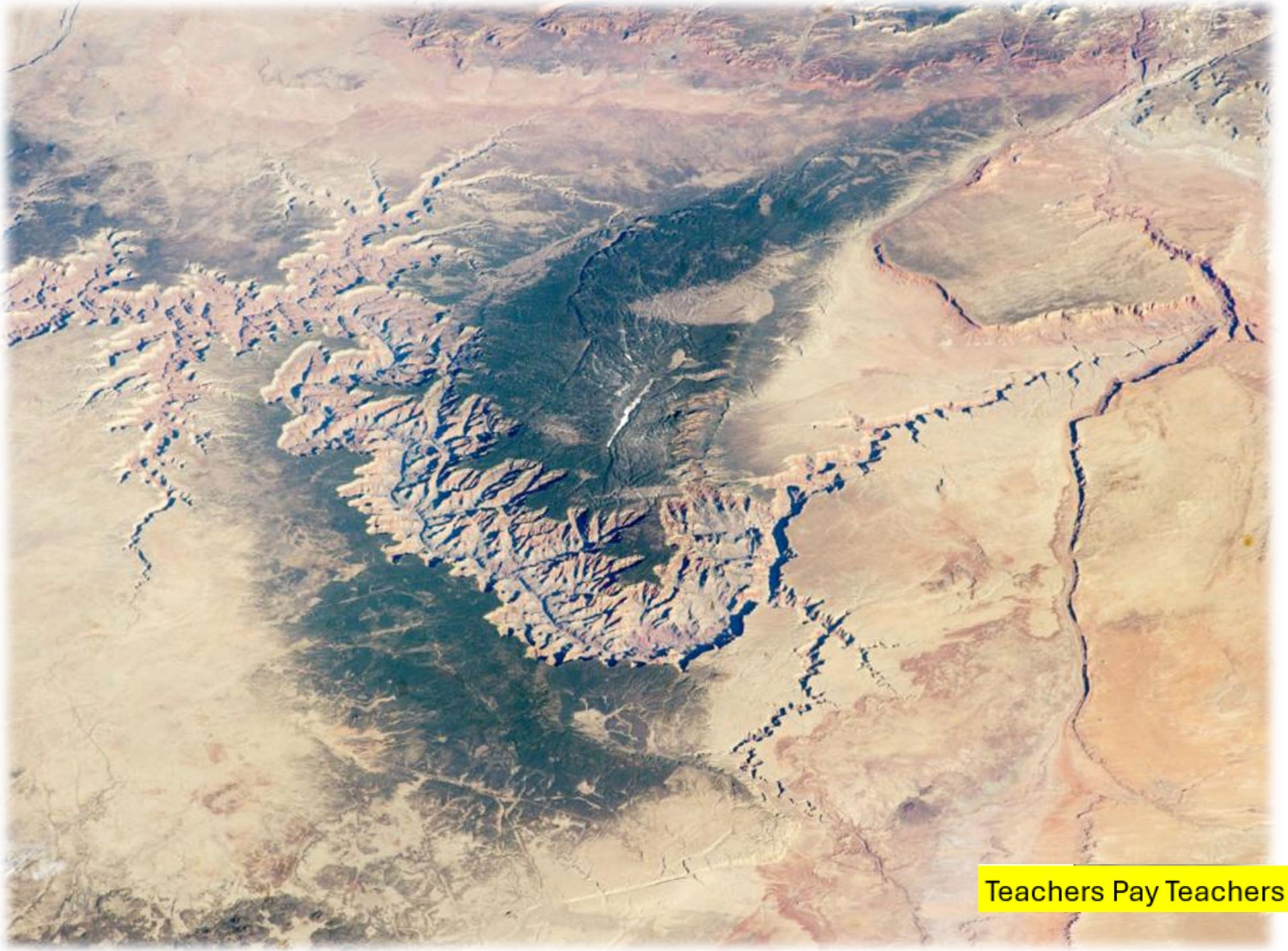
- The first humans began living near Grand Canyon around 10,500 years ago. Later Pueblo people built their homes in the canyon's walls. Around 500 years ago a people called t he Navajo settled in the area. During the 1500s the Spanish, led by Francisco Coronado, first saw the canyon. During the 1800s conflicts with new American settlers led to the Navajo being forced into reservations.
- An explorer, John Wesley Powell, made several trips through the canyon in the 1870s. His books helped to spread interest in the canyon but attempts to create a National Monument were opposed by ranchers and miners. In 1908, Roosevelt created the Grand Canyon National Monument. Railroads then began transporting large numbers of tourists to the area. However, farming and mining continued causing huge damage. Attempts to create a National Park were opposed by Ralph Cameron, a wealthy landowner and senator who made a fortune by ripping off tourists. In 1919 Congress created Grand Canyon National Park but Cameron simply ignored them and made plans to build dams and a mine. Finally Cameron was voted out of the Senate and had to give up his lands.

Geography

- The oldest rocks at Grand Canyon are 1.7 billion years old. Most layers were created when the area was under a shallow sea. Around 75 million years ago the lands began to rise up to heights of up to 2 mile above sea level. The Colorado river then began cutting its way through the rock. As its course changed it created a wide and deep canyon. Its sides were then further eroded by rain and ice. Today the Grand Canyon has an average width of 10 miles and depth of 1 mile. From east to west it is 277 miles long.

Animals & Plants

- **Mammals** : Deer, sheep, black bears, elk, squirrels, raccoons, beavers **Reptiles** : Snakes, lizards **Arthropods** : Scorpions
- **Birds** : Condors, owls, hawks, falcons, vultures **Plants** : Willow, acacia, shrubs, spruce, fir, cacti


Teachers Pay Teachers


Teachers Pay Teachers

The Grand Canyon Brochure

Brochure assignment- (at least two drawings are needed per section)

1.Grand Canyon National Park-

Include the following-

1. Drawing (with color) of the Grand Canyon.
2. Map of Arizona highlighting the Grand Canyon
3. Directions of how to get there from Dodge.

2.History-

Include the following-

1. The history of the people that first settled in the Grand Canyon (Pueblo, Navajo).
2. The history of how the Spanish sighted the Grand Canyon (led by Coronado)
3. The history of the American settlers (1869 expedition led by Powell, reservations).
4. How the Grand Canyon became a National Park.

3.Geography-

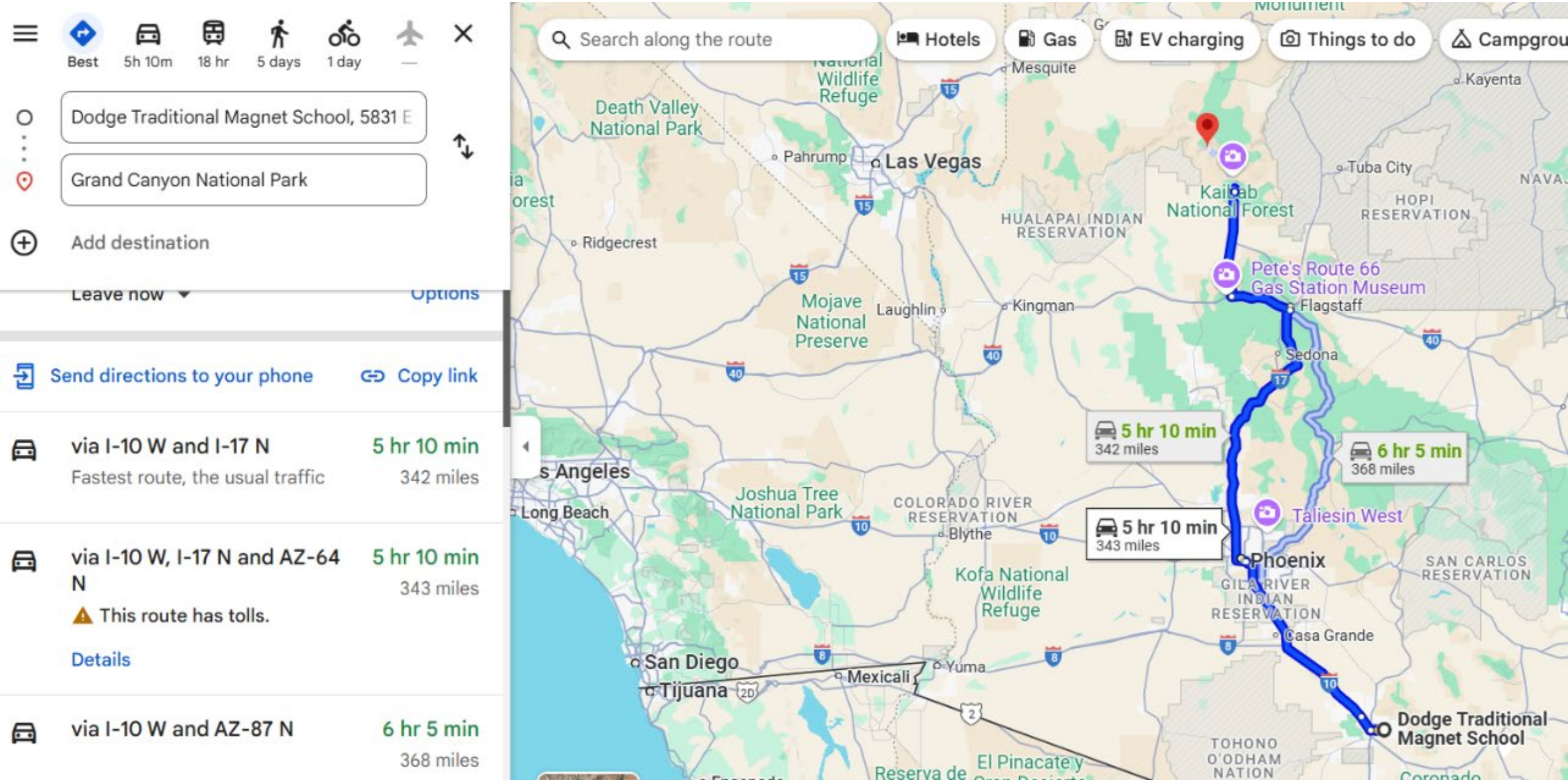
Include the following-

1. What type of rock is found in the Grand Canyon?
2. How was it shaped?
3. What runs along the Grand Canyon (Colorado River)?
4. How large is the river (wide and depth)?

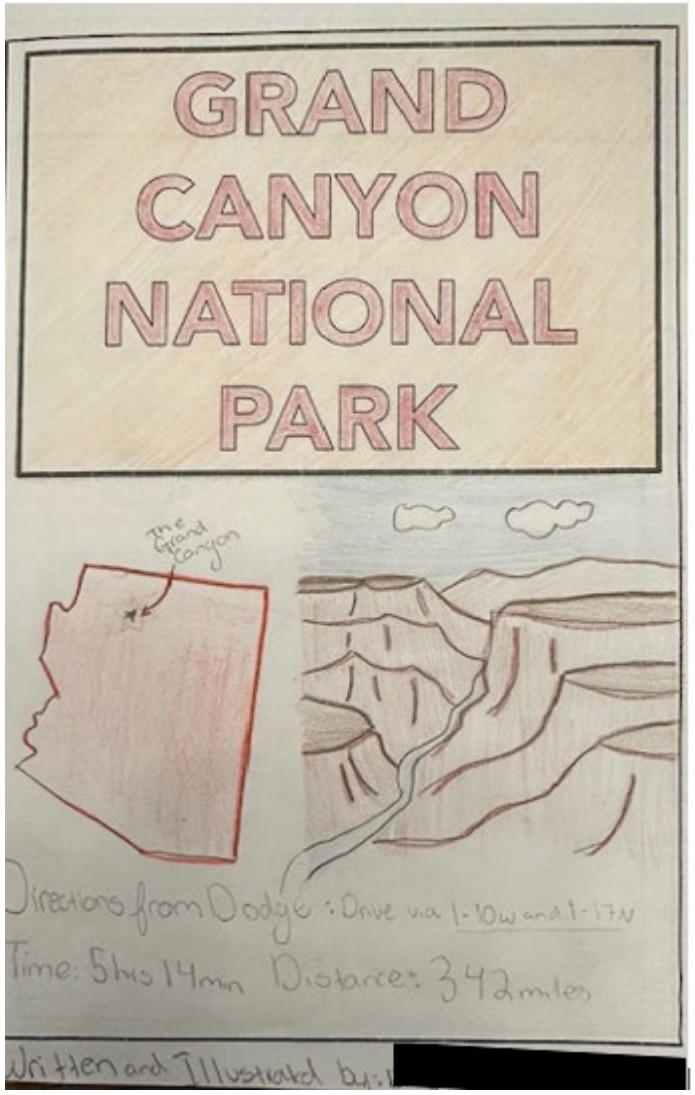
4.Wildlife-

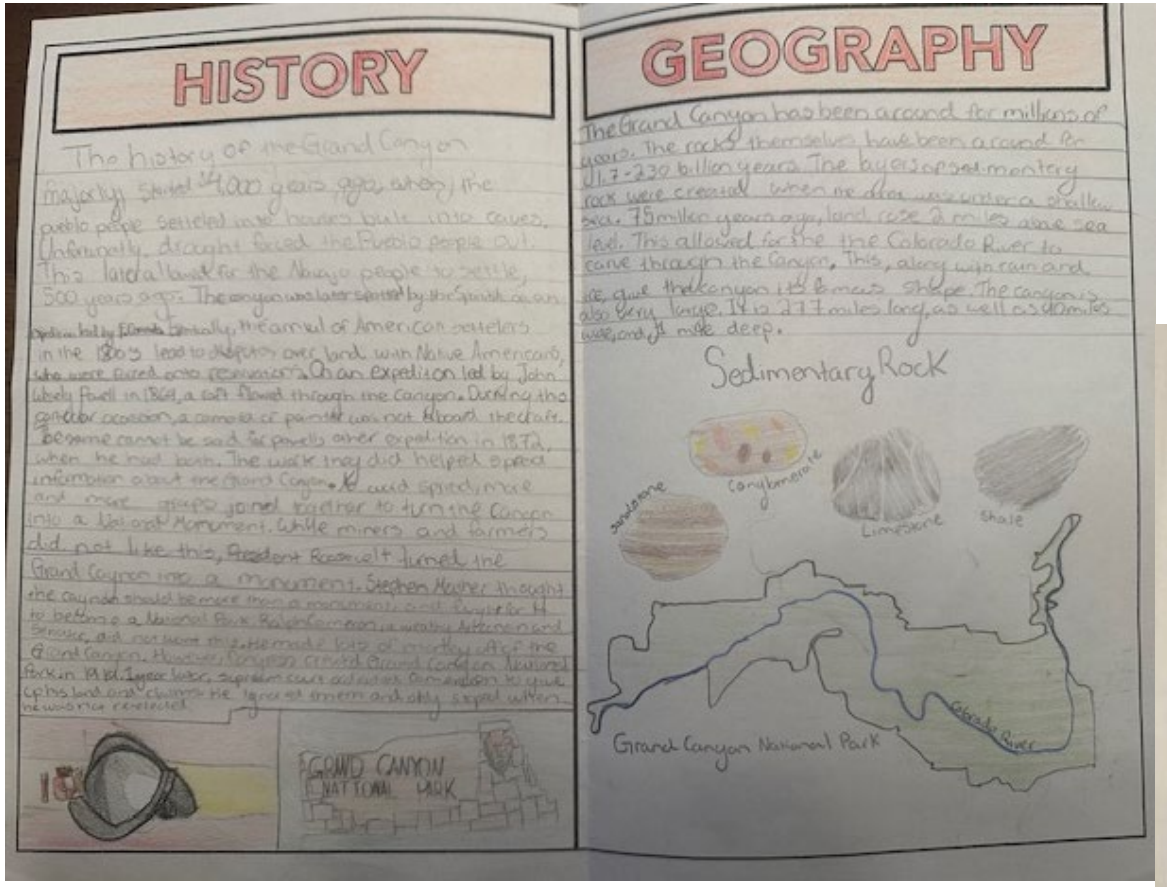
Include the following-

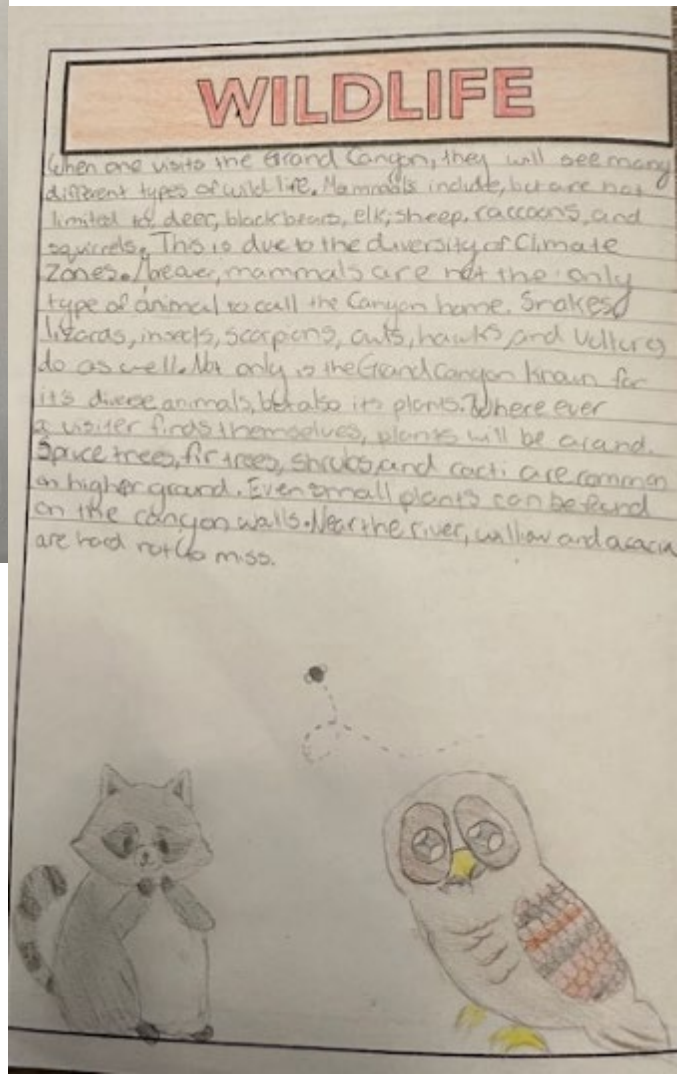
1. What organisms can visitors expect to see when visiting.


Best
5h 10m
18 hr
5 days
1 day
Dodge Traditional Magnet School, 5831 E
Grand Canyon National Park
Add destination
Leave now
Options
Send directions to your phone
Copy link
via I-10 W and I-17 N
5 hr 10 min
Fastest route, the usual traffic
342 miles
via I-10 W, I-17 N and AZ-64 N
5 hr 10 min
343 miles
This route has tolls.
Details
via I-10 W and AZ-87 N
6 hr 5 min
368 miles
Search along the route
Hotels
Gas
EV charging
Things to do
Campgrou
Death Valley National Park
Pahrump
Las Vegas
Mesquite
Kayenta
Tuba City
Kaibab National Forest
HUALAPAI INDIAN RESERVATION
HOPI RESERVATION
Ridgecrest
Pete's Route 66 Gas Station Museum
Flagstaff
Mojave National Preserve
Laughlin
Kingman
Sedona
5 hr 10 min
342 miles
6 hr 5 min
368 miles
Joshua Tree National Park
COLORADO RIVER RESERVATION
Blythe
Taliesin West
5 hr 10 min
343 miles
Phoenix
Kofa National Wildlife Refuge
GILA RIVER INDIAN RESERVATION
SAN CARLOS RESERVATION
Casa Grande
Long Beach
San Diego
Tijuana
Mexicali
Yuma
Dodge Traditional Magnet School
TOHONO O'ODHAM NATION
El Pinacate y Reserva de

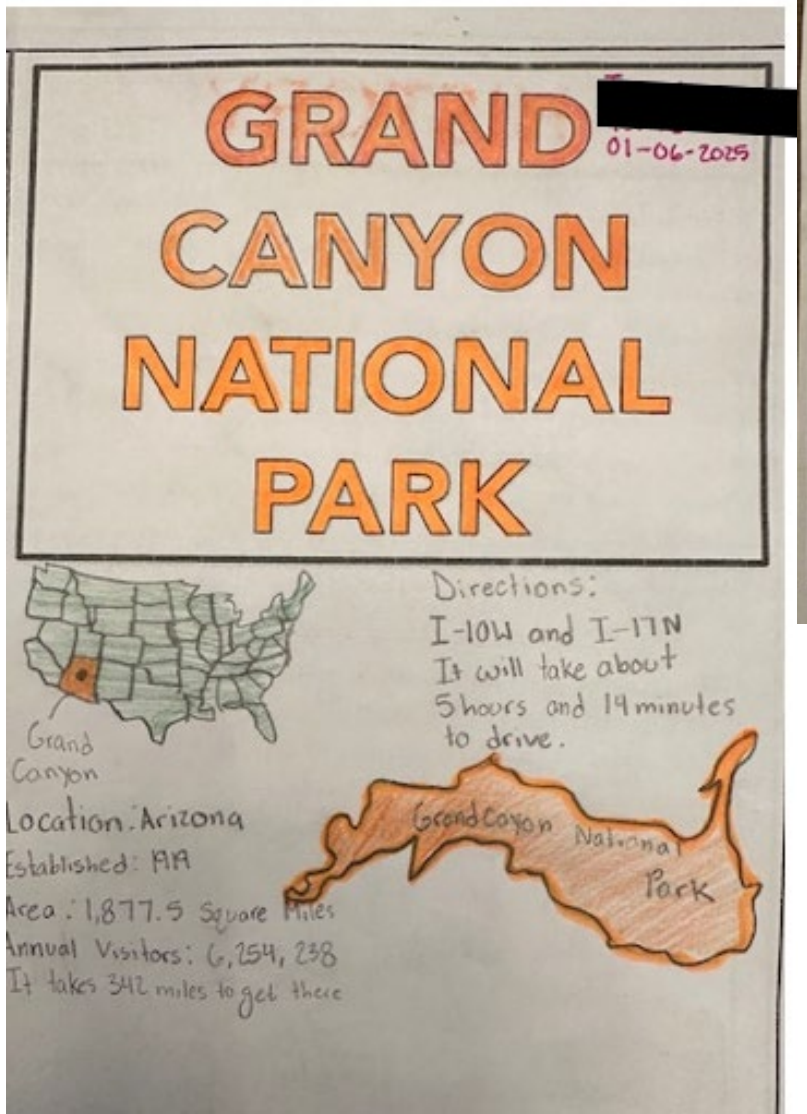
Student Work:

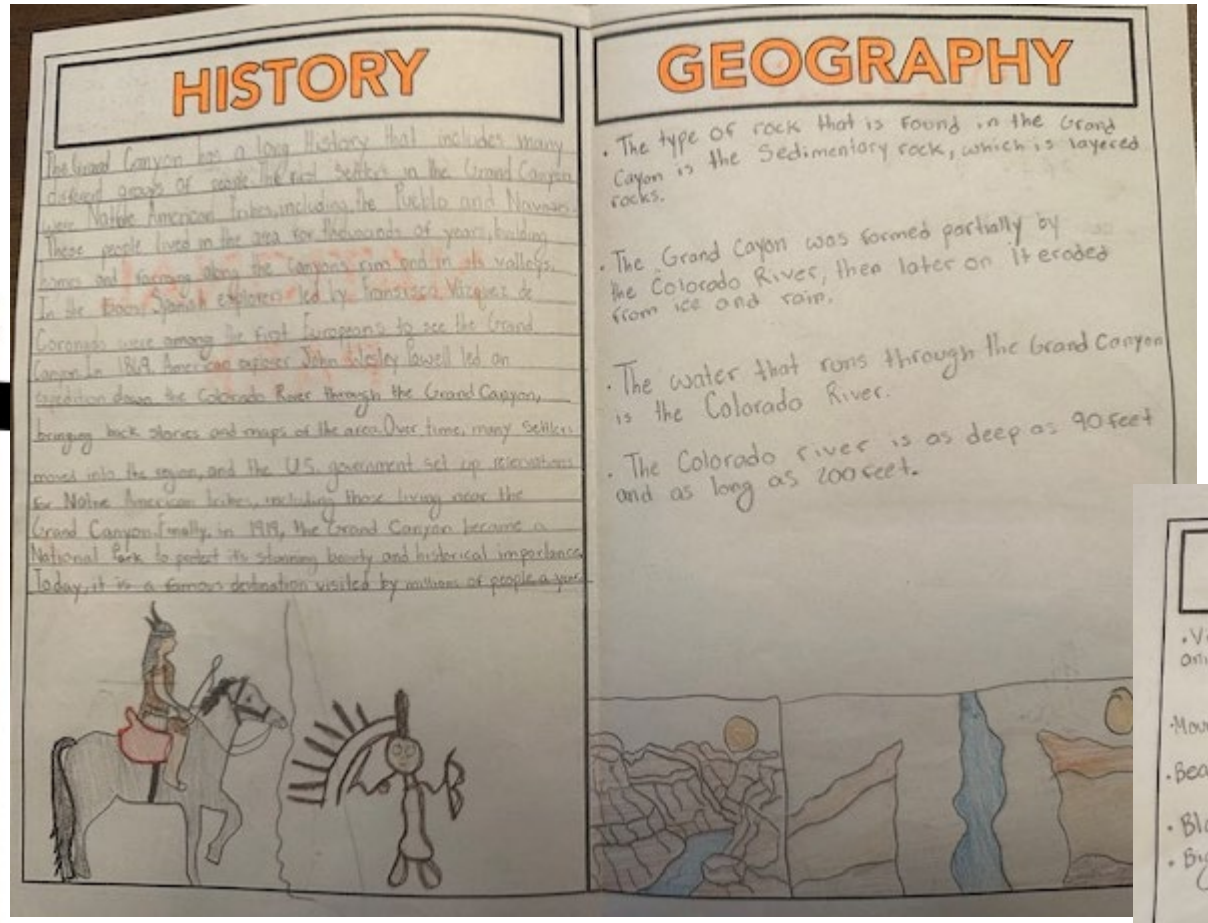


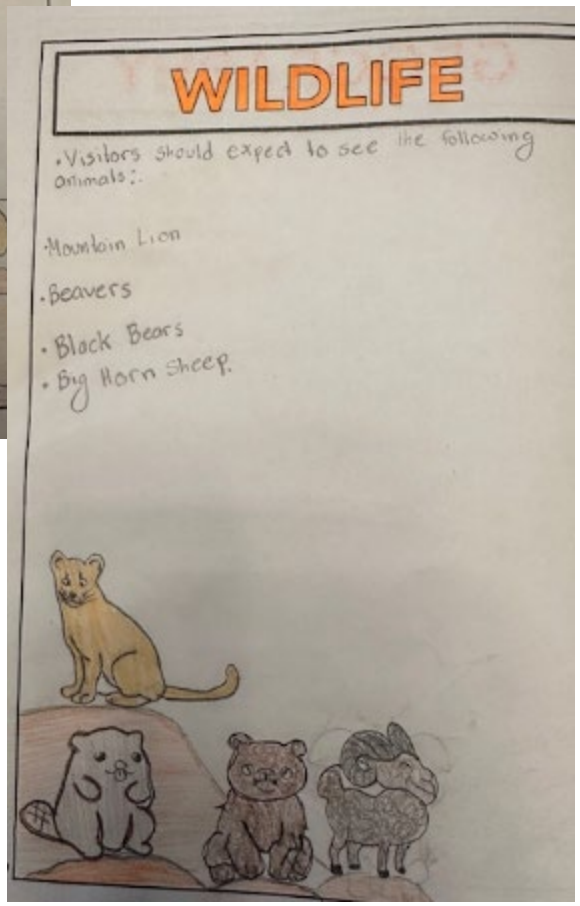




Student Work:







Lesson 4

Learning Target:

-I am learning about the Colorado River, Central Arizona Project (CAP), reclaimed water and its importance to Tucson.

Success Criteria:

-I can explain the impact CAP and reclaimed water has on Tucson's water supply.

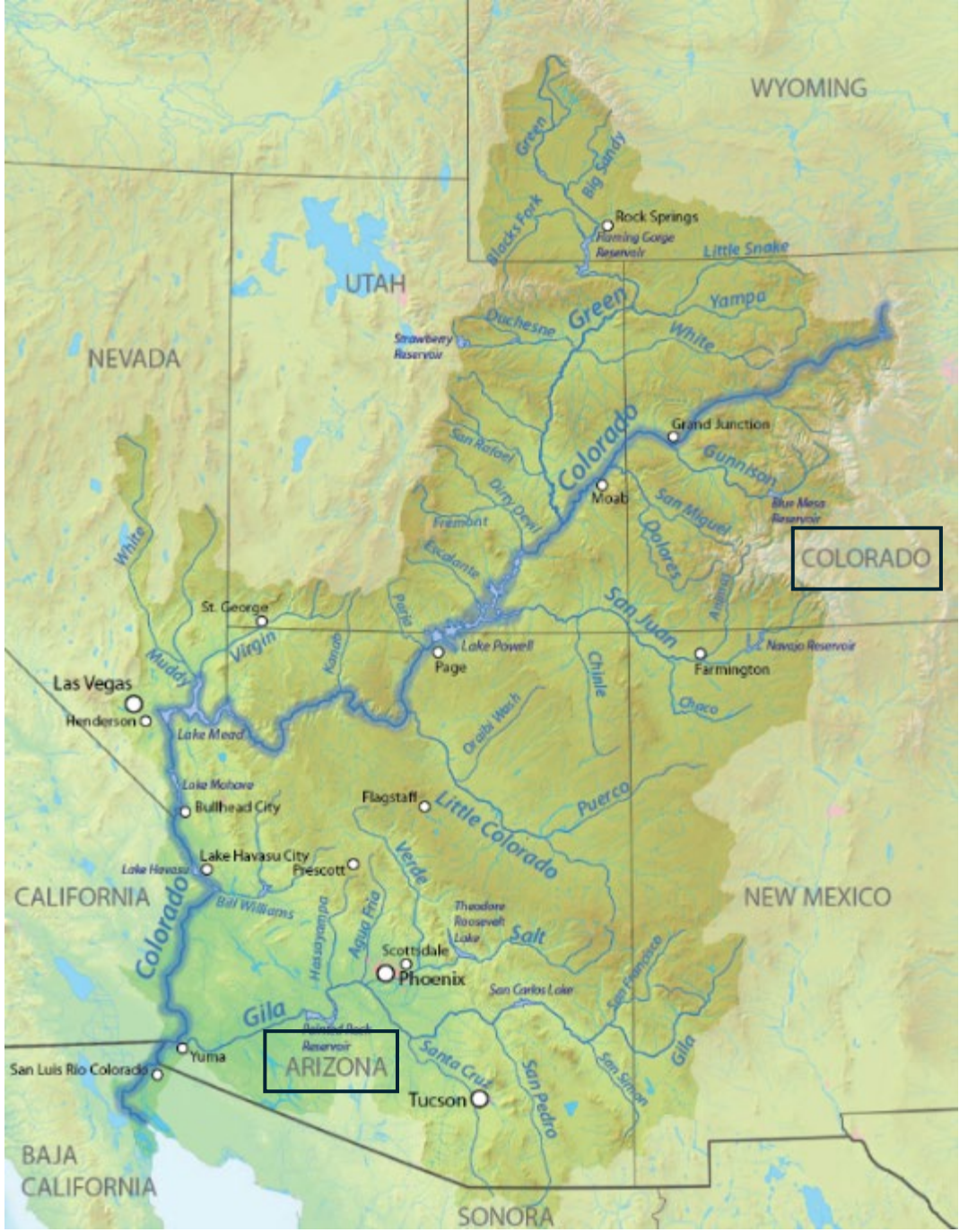
-I can explain how Tucson's water supply has changed over time.

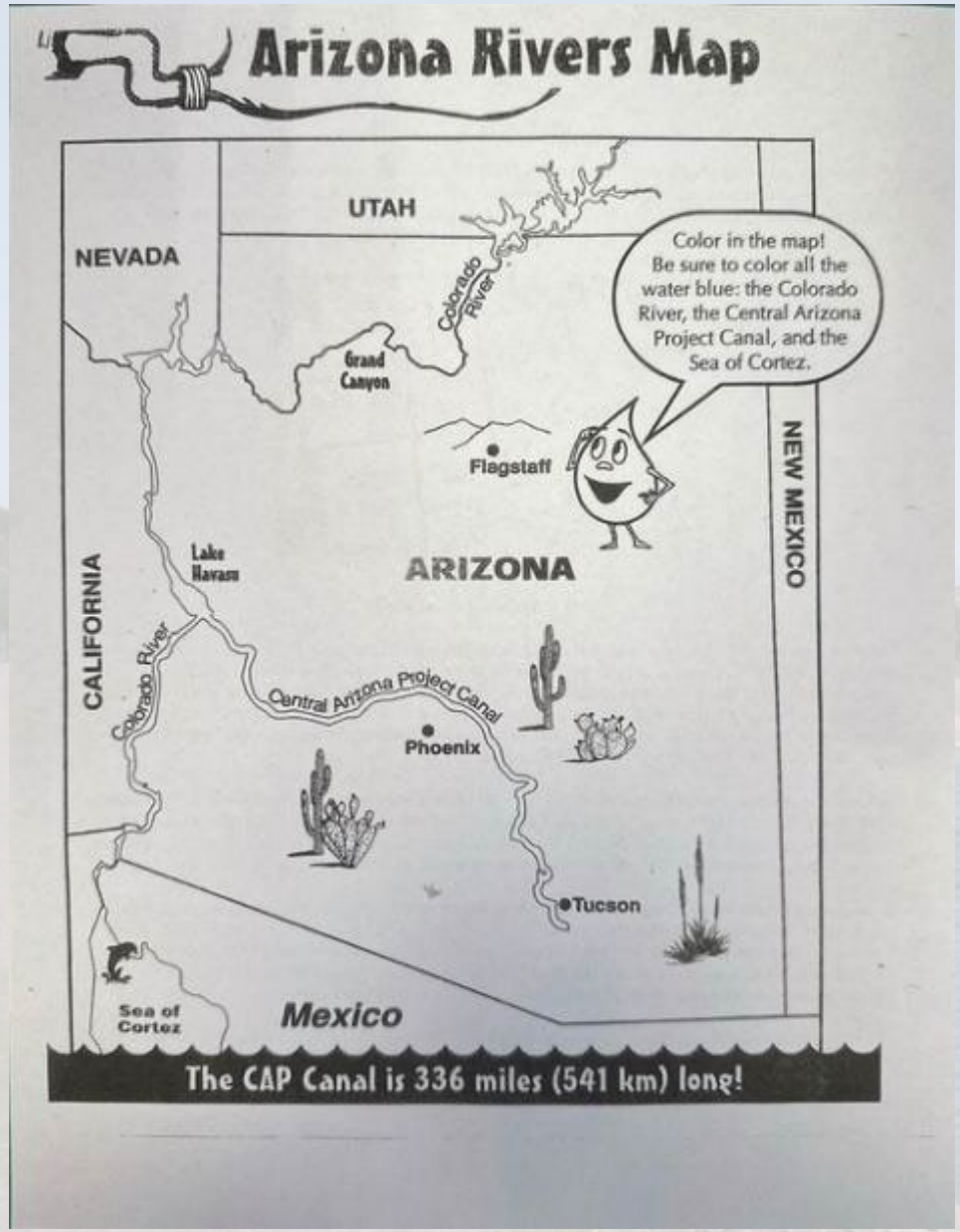
The Colorado River Video

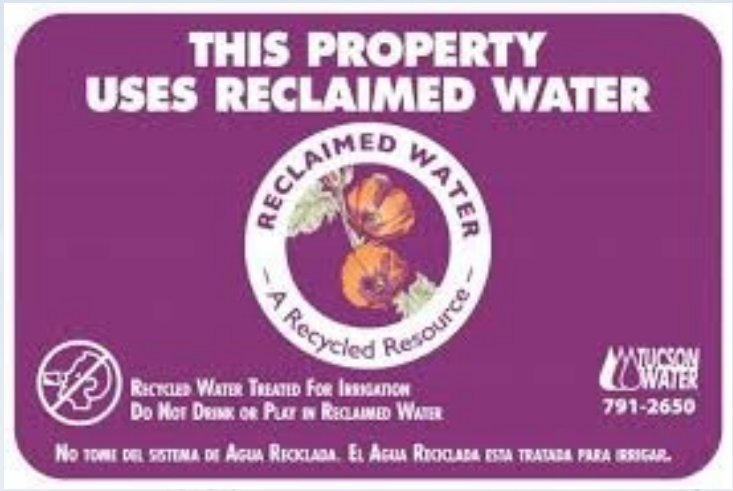
https://santacruz.arizona.edu/sites/default/files/2025-04/Tucson-Water-Unit-Slide-43-Video.mp4

Colorado River

- Before CAP (Central Arizona Project)




Arizona Rivers Map
UTAH
NEVADA
Colorado River
Grand Canyon
Color in the map! Be sure to color all the water blue: the Colorado River, the Central Arizona Project Canal, and the Sea of Cortez.
Flagstaff
NEW MEXICO
CALIFORNIA
Lake Havasu
ARIZONA
Colorado River
Central Arizona Project Canal
Phoenix
Tucson
Sea of Cortez
Mexico
The CAP Canal is 336 miles (541 km) long!


THIS PROPERTY
USES RECLAIMED WATER
RECLAIMED WATER
A Recycled Resource
Recycled Water Treated For Irrigation
Do Not Drink or Play in Reclaimed Water
TUCSON WATER
791-2650
No tome del sistema de Agua Reciclada. El Agua Reciclada esta tratada para irrigar.


DODGE
MIDDLE SCHOOL

Reclaimed Water Video

https://www.youtube.com/watch?v=ist-8l5cfSc

Reclaimed Water (purple pipes)

Lesson 5

Learning Target:

I am learning about Tucson's groundwater so I can appreciate the water I drink.

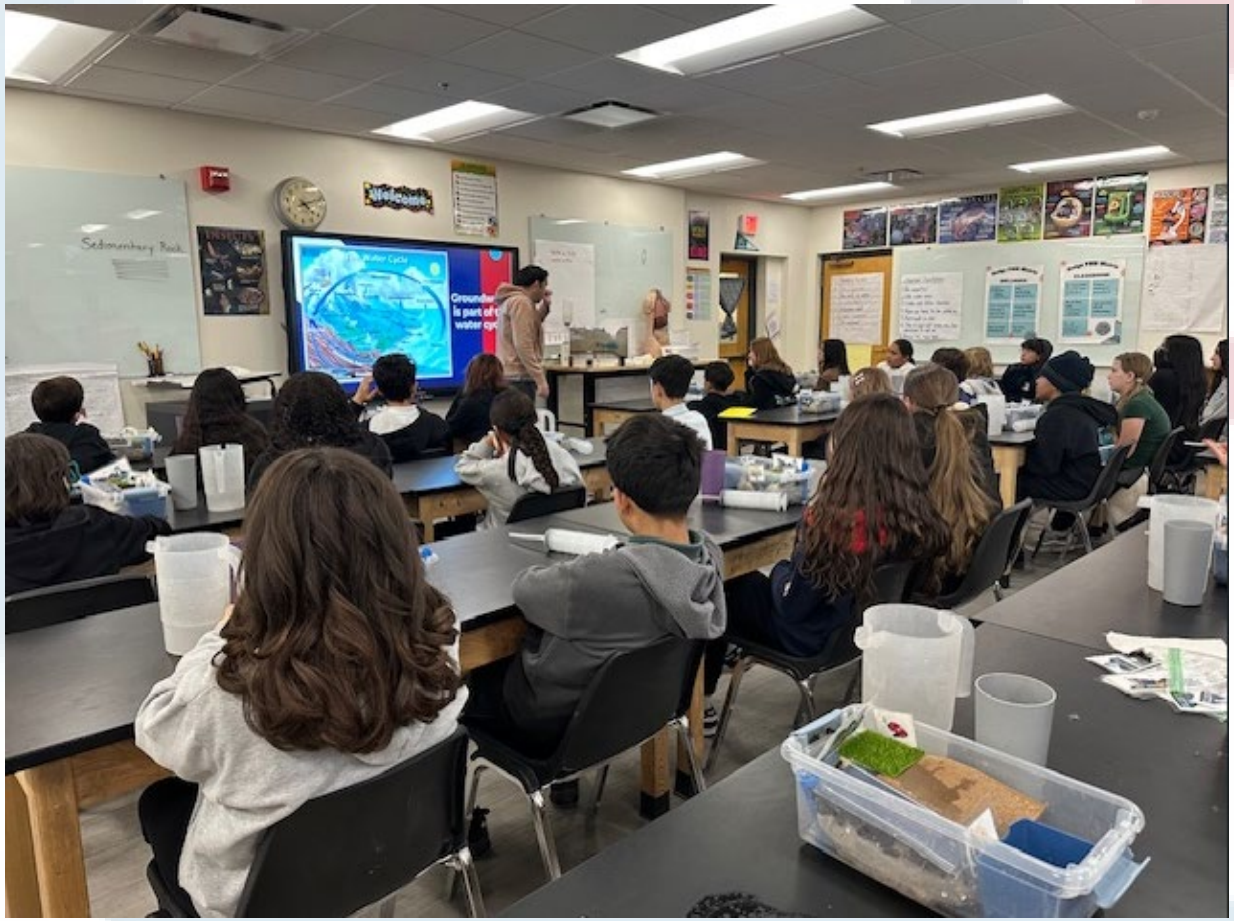
Success Criteria:

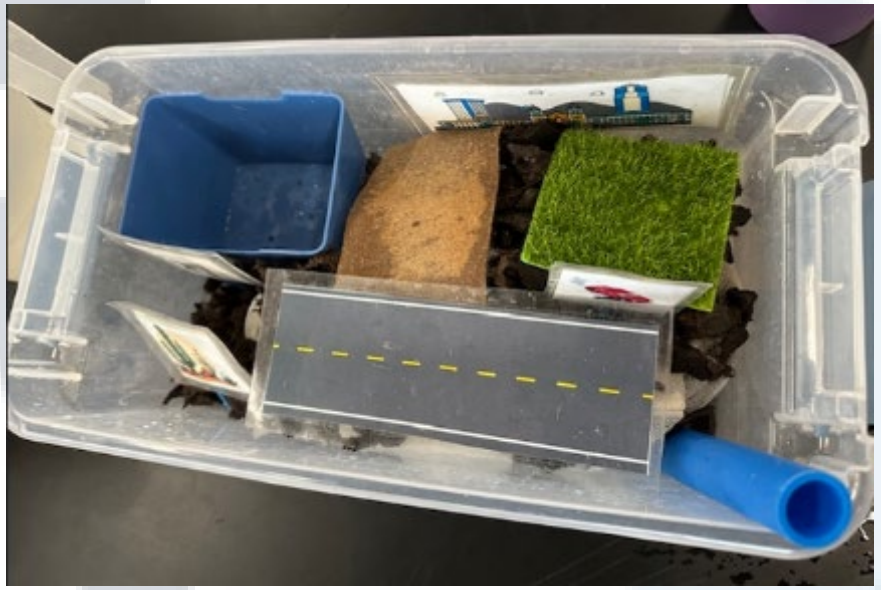
-I can explain how groundwater is pumped and delivered to our homes.

-I can explain how reclaimed water helps us save drinking water in Tucson.

-I can explain how dumping chemicals on the ground pollutes our groundwater.

Arizona Project Wet with Lexi and Brian





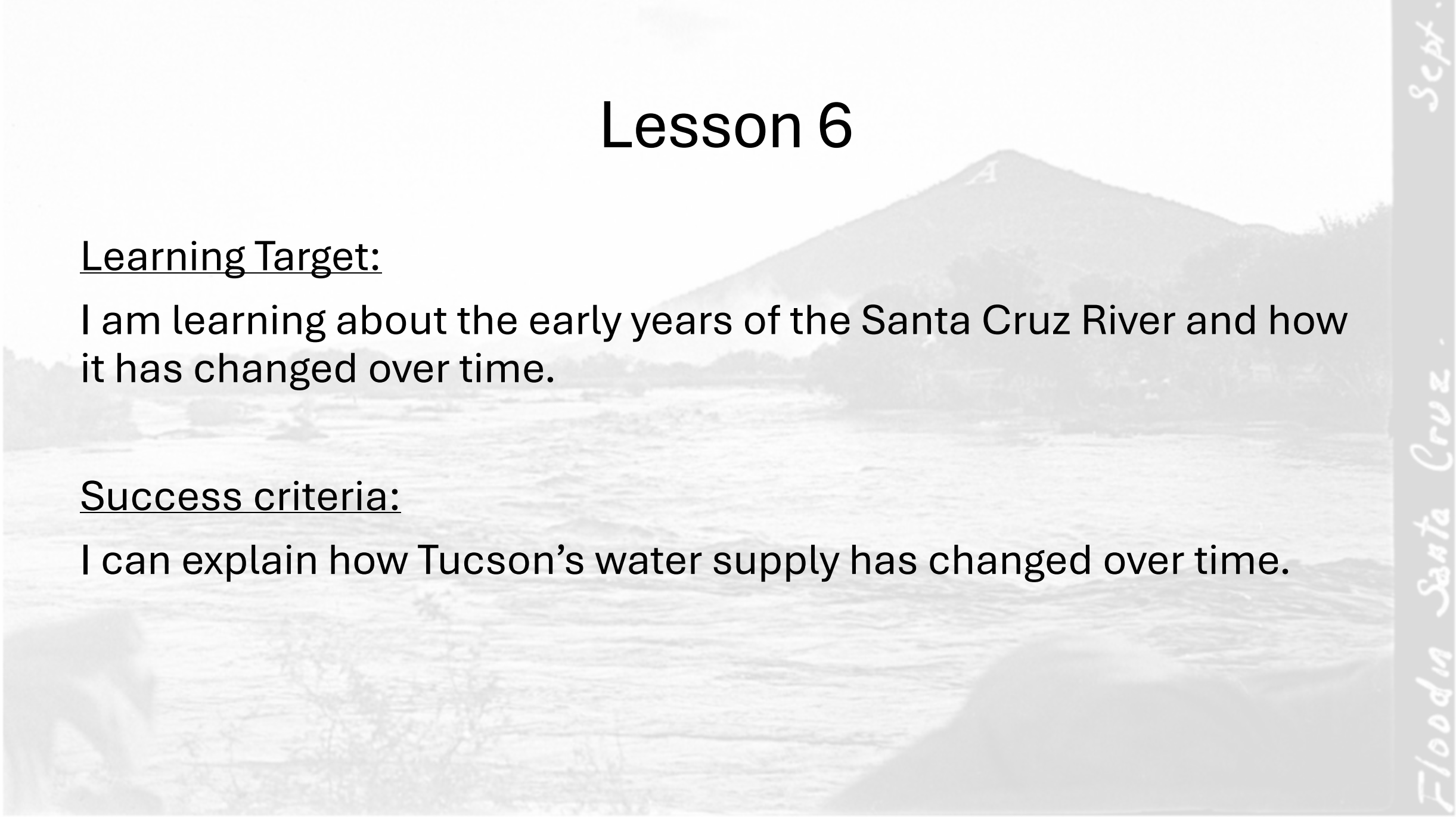
Lesson 6

<u>Learning Target:</u>

I am learning about the early years of the Santa Cruz River and how it has changed over time.

<u>Success criteria:</u>

I can explain how Tucson's water supply has changed over time.



Flooding of the Santa Cruz River, Tucson, in September, 1926, from "Letters from Tucson, 1925-1927" by Ethel Stiffler.

Questions to Deepen Your Thinking

1. What do you wonder about the relationship that Native Americans, such as the Hohokam, had with water?

2. In what ways, did Native Americans use science to improve their lives?

3. How did Native Amercans apply engineering practices to solve problems?

4. Why did the level of surface water in the Santa Cruz River go down as the population of Tucson grew?

5. What is the relationship between the river and groundwater?

6. From your perspective, what is the significance of having water in the Santa Cruz River in downtown Tucson?

Flooding of the Santa Cruz River, Tucson, in September, 1926, from "Letters from Tucson, 1925-1927" by Ethel Stiffler.

No Place for Isolation: Life in the Desert

https://www.youtube.com/watch?v=gvlNgqQJLGI

Flooding of the Santa Cruz River, Tucson, in September, 1926, from "Letters from Tucson, 1925-1927" by Ethel Stiffler.

Photos

30+ historic photos of the Santa Cruz River through Tucson

Rick Wiley Jul 28, 2023 Updated May 28, 2024

The Santa Cruz River was the lifeblood of Tucson for early Native Americans, the Spanish Conquistadores and early American settlers. It languished for years and became dry most of the year as the water table dropped.

It also became a neglected trench and trash heap. City leaders envisioned something better. By the early 1970s, the Army Corps of Engineers was studying the feasibility of channeling the river and creating a park. In 1977, work began.

Flooding of the Santa Cruz River, Tucson, in September, 1926, from "Letters from Tucson, 1925-1927" by Ethel Stiffler.

The Santa Cruz River 1926

Flooding of the Santa Cruz River, Tucson, in September, 1926, from "Letters from Tucson, 1925-1927" by Ethel Stiffler.

Courtesy Roger E. Carpenter

Flooding of the Santa Cruz River, Tucson, in September, 1926, from "Letters from Tucson, 1925-1927" by Ethel Stiffler.

New way of using Reclaimed Water: The Santa Cruz Heritage Project

Johnny Dearmore skips a rock in the Santa Cruz River as reclaimed water is released into the channel at 29th Street as part of the Santa Cruz River Heritage Project on June 24, 2019. The release of effluent is the city's first effort to restore a fraction of the river's flow since groundwater pumping dried it up in the 1940s.

Lesson 7

Learning Target:

I am learning about the early years of the Santa Cruz River and how Agua Nueva Reclamation Facility is doing to rebuild the Santa Cruz River.

Success criteria:

I can explain what the Agua Nueva Reclamation Facility does and how it is rebuilding the Santa Cruz river.

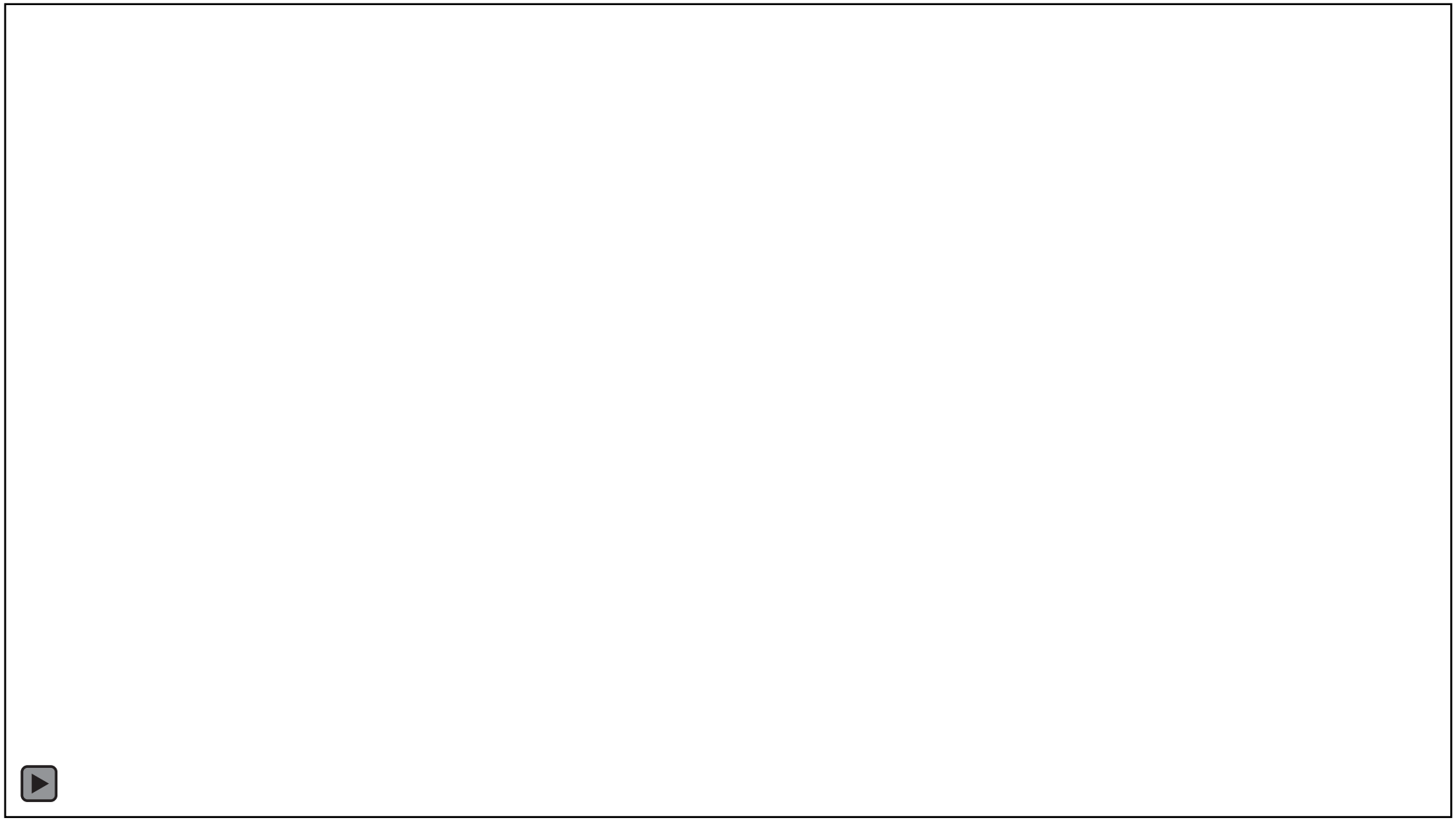
Agua Nueva Water Reclamation Facility Video

https://www.youtube.com/watch?v=vcR2bzcSQ5o

Agua Nueva Water Reclamation Facility

Agua Nueva Reclamation Facility

Agua Nueva Water Reclamation Facility



Santa Cruz river being recreated through reclaimed water

Heritage

Crossroads at Silverbell District Park

The Santa Cruz River being recreated though reclaimed water

Sunset

Tangerine

Lesson 8

Learning Target:

I can explain and create a timeline about Tucson's Water history.

Success criteria:

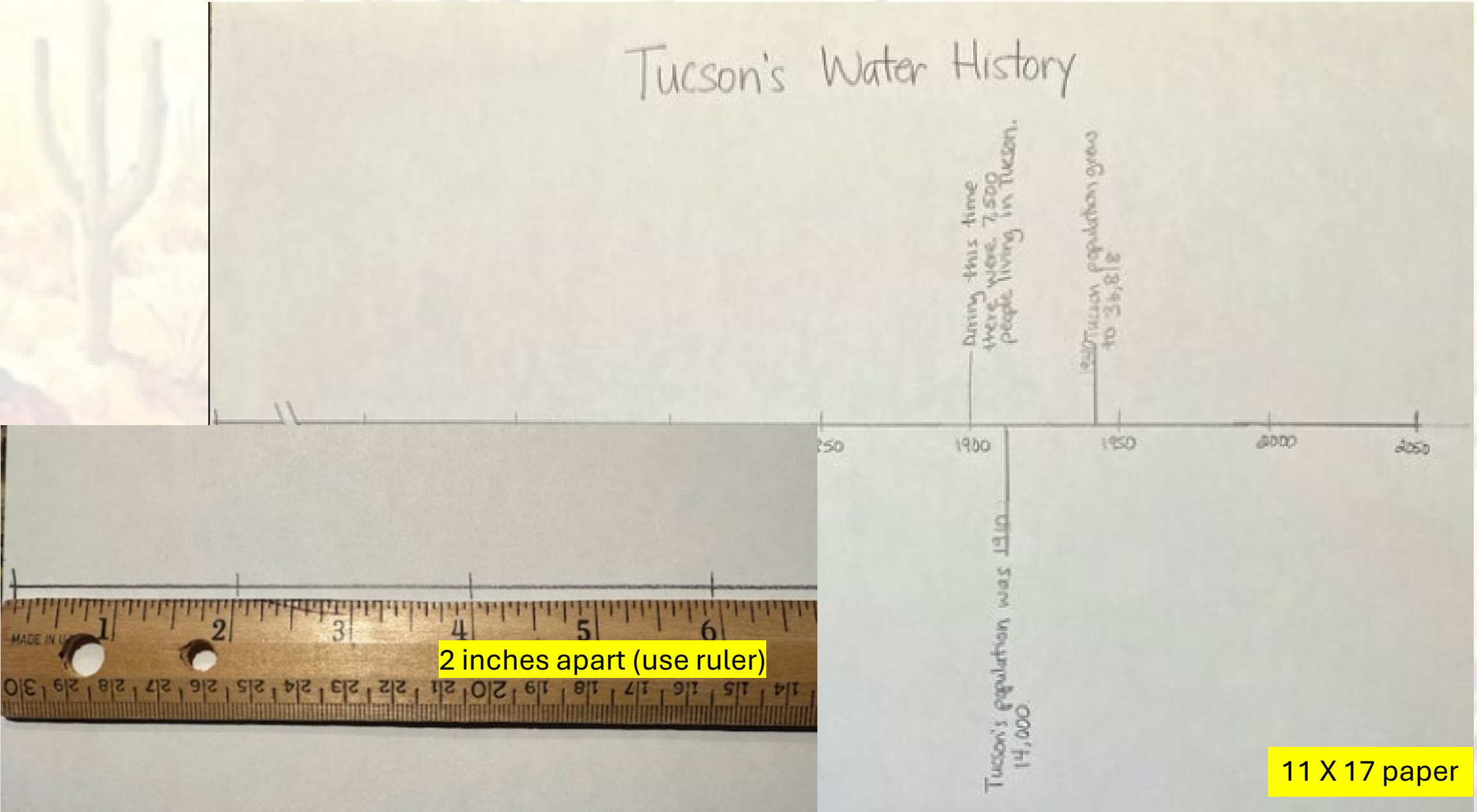
-I can explain how the Hohokam people used the Santa Cruz River to grow their crops.

-I can explain how Tucson's population grew over time.

-I can explain why the Santa Cruz River stopped flowing.

-I can explain how reclaimed water is bringing back the Santa Cruz River.

Timeline


Tucson's Water History
During this time there were 7,500 people living in Tucson.
Tucson's population grew to 34,818
1900
1950
2000
2050
Tucson's population was 1910 at 14,000
2 inches apart (use ruler)
11 X 17 paper

Tucson's Water History

Map to Tucson's Water history

~200 mid ~1400s

For thousands of years, the Hohokam lived near the base of the Tucson Mountains, close to the Santa Cruz River, which flowed year-round. They built irrigation canals to channel water from the river to the fields and villages. The Hohokam figured out when best to plant seeds and harvest their crops.

The Tohono O'odham, or desert people, and the Akimel O'odham, or river people are the descendants of the Hohokam.

~mid 1700s

In 1775, Spanish settlers founded the Presidio San Agustin del Tucson, with just a couple hundred people living within the fort. The settlers carried buckets of water from the always flowing river.

~mid 1800s

People continued to move to Tucson, traveling via horse and wagon, and later, by trains! They lived further from the river and got their water from shallow wells dug by hand. Water was also delivered in canvas bags carried on donkeys, or later in horse-drawn metal-lined carts.

1882-early 1900s:

The Tucson Water Company, known today as Tucson Water, pumped the first piped water to homes and businesses in 1882. By 1900, there were 7,500 people living in Tucson.

By 1910, Tucson's population had doubled to approximately 14,000 people and in 1940 its population increased to 36,818.

1950s:

Technology improved as Tucson's population and industry continued to grow. This meant that more water wells were drilled faster and deeper. By this time the Santa Cruz River gradually stopped flowing year around.

1970s-1990s:

By this time people started to realize that their water usage couldn't keep up with their water demand, so Tucson began to plan for the future. In 1973, the construction of the Central Arizona Project (CAP) began at Lake Havasu, and it was completed twenty years later south of Tucson. This entire project cost over $4 billion to construct the 336-mile canal.

CAP helps deliver water from the Colorado River to Tucson. Approximately 80% of the water we use comes from CAP and 20% comes from groundwater. However, both waters are mixed and stored together in the aquifers and later pumped to homes.

In 1984, Tucson started to reuse its water by filtering it, cleaning it and then using it for irrigation purposes in schoolyards, parks, and golf courses. This water is called reclaimed water. This reclaimed water does not go through the same rigorous testing that drinking water goes through. This water cannot be used for drinking purposes. If this water is not needed at any time, it is stored in aquifers to be used in the future. So far there are 1000 customers in Tucson that use reclaimed water for their irrigation.

Today:

Almost 1 million people live in the Tucson area, using groundwater, Colorado River water, reclaimed water, and harvested rainwater. In 2019, the wastewater treatment facility called Agua Nueva Reclamation Facility (build in 2013) started to discharge 5% or 2.8 million gallons per day of its reclaimed water to the Santa Cruz River Heritage Project. This discharge allows Tucson to recreate the ecosystem that existed before the river dried out. We can appreciate the riparian plants (plants that grow along the river or body of water), as well as the fish, birds, turtles, and all the insects that live along the Santa Cruz River (we will visit the Santa Cruz River in our upcoming field trip).

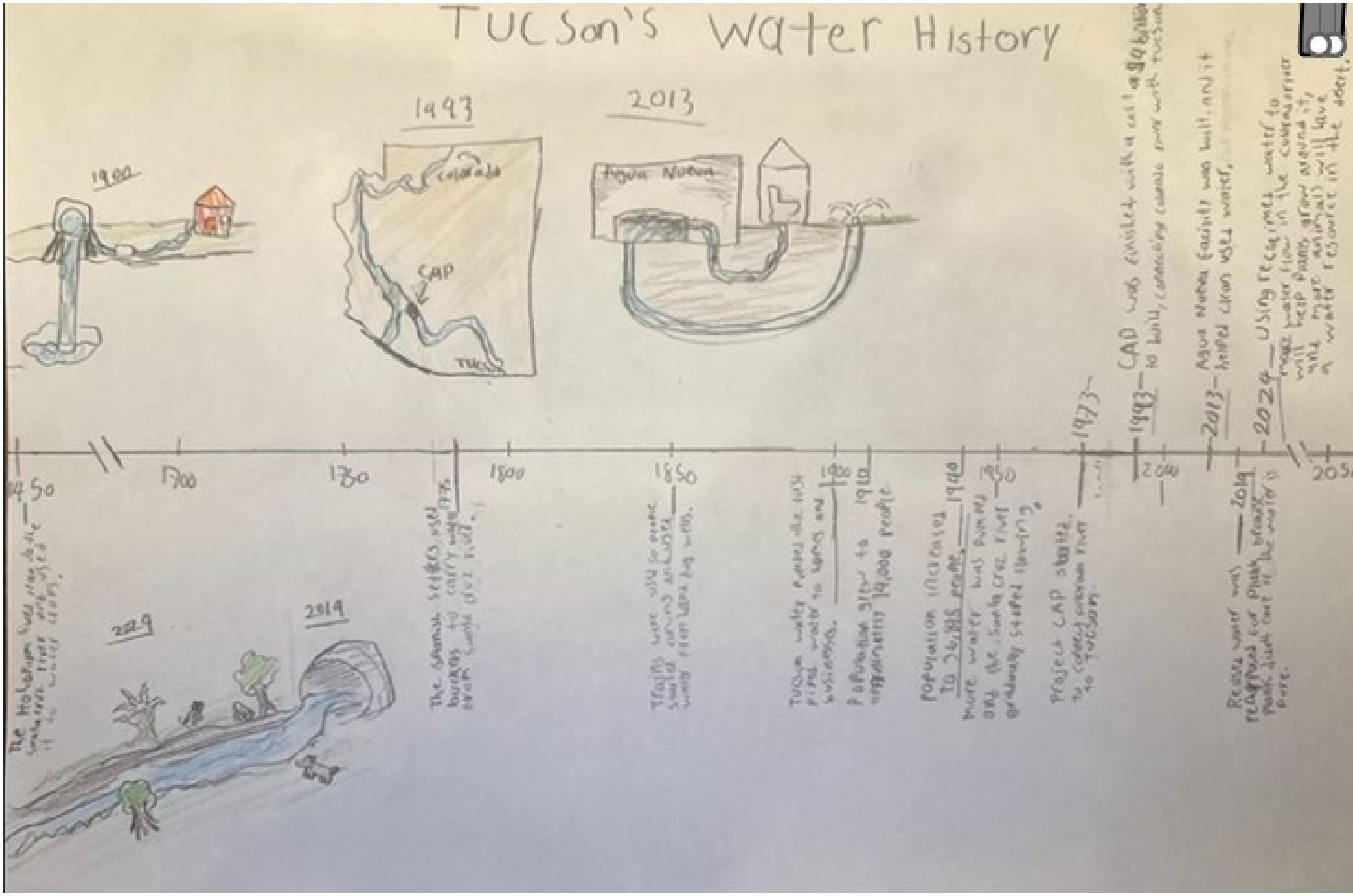
The Agua Nueva Reclamation Facility sends 95% of the effluent water to Tucson Water and they send it to the aquifers as recharge credit for later use.

Tucson's Water History

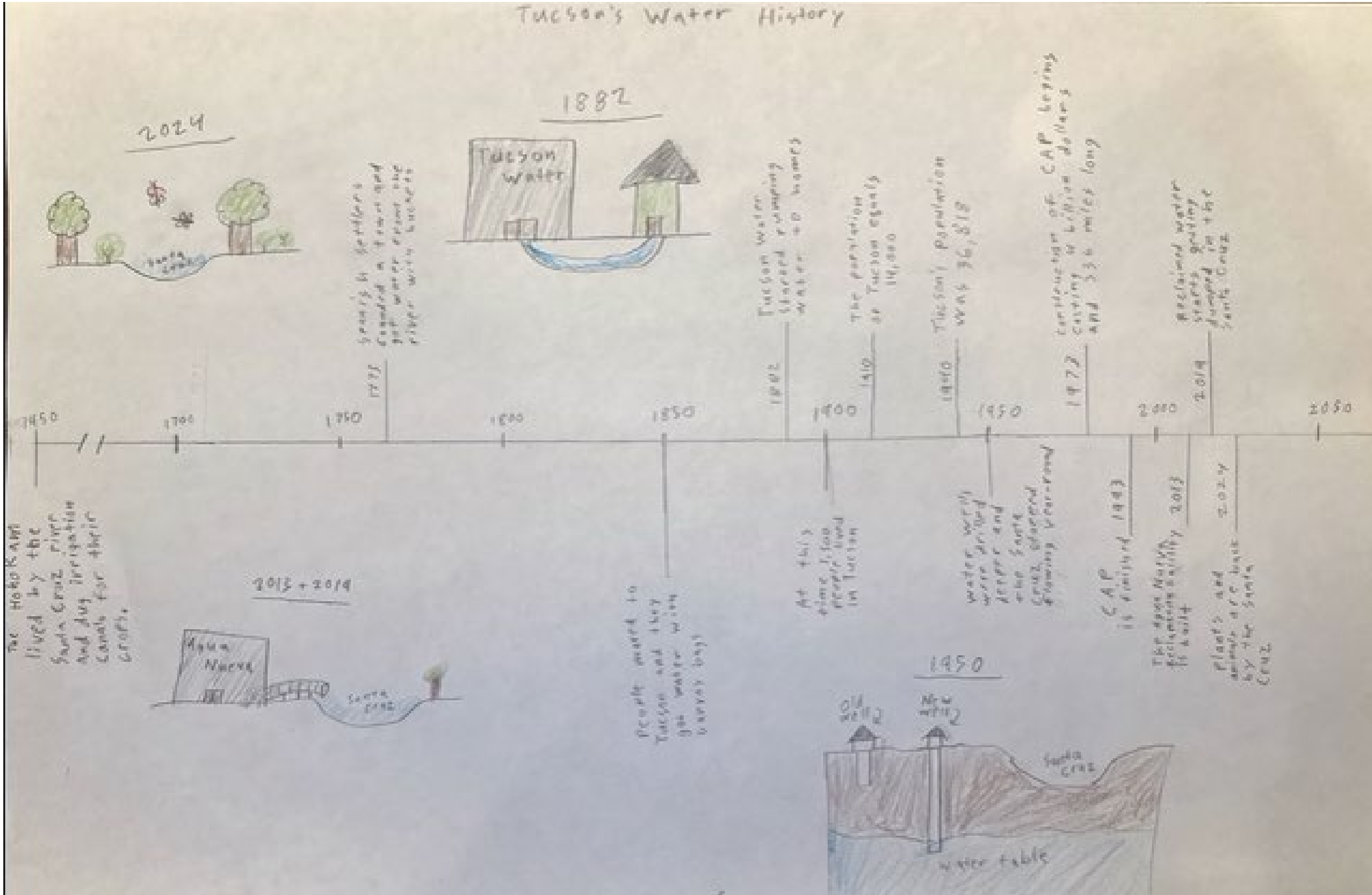
Directions: 1. Using the reading "Map to Tucson' Water history" located in *Canvas* (or in the back of this paper) write the importance of these years incomplete sentences. The questions are meant to help you focus on what to write. The writing needs to be in your own words and in complete sentences. 2. You also need at least five drawings highlighting Tucson's water history (you pick the years you want to illustrate in your timeline).

Year	What happened during this year
1450	Who lived here and how did they grow their crops?
1775	What did the Spanish settlers do and how did they gather water?
1850	How did Tucson's population grow and how did they obtain water?
1882	What did *Tucson Water* do?
1900	How many people lived in Tucson this year?
1910	How many people lived in Tucson this year?
1940	How many people lived in Tucson this year?
1950	What happened to the water wells? What happened to the Santa Cruz River?
1973	What was constructed during this time? Why was this needed? How much did it cost and how big was the canal?
1984	What did Tucson do to save drinkable water and where does this water go?
1993	What started to flow in Phoenix and Tucson? (hint: starts at Lake Havasu)
2013	What was built this year and why is this facility important?
2019	There is a new way of using reclaimed water. What is it? Explain.
2024	What are the benefits of discharging reclaimed water into the Santa Cruz River?

Student Work:



Student Work:



Lesson 9

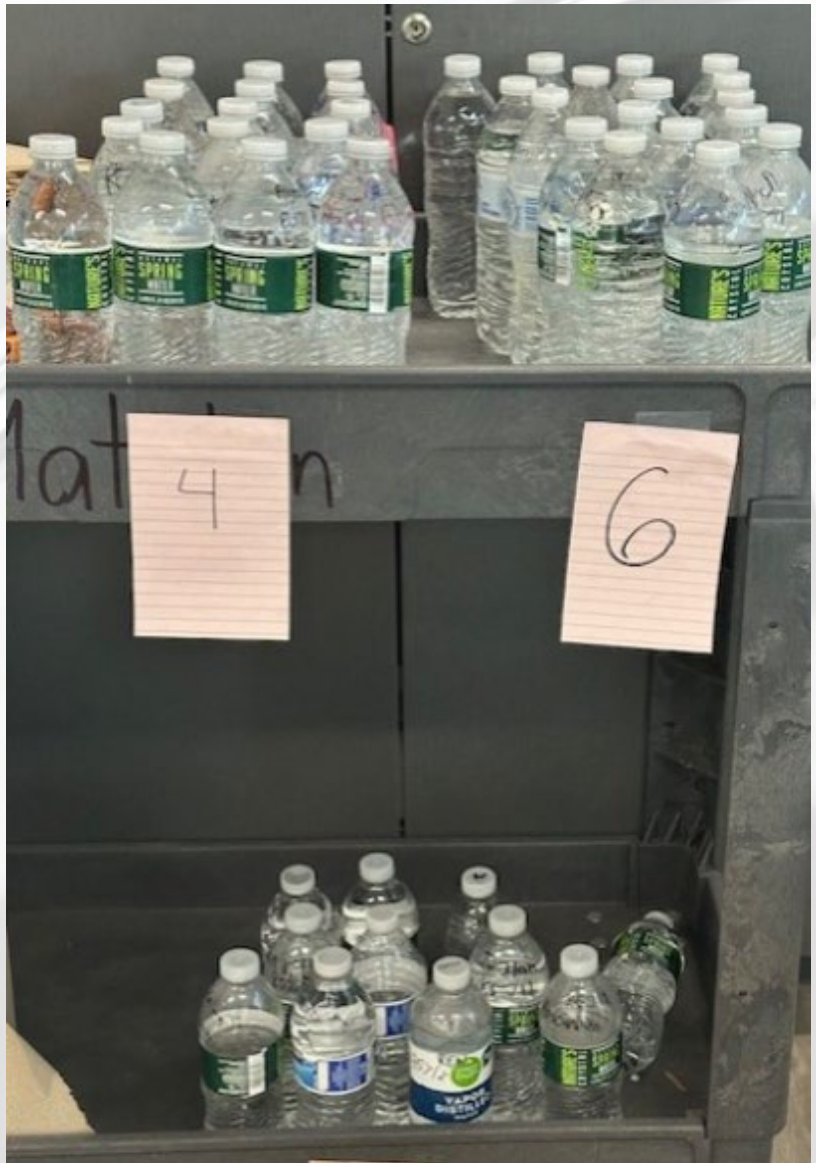
<u>Learning Target:</u>

I am learning what is in my tap water so I can appreciate what *Tucson Water* does.

<u>Success criteria:</u>

I can explain what is in tap water and if my tap water is safe to drink.

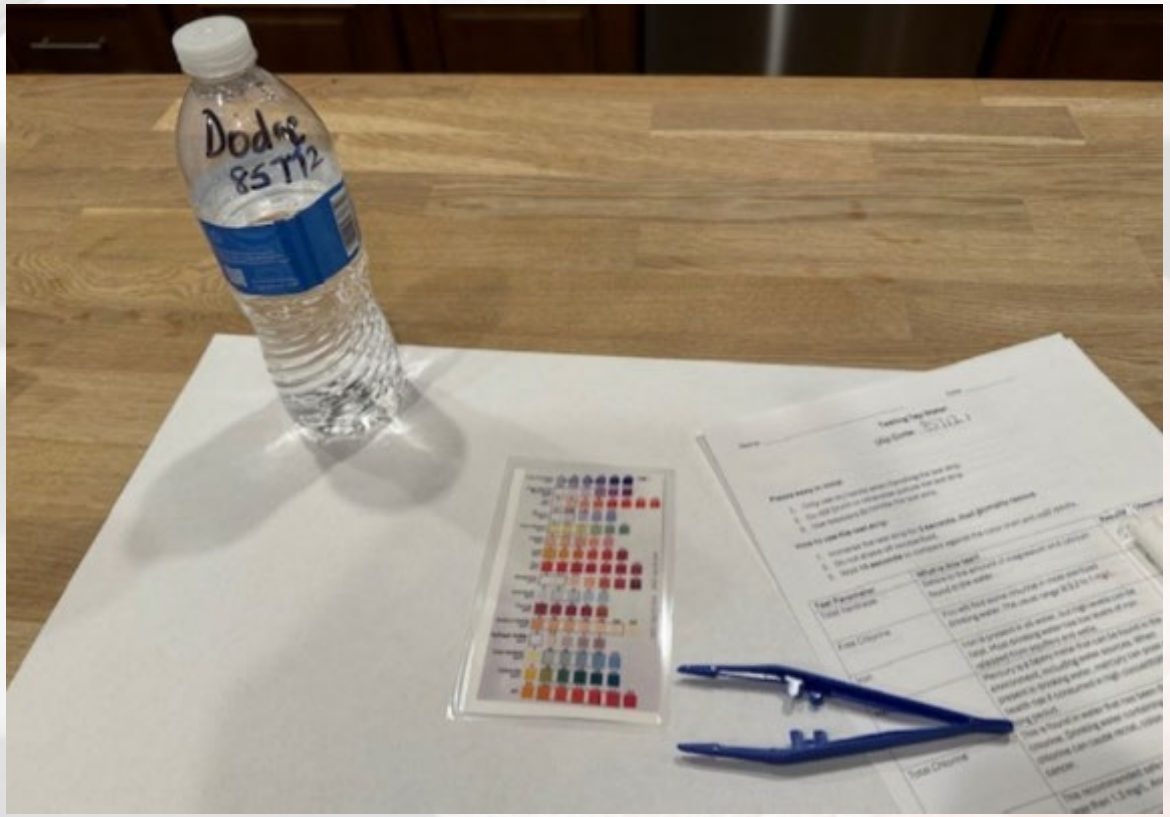
Student’s tap water



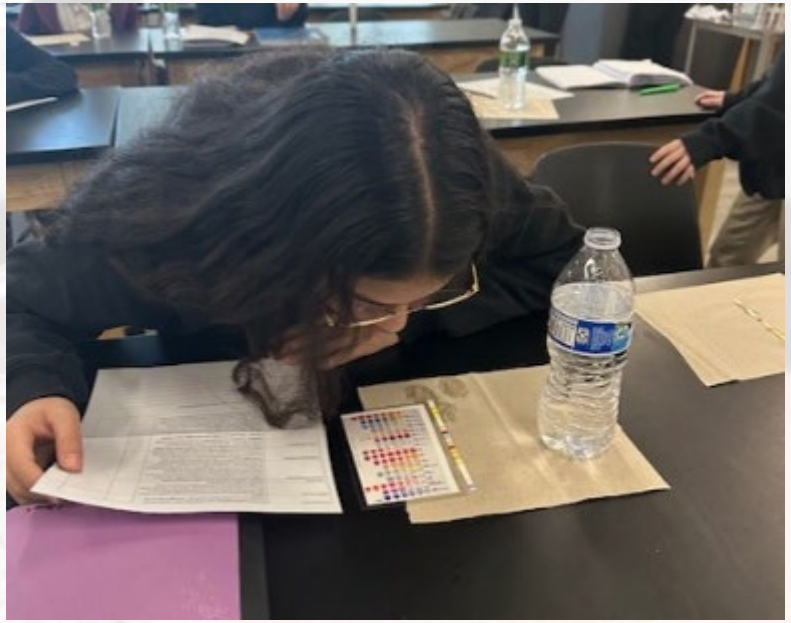
Drinking Water Test Kit

Test Parameter	Normal Range
Total hardness (ppm)	**Any**
Free Chlorine (ppm)	**0(0)** or **0.5(1)** or **1(2)** or **3(6)**
Iron (ppm)	**0** or **5**
Mercury (ppm)	**0** or **0.002**
Total Chlorine (ppm)	**0** or **0.5** or **1** or **3**
Copper (ppm)	**0** or **0.5** or **1**
Lead (ppm)	**0**
Zinc (ppm)	**0** or **2** or **5**
Manganese(ppm)	**0** or **0.1**
QAC/QUAT (ppm)	**5** or **10**
Floride (ppm)	**0**
Sodium Chloride(ppm)	**0** or **50** or **75** or **100** or **150** or **250**
Hydrogen Sulfide (ppm)	**0**
Total Alkalinity (ppm)	**40** or **80** or **120** or **180**
Carbonate (ppm)	**40** or **80** or **120**
pH	**6.4** or **6.8** or **7.2** or **7.6** or **8.2**


Total Hardness ppm
Free Chlorine (Branching) ppm
Iron ppm
Mercury ppm
Total Chlorine ppm
Copper ppm
Lead ppm
Zinc ppm
Manganese ppm
QAC/QUAT ppm
Fluoride ppm
Sodium Chloride ppm
Hydrogen Sulfide ppm
Total Alkalinity ppm
Carbonate ppm
pH
MFG: Sep.03.2024
EXP: Sep.04.2026


Dodge
85772

Testing our Tap Water



Name: _____ Date: _____

Testing Tap Water

(Zip Code: _____)

Please keep in mind:

1. Only use dry hands when handling the test strip.
2. Do not touch or otherwise pollute the test strip.

How to use the test strip:

1. Immerse the test strip for **2 seconds, then promptly remove**.
2. Do not shake off excess fluid.
3. Wait **15 seconds** to compare against the color chart and read results.

Test Parameter	What is this test?	Results	Observations
Total hardness	Refers to the amount of magnesium and calcium found in the water.		
Free Chorine	You will find some chlorine in most sterilized drinking water. The usual range is 0.2 to 1 mg/L.		
Iron	Iron is present in all water, but high levels can be fatal. Most drinking water has low levels of iron released from aquifers and wells.		
Mercury	Mercury is a heavy metal that can be found in the environment, including water sources. When present in drinking water, mercury can pose a health risk if consumed in high concentration over a long period.		
Total Chlorine	This is found in water that has been disinfected by chlorine. Drinking water containing high levels of chlorine can cause rectal, colon, and bladder cancer.		
Copper	This recommended safe level for drinking water is less than 1.3 mg/L. Anything above this is harmful to humans.		
Lead	The release of lead is usually caused by corrosion of the pipe network and excess lead found in faucets as well. Excessive lead is harmful to the body and causes damage to the kidney, liver, and blood systems.		
Zinc	Zinc is an essential mineral for human health and is required in small amounts, excessive levels of zinc in drinking water can lead to adverse health effects.		
Manganese	In the United States, the EPA has set a secondary maximum contaminant level for manganese 0.05 mg/L.		
QAC/QUAT	QUAT (Quaternary Ammonium Compounds) or QAC (Quaternary Ammonium Compounds) refers to a group of chemical compounds, they are widely used as disinfectants and preservatives due to their antimicrobial properties.		
Fluoride	Water additive which promotes strong teeth.		
Sodium Chloride	High levels of sodium in drinking water can be a concern for individuals on sodium restricted diets or those with certain health conditions such as hypertension (high blood pressure) or kidney problems. It is worth noting that the sodium levels in drinking water are generally much lower compared to the amount typically consumed through food.		
Hydrogen Sulfide	Hydrogen sulfide is not considered toxic at the concentrations typically found in drinking water. However, it can cause some short-term effects like nausea and diarrhea when consumed at high levels.		
Total alkalinity	This measures water's ability to deal with hydrogen and acid ions. The base in water keeps the pH stable. If water is too alkaline, it will taste like soda water. This type of water will damage your water pipes and dry out your skin.		
Carbonate	Carbonate occurs naturally in the earth's crust. Heath effects: Too much intake can lead to nausea, vomiting, or loss of appetite.		
pH	While there is not an official guidance for pH in drinking water. A high pH affects the taste of you water and low pH makes your water more corrosive. The sanatory Standards for Drinking Water indicate drinking water should have a pH of between 6.4 and 8.2		

What conclusions can you make from your water testing sample:

_____

_____

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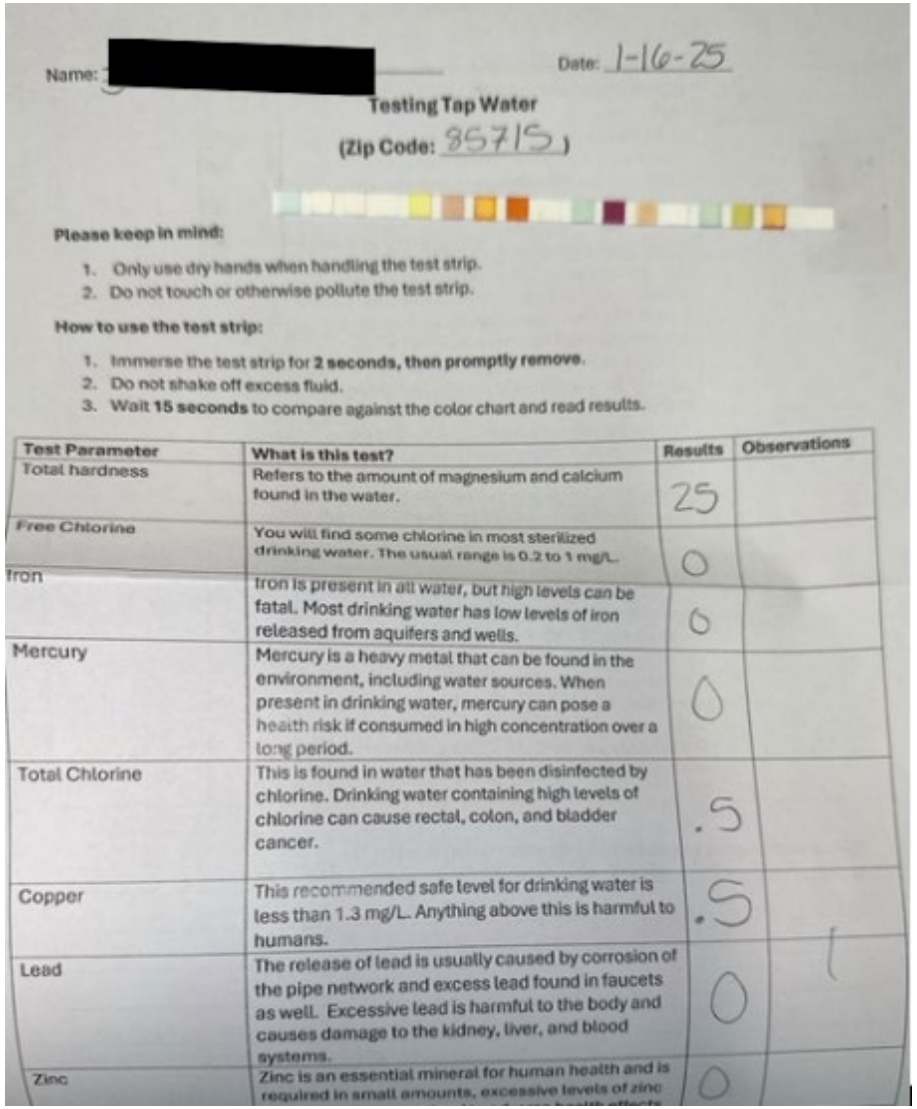
Student Work:



Name: [redacted] Date: 1-16-25

Testing Tap Water

(Zip Code: 85715)

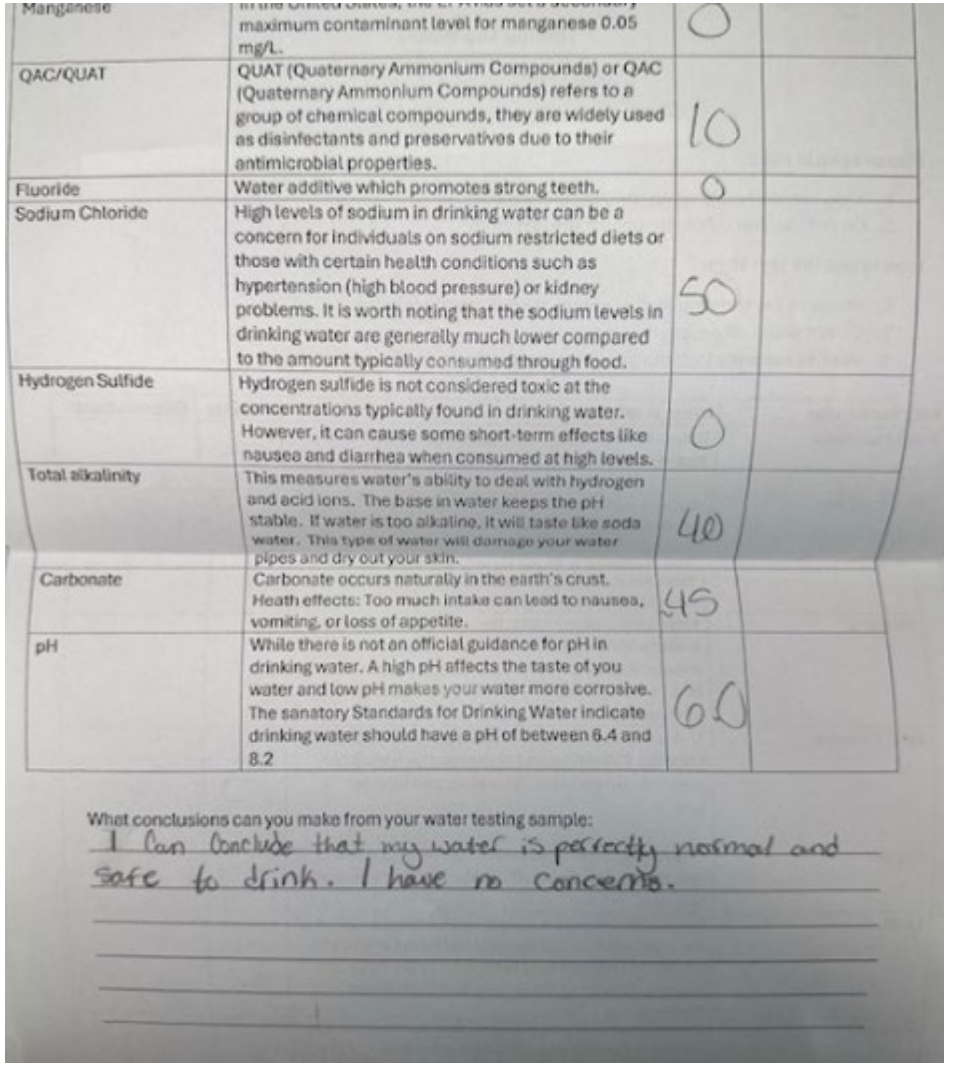
Please keep in mind:

1. Only use dry hands when handling the test strip.
2. Do not touch or otherwise pollute the test strip.

How to use the test strip:

1. Immerse the test strip for **2 seconds, then promptly remove**.
2. Do not shake off excess fluid.
3. Wait **15 seconds** to compare against the color chart and read results.

Test Parameter	What is this test?	Results	Observations
Total hardness	Refers to the amount of magnesium and calcium found in the water.	25	
Free Chlorine	You will find some chlorine in most sterilized drinking water. The usual range is 0.2 to 1 mg/L.	0	
Iron	Iron is present in all water, but high levels can be fatal. Most drinking water has low levels of iron released from aquifers and wells.	0	
Mercury	Mercury is a heavy metal that can be found in the environment, including water sources. When present in drinking water, mercury can pose a health risk if consumed in high concentration over a long period.	0	
Total Chlorine	This is found in water that has been disinfected by chlorine. Drinking water containing high levels of chlorine can cause rectal, colon, and bladder cancer.	.5	
Copper	This recommended safe level for drinking water is less than 1.3 mg/L. Anything above this is harmful to humans.	.5	
Lead	The release of lead is usually caused by corrosion of the pipe network and excess lead found in faucets as well. Excessive lead is harmful to the body and causes damage to the kidney, liver, and blood systems.	0	
Zinc	Zinc is an essential mineral for human health and is required in small amounts, excessive levels of zinc	0	

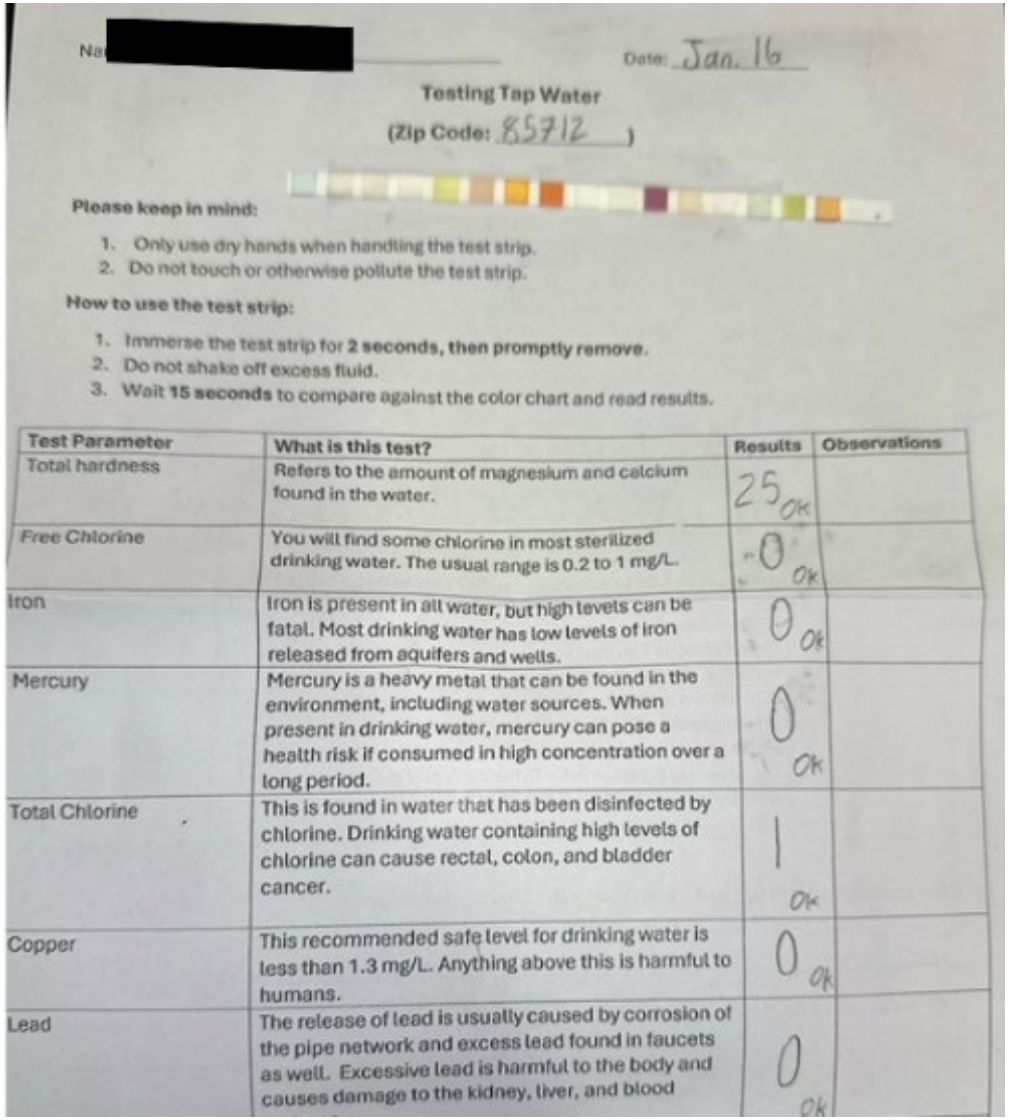


Manganese	maximum contaminant level for manganese 0.05 mg/L.	0	
QAC/QUAT	QUAT (Quaternary Ammonium Compounds) or QAC (Quaternary Ammonium Compounds) refers to a group of chemical compounds, they are widely used as disinfectants and preservatives due to their antimicrobial properties.	10	
Fluoride	Water additive which promotes strong teeth.	0	
Sodium Chloride	High levels of sodium in drinking water can be a concern for individuals on sodium restricted diets or those with certain health conditions such as hypertension (high blood pressure) or kidney problems. It is worth noting that the sodium levels in drinking water are generally much lower compared to the amount typically consumed through food.	50	
Hydrogen Sulfide	Hydrogen sulfide is not considered toxic at the concentrations typically found in drinking water. However, it can cause some short-term effects like nausea and diarrhea when consumed at high levels.	0	
Total alkalinity	This measures water's ability to deal with hydrogen and acid ions. The base in water keeps the pH stable. If water is too alkaline, it will taste like soda water. This type of water will damage your water pipes and dry out your skin.	40	
Carbonate	Carbonate occurs naturally in the earth's crust. Heath effects: Too much intake can lead to nausea, vomiting, or loss of appetite.	45	
pH	While there is not an official guidance for pH in drinking water. A high pH affects the taste of you water and low pH makes your water more corrosive. The sanatory Standards for Drinking Water indicate drinking water should have a pH of between 6.4 and 8.2	60	

What conclusions can you make from your water testing sample:

I can conclude that my water is perfectly normal and safe to drink. I have no concerns.

Student Work:



Na[redacted] Date: Jan. 16

Testing Tap Water

(Zip Code: 85712)

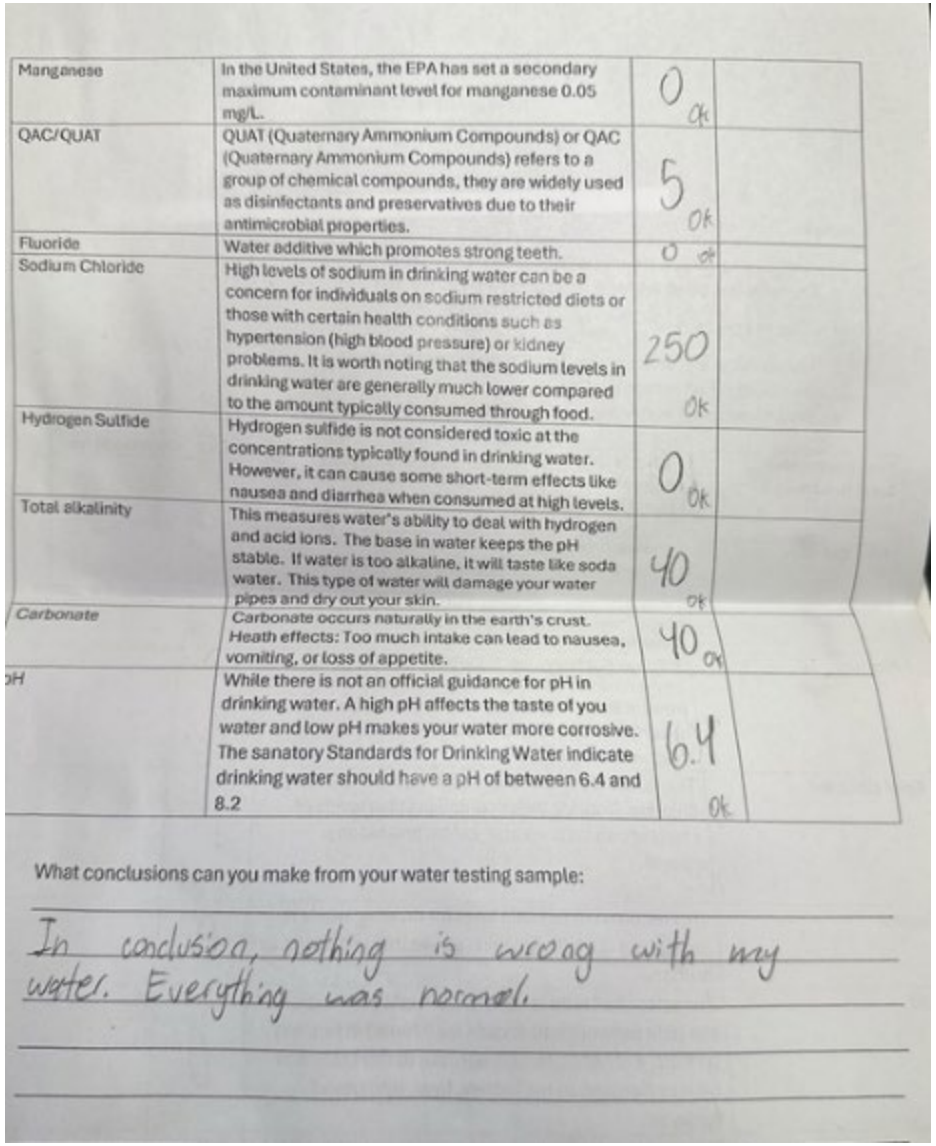
Please keep in mind:

1. Only use dry hands when handling the test strip.
2. Do not touch or otherwise pollute the test strip.

How to use the test strip:

1. Immerse the test strip for **2 seconds, then promptly remove.**
2. Do not shake off excess fluid.
3. Wait **15 seconds** to compare against the color chart and read results.

Test Parameter	What is this test?	Results	Observations
Total hardness	Refers to the amount of magnesium and calcium found in the water.	25 ok	
Free Chlorine	You will find some chlorine in most sterilized drinking water. The usual range is 0.2 to 1 mg/L.	0 ok	
Iron	Iron is present in all water, but high levels can be fatal. Most drinking water has low levels of iron released from aquifers and wells.	0 ok	
Mercury	Mercury is a heavy metal that can be found in the environment, including water sources. When present in drinking water, mercury can pose a health risk if consumed in high concentration over a long period.	0 ok	
Total Chlorine	This is found in water that has been disinfected by chlorine. Drinking water containing high levels of chlorine can cause rectal, colon, and bladder cancer.	1 ok	
Copper	This recommended safe level for drinking water is less than 1.3 mg/L. Anything above this is harmful to humans.	0 ok	
Lead	The release of lead is usually caused by corrosion of the pipe network and excess lead found in faucets as well. Excessive lead is harmful to the body and causes damage to the kidney, liver, and blood	0 ok	



Manganese	In the United States, the EPA has set a secondary maximum contaminant level for manganese 0.05 mg/L.	0 ok	
QAC/QUAT	QUAT (Quaternary Ammonium Compounds) or QAC (Quaternary Ammonium Compounds) refers to a group of chemical compounds, they are widely used as disinfectants and preservatives due to their antimicrobial properties.	5 ok	
Fluoride	Water additive which promotes strong teeth.	0 ok	
Sodium Chloride	High levels of sodium in drinking water can be a concern for individuals on sodium restricted diets or those with certain health conditions such as hypertension (high blood pressure) or kidney problems. It is worth noting that the sodium levels in drinking water are generally much lower compared to the amount typically consumed through food.	250 ok	
Hydrogen Sulfide	Hydrogen sulfide is not considered toxic at the concentrations typically found in drinking water. However, it can cause some short-term effects like nausea and diarrhea when consumed at high levels.	0 ok	
Total alkalinity	This measures water's ability to deal with hydrogen and acid ions. The base in water keeps the pH stable. If water is too alkaline, it will taste like soda water. This type of water will damage your water pipes and dry out your skin.	40 ok	
Carbonate	Carbonate occurs naturally in the earth's crust. Heath effects: Too much intake can lead to nausea, vomiting, or loss of appetite.	40 ok	
pH	While there is not an official guidance for pH in drinking water. A high pH affects the taste of you water and low pH makes your water more corrosive. The sanatory Standards for Drinking Water indicate drinking water should have a pH of between 6.4 and 8.2	6.4 ok	

What conclusions can you make from your water testing sample:

In conclusion, nothing is wrong with my water. Everything was normal.

Lesson 10

Learning Target:

I am learning about the turtles that live in the Santa Cruz River.

Success criteria:

I can make line graphs for the turtles found along the Santa Cruz River in 2022, 2023, and 2024.

Meet the Turtles of the Santa Cruz River

https://www.youtube.com/watch?v=iGJ1CMMuKNQ

Turtles that live in the Santa Cruz River

Sonoran Mud Turtle

Spiny Soft Shell

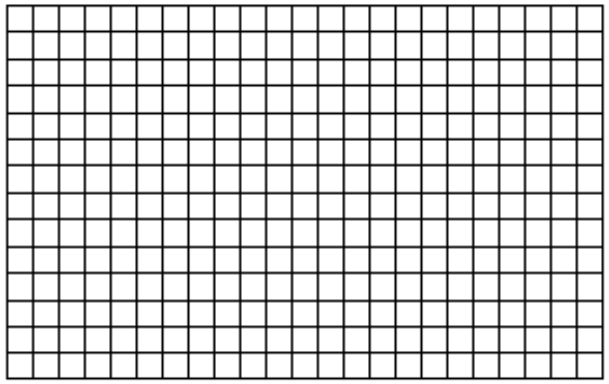
Pond Slider

Name: _____

Turtles Captured by Site Per Year
(combined across traps within site and year)

Site #1	Year	Sonoran Mud Turtles (native to Tucson)	Spiny Softshell (native to the eastern United States)	Pond sliders
Cortaro	2022	0	21	1
Cortaro	2023	1	12	1
Cortaro	2024	0	18	3

Title: _____



Conclusion: What can we conclude about the reclaimed water that is being discharged into the Santa Cruz River based on the turtle data above? Why do you think there are differences between species? Explain.

_____

_____

_____

_____

_____

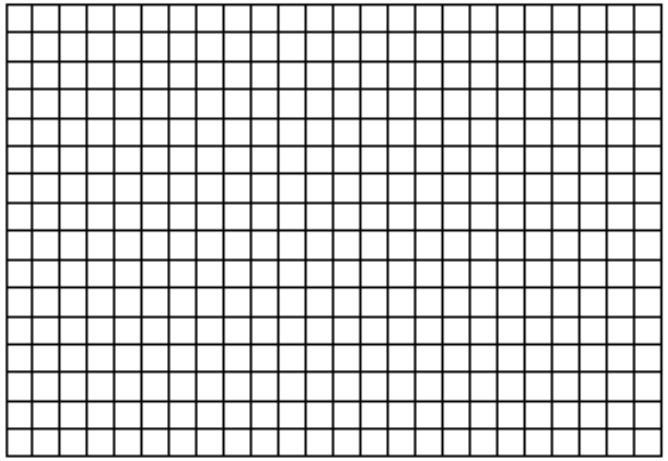
_____

Your graph must have the following:
1.Title
2. “y” and “x” axis labeled
3.Legend
4. Graph
5. Conclusion

Turtles Captured by Site Per Year
(combined across traps within site and year)

Site #2	Year	Sonoran Mud Turtles (native)	Spiny Softshell	Pond sliders
Tangerine	2022	0	29	12
Tangerine	2023	1	22	1
Tangerine	2024	3	19	3

Title: _____



Conclusion: Hypothesize some reasons for the differences among species within site and year?

_____

_____

_____

_____

_____

_____

Your graph must have the following:
1.Title
2. “y” and “x” axis labeled
3.Legend
4. Graph
5. Conclusion

Student Work:

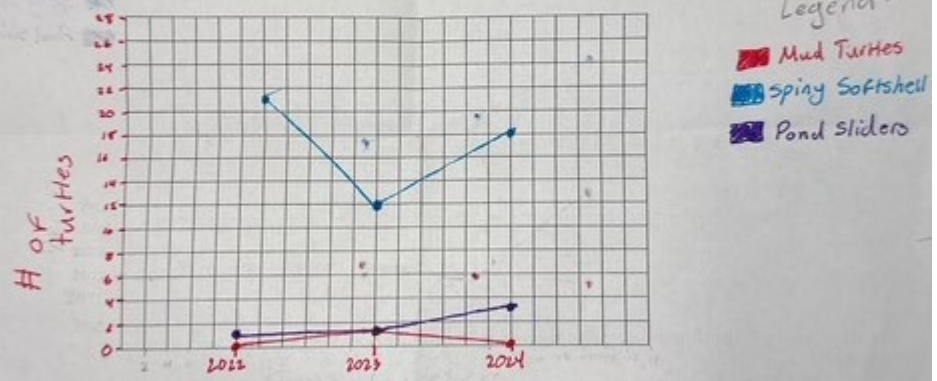
Name: [redacted]

Period 2 1/22/2025

Turtles Captured by Site Per Year
(combined across traps within site and year)

Site #1	Year	Sonoran Mud Turtles (native to Tucson)	Spiny Softshell (native to the eastern United States)	Pond sliders
Cortaro	2022	0	21	1
Cortaro	2023	1	12	1
Cortaro	2024	0	18	3

Title: Turtles found in the Santa Cruz River (Cortaro)



Conclusion: What can we conclude about the reclaimed water that is being discharged into the Santa Cruz River based on the turtle data above? Why do you think there are differences between species? Explain.

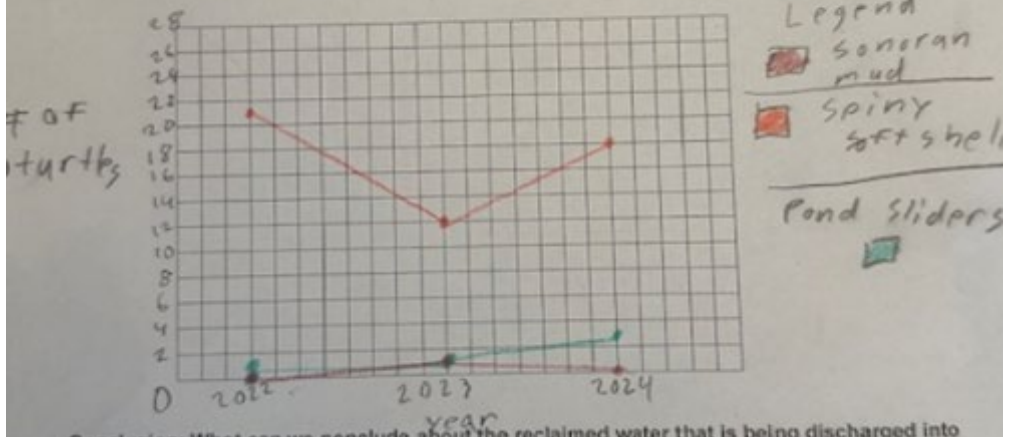
As more and more water is dumped into the Santa Cruz, it allows for organisms such as these turtles to thrive in this environment. There is a difference between species by some being rare species and some being pretty common to find along the Santa Cruz. You could assume that the Spiny Softshell is a common species since it has the most captures out of all the species that were graphed.

Name: [redacted] P3

Turtles Captured by Site Per Year
(combined across traps within site and year)

Site #1	Year	Sonoran Mud Turtles (native to Tucson)	Spiny Softshell (native to the eastern United States)	Pond sliders
Cortaro	2022	0	21	1
Cortaro	2023	1	12	1
Cortaro	2024	0	18	3

Title: Population of turtles in the Santa Cruz



Conclusion: What can we conclude about the reclaimed water that is being discharged into the Santa Cruz River based on the turtle data above? Why do you think there are differences between species? Explain.

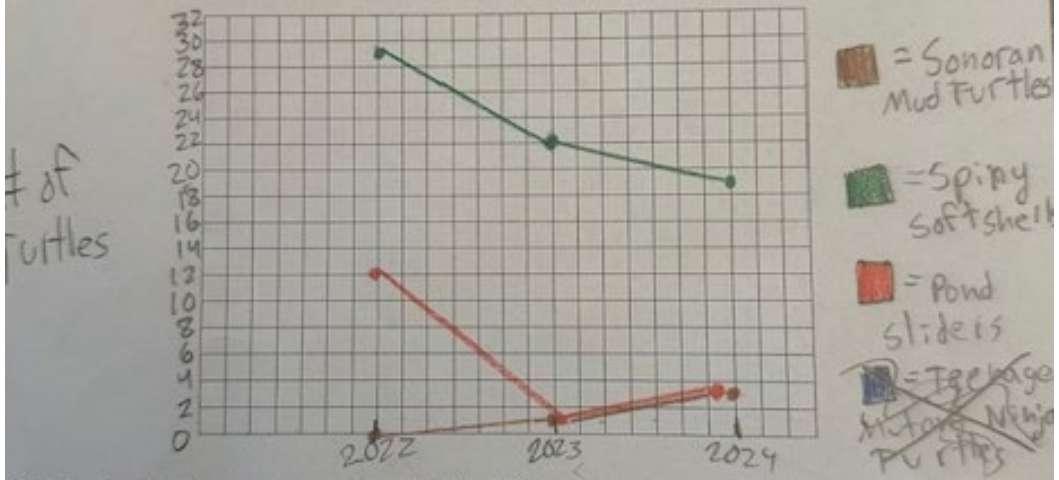
Some turtles aren't thriving in the river, and some are since one species only had a total of 1 and another had a total of 21. There are differences because the Mud turtles are getting eaten by the softshell.

Student Work:

Turtles Captured by Site Per Year
(combined across traps within site and year)

Site #2	Year	Sonoran Mud Turtles (native)	Spiny Softshell	Pond sliders
Tangerine	2022	0	29	12
Tangerine	2023	1	22	1
Tangerine	2024	3	19	3

Title: Turtle populations in Tangerine in the Santa Cruz River



Conclusion: Hypothesize some reasons for the differences among species within site and year?
I think that there are more turtles in this area because this is where more water is, which means more life. I think there are less Pond Sliders because they are not native and are dying.

Turtles Captured by Site Per Year
(combined across traps within site and year)

Site #2	Year	Sonoran Mud Turtles (native)	Spiny Softshell	Pond sliders
Tangerine	2022	0	29	12
Tangerine	2023	1	22	1
Tangerine	2024	3	19	3

Title: Population of turtles in Tangerine River

Conclusion: Hypothesize some reasons for the differences among species within site and year?
There are alot more Sonoran Mud turtles and Pond sliders than the Cortaro river and also more Spiny Softshells.