
WATER IN THE DESERT

Activity Summary

Students will listen to a story about rain in the desert. After a discussion about where students get their water today, the concept of groundwater will be introduced and illustrated. The importance of conserving and protecting all of our water resources will be stressed. As an extension of this lesson, students may engage in an activity in which they read a participatory script and pretend to pollute the water of a fish named Fernando.

Bringing it Together

Objectives

Students will:

- listen to a story about rain in the desert.
- consider their personal experiences with obtaining and using water.
- define and discuss groundwater as human's primary source of water in the desert today.

Perhaps the most contributing factor to our dry desert conditions is the fact that we receive very little rainfall. As we discussed in the activity "Other Desert Dwellers", animals and plants adapt to desert life by keeping cool, conserving water, avoiding the sun, or waiting it

Materials

- The story "Ju:ki" (provided)
- The story "The Well" (provided)
- The Water Cycle (graphic provided)
- "Fernando the Fish's Big Adventure" activity description (provided for "Taking it Home and Other Extensions")

out. Humans living in the desert must deal with the issue of the desert being an environment with very little water. Humans also respond to this scarcity of water in very similar ways. One option that humans do not have

however, is to go without water. Humans must have water each day to survive. Our kidneys do not have the same capacities of the kangaroo rat, we can not bury ourselves in the mud until conditions improve, nor can we store water for a very long time in our bodies. As humans living in the desert, a clean water source must always be available to ensure our survival.

This activity stresses the concept that water is scarce in the desert and that the water we do have available to us, we must conserve as well as keep clean. The activity illustrates that we obtain most of our water from under the ground and that we can each personally contribute to its conservation as well as to its quality. We urge you to conduct the extension activity "Fernando the Fish's Big Adventure." Fernando is a fun, hands-on activity which focuses more on water quality and how human activities affect water quality.

Taking it Home and Other Extensions

Water conservation is an important issue in many desert communities. Are there practices around the school that could be done with more attention to the conservation of water? For example what kinds of trees are planted around the school? Are they “exotics” that require lots of water? If water conservation is important to the students, encourage them to “make waves” and create a “water conservation campaign.” Students may choose to educate other classes, their families, or the community about ways to save water or they may be inspired to take personal action to reduce water use. Regardless of the projects students get involved in, let their own motivation and enthusiasm be their guide and be sure they understand why they are doing it.

The city of Tucson has a water conservation campaign to encourage wise use of water. Tucson Water provides a program for grades 4 and 5, “*Our Water, Our Future*” which teaches the concepts of water cycles, water quality and water conservation. Call to schedule a program for your school.

Conduct the activity “Fernando the Fish’s Big Adventure” (attached). Explain to students that the activity is a fun exercise in which the class reads a script together about the adventures of a Fish named Fernando. The story describes the many things that people do which can pollute water.

After conducting “Fernando the Fish’s Big Adventure,” as a class, clean up Fernando’s water! Try using different filters and filtering media such as sand or gravel to clean up his water.

Have students make a cartoon-type series of illustrations of Fernando’s adventure.

We present it as an extension activity as we feel students should first be made aware of how we obtain and use water before getting involved in such an intensive conservation activity.

A vital concept for students to understand about water is the water cycle itself. Although that is not the primary focus of this activity, we have included an illustration of the basic water cycle following this activity should you have time for such a review.

Activity Procedure

1) Introduce this activity by telling students that this exercise focuses on the most important thing for all life in the desert. Can anyone guess what that might be? Water! Review some of the primary environmental conditions to which plants and animals in the desert must adapt (heat, scarceness of water, and high evaporation). Briefly review with students where some of the animals and plants of the desert get their water (from their food, storing it in their bodies, rivers, tanks, etc.). Remind students that all of these conditions occur mainly because of the limited rainfall received in the desert.

2) Explain that next, to “set the stage”, you are going to read a story written by Ophelia Rivas, a Tohono O’odham. The story is about water in the desert. Just as they did for the “Stories from the Desert People” activity, students should close their eyes, relax, and use their imaginations as they listen to the story. After reading the story discuss the students’ reactions and pose some of the following questions:

How do they feel when it rains?

Do any of the students in the class have to walk a mile to obtain water?

How would they feel about the water they use if they did had to walk that far?

3) Next, conduct a discussion on where students get *their* water. This answer will vary from community to community but likely answers will be “the faucet” or “the well.” Discuss where the water in the faucet or the well comes from. Point out that there is neither enough rainfall nor open water (such as rivers, springs, or lakes) in the Sonoran Desert to support the numbers of humans who live here today. Now, all of us in this region (including the O’odham) get most of our water for use at home from underground although the Central Arizona Project (CAP) is a new source that is used in many homes. CAP is water diverted from the Colorado River and pumped through canals almost 400 miles to the Tucson area.

The way most of us get the water we use at home is through wells. In some places in the Sonoran Desert, the underground water (or groundwater) is shallow enough that one can reach the water in a well from the surface with a bucket and rope. In other areas (such as the Tucson Basin) the water is now very deep in the ground and must be pumped up for use.

4) Explain that you are going to read another story which describes how the people of Ajo, about 120 miles west of Tucson, get their water. Read the story “The Well” to the class. After you read the story, use the following question as a guide for discussion about the story:

How deep did the people of Ajo have to dig to find water?

Why do they call their well “Ajo’s Lifeline?”

What is different about the two stories, “The Well” and “Ju:ki?” What is similar?

5) Continue the discussion on how we as human desert dwellers obtain water. Some students may be familiar with other ways of obtaining water for human use. For example, the Tohono O’odham traditionally built water catchments, called charcos, to gather rainwater for agricultural use. Some students may live near a wash or river in Tucson. What experiences do they have with using water from these sources? Be sure to ask and include everyone’s contribution to this discussion on where humans get water.

6) As groundwater continues to be our most important source of water, point out the following key concepts about groundwater:

Water that is found underground between the soil particles is called groundwater. (There is no underground “lake” beneath the earth’s surface in the Sonoran Desert.)

Groundwater is often closer to the earth’s surface in areas near rivers and lakes.

Groundwater is pumped to the surface through wells.

Rainwater, runoff from washes and streams, seepage from agricultural fields, and water running off of city streets all contribute to the replenishment of groundwater. The process can be very slow as the water must percolate through the soil and back to the groundwater. Also, because our rainfall is so low, this “recharge” takes a very long time.

Groundwater is vulnerable to contamination because of the ability of many things to seep down through the soil into the groundwater.

7) Once students are familiar with the concept of groundwater, point out that much of the surface water we see (water in washes, rivers, ponds, and water tanks) evaporates quickly in the desert air. Some of it does seep into the soil and eventually reach the groundwater. That same water may later be pumped up and used by humans. Thus, all of the plants, animals, and people of the desert rely on the same water. It is important to respect water by using it conservatively and taking measures to keep it clean.

Ju:ki (Rain)

by Ophelia Rivas

My legs feel numb from the blowing sand in the wind. The **ha'a** (clay pottery for holding water) shifted its empty weight on my head as I strain against the wind. My hair braid is violently whipping my legs, hurrying me along.

I live in **Ali-Chuk** -- it means small clearing. My grandfather and grandmother raised their family of five girls and four boys in this area. The Tohono O'odham use to live in many areas in the desert. Some homes were used only during the summer when the saguaro cactus fruit is ripe for harvest. Other homes are usually near a **wo'o**, a place where water collects. The O'odham grew crops near the mouth of a wash. My grandfather grew squash, beans, corn, and other crops in **Ak-chin** (the mouth of a wash). In Ali-chuk, my father grows his crops near the wo'o, which provides water to the fields.

The wo'o is not far to fetch water for tomorrow morning. As I walk, I think about how far my grandmother used to walk to get water for her family when she was a young girl -- she walked more than one mile.

The buzzard people enjoy flying in the wind. They fly with the wind pushing them, they open their wings and glide. The old people say that the wind clears and cleanses everything for the rain which follows. The air smells of damp clay and wet sand as the wind suddenly calms. The red ant people smell the oncoming storm and make a fast trail home -- everyone is in a hurry. I should hurry also, the smell of sweet greasewood means the clouds have burst, releasing water on dry land.

The water in the wo'o is low as I fill my ha'a -- soon the rainwater will rush to refill it. I set my ha'a back on the yucca holder on my head, the weight of the water keeps me bound to the ground as I return home. Hurrying along the well traveled path I see spots of water on the soft dry dirt before I feel their cool drops.

The raindrops fall on my skin creating designs. I love my raindrop designs on my arms and legs. I try to remember how they looked as the increasing rain washes them away. At home under the **watto** (ramada) my mother is waiting for me. She is hugging herself to keep warm from the chill of her wet dress. Like the desert frogs, my baby sister is hopping around in the rain, smiling. My brothers are playing with the cousins at the nearby home. Father is standing straight facing the east where the sun rises. I know he is thanking the rainmaker for the blessing of rain. I can almost hear him singing along with my uncles at the roundhouse, four days ago. They were singing for the rain people to come for a visit.

The rain has come to provide nourishment to all living things on the land.

O'odham word:

ju:ki
ha'a
Ali-Chuk
wo'o
watto
Ak-Chin

Pronunciation:

ju-hk
ha-ah
ahlee-chuuk
woo-oo
vato
ahk-chin

English meaning:

rain
clay pot for holding water
small clearing (an O'odham village)
a place where rain collects
ramada
mouth of a wash

The Well

A Desert Miracle: Ajo's Lifeline

The year was 1913 and Ajo needed an ample water supply for both the town and the mine. Col. John Greenway, who was the manager of the Ajo Mine as well as a prominent citizen of Ajo, organized the search for water. With hired water experts, they surveyed in all directions from Ajo, up to fifty miles away.

Four test wells were dug in search of water. To dig the wells, they used an oil well drilling rig which was transported to the test sites by horses, burros, and wagons. Well # 1 was dug six and one-half miles north of town. Well # 2 was dug four miles north of town. Well # 3 was drilled about seven miles west of Well # 1. Well # 4 was drilled north of the Crater Range.

Whether it was knowledge -- or just plain luck, they hit an ample water supply at Well # 1, six and one-half miles north of town. None of the other wells gave very much water. As far as is known, Well # 1 is the only large water supply in the Ajo area.

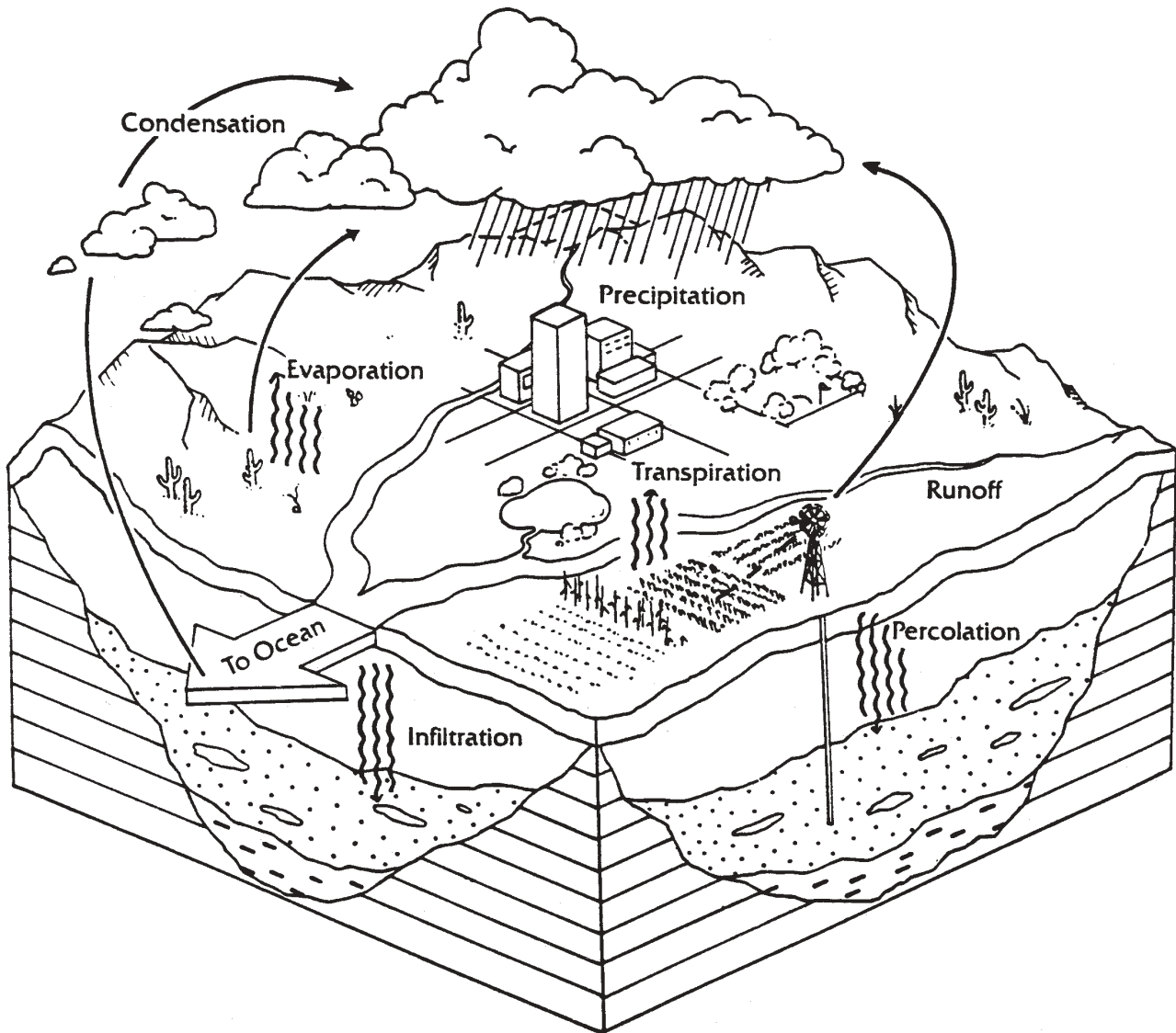
The shaft of Well # 1 was drilled to a depth of 1,350 feet below the ground. Sand and gravel were encountered to a depth of 173 feet. After that was red and black lava. The red lava was soft and contained blow holes. The black lava was hard. Water was reached at 650 feet below the ground. When it was first encountered, the water was thought to be an underground river. However, instead of an underground river, it was discovered that the well is in an underground volcanic cone. Although lava is hard, it is full of holes, like a sponge. For thousands of years the lava absorbed and contained water. Such water is called fossil water. The water coming out of the well was (and still is) 104° F.

Once they located the water, they had to figure out how to pump it up from underground and deliver it to Ajo. A two-compartment shaft was dug to a depth of 650 feet. Then, an underground station room was dug out of the rock. It was equipped with pumps, pipe, and wiring to operate the pumps. The underground station was 21 feet wide by 43 feet long by 15 feet high. Once the water was pumped up to the surface, it was pumped to Ajo through a 10 inch pipe.

Over the years, another shaft was dug and the room was enlarged to 142 feet long. The second shaft was used for reaching the pump station, ventilation, safety, and additional machinery. With only one shaft, the pump area had been about 135 °F! Five large water pumps were added to the new room. They were ten feet wide and needed a great amount of electricity to operate. Two, 20 inch pipes were added to deliver the water to Ajo.

Today there are more pumps, surface pump houses, and two 100,000 gallon holding tanks. About 1500 gallons of water each minute can be pumped from Ajo's well! Millions and millions of gallons of water have been pumped from the well since 1913. According to Charles Gaetjens, Ajo Historian, "the future of Ajo lives or dies with this well!"

The Water Cycle



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Fernando the Fish's Big Adventure

(Taking it Home and other Extensions)

Materials

Objectives

Students will:

- ♦ define water pollution and describe ways in which water becomes polluted.
- ♦ list ways in which human activities contribute to the quality of the water we use.
- ♦ describe ways to prevent water pollution and/or water contamination.

- ♦ 1 Fernando the Fish Sponge (cut a kitchen sponge into a fish shape as shown and punch two very small holes as indicated)
- ♦ 1 pencil or stick
- ♦ 1 length of string (approx. 12 inches)
- ♦ one metal washer (approx. 1 inch diameter)
- ♦ a one gallon jar (full of water)
- ♦ script for Fernando the Fish's Big Adventure (provided)
- ♦ 8 cups each with one of the following ingredients:
 - ♦ one marked "erosion" and filled with 1/2 cup soil
 - ♦ one marked "oil" and filled with 1/8 cup cooking oil
 - ♦ one marked "leaves" and filled with a handful of small leaves or other vegetation
 - ♦ one marked "trash" and filled with 1/4 cup paper dots (collected from a hole punch)
 - ♦ one marked "pesticides" and filled with 1/8 cup liquid soap
 - ♦ one labeled "toxic waste" and filled with 2 alka-seltzer tablets
 - ♦ one labeled "hot water" and filled with 1/2 cup water (does not need to be hot)
 - ♦ one labeled "bacteria" and filled with 1 tablespoon of pepper

Activity Preparation

- 1) Place the Fernando the Fish sponge in the gallon jar filled with water as depicted in the illustration. Fernando will have to be weighted with the washer and suspended from the mouth of the jar.
- 2) Prepare the 8 cups with the appropriate labels and ingredients listed in Materials Needed. Set the cups on a table in front of the classroom.
- 3) Photocopy the script from the master "Fernando the Fish's Big Adventure" and cut each player's role out as indicated.

Activity Procedure

1. Set Fernando the Fish's jar in front of the classroom and introduce students to Fernando the Fish. Tell the students that today, the class will be studying water quality and that Fernando the Fish can tell us a lot about how our human activities affects the quality of the water we use.
2. Ask the students "What does the word quality mean?" Discuss the meaning of this word and then discuss quality as it relates to water. Explain that good water quality (water that is pure, clean and safe) is essential to the health of not only humans, but to all living things. Even if we had all the water we ever needed for anything, if it was not of good quality, it would be of no use to humans and other living things.
3. Tell the students that Fernando is going to take us on a little adventure in order to show us things we do which make water unsafe for living things. The whole class will participate in the adventure. First you will need some students to read about Fernando's adventure. Assign roles for students to read and pass out the appropriate script pieces to each player. You may want to assign one student to write on the board listing the adventures Fernando has in order.
4. Ask the students to have pencil and paper ready and that each time someone says "How's Fernando?" they should write down a word that describes Fernando's condition. What is the name of words used to describe things? (adjectives)
5. Have the students come up one by one, in order (their script pieces are numbered), read their role in the adventure, and add the ingredients from the appropriately marked cup to Fernando's jar. After each addition, and after each student has asked "How's Fernando?" remind students to write down at least one descriptive adjective.
6. After Fernando has gone through all of his adventures, lift him out of the jar and discuss his condition. Ask students to share with the rest of the class some of their adjectives. Ask students if the things that occurred to Fernando are realistic, do people really do these things to water? Using several of Fernando's encounters with pollutants as examples, review how different human activities affect the quality of water.
7. Ask students if they can think of other human activities (which Fernando did not experience) which affect water quality. Some people think that water pollution occurs because of the activities of big industries. What about the things that people pour down their home drains (paint, "industrial strength" cleaners, chemicals)? Where does our drain water go? Do things we pour "down the drain" just go away? How do these harsh chemicals affect water quality and hence, the living things that depend on water? *Encourage students not to blame different groups of people for polluting water. Help them realize that many of our activities are done in ignorance and that we mainly need to understand how our activities affects water in order to avoid such practices.*
8. Wrap up the activity by asking if there are ways to clean up polluted water such as Fernando's. Ask students how they would clean Fernando's water. You can attempt to clean Fernando's water using sand, gravel and coffee filters to demonstrate how water can be purified. Express that there is hope for Fernando if everyone contributes. Finally, ask the class what they think is really the best solution for water pollution? Lead students to the conclusion that AVOIDING WATER POLLUTION in the first place is the best solution for insuring quality water for all living things. We can all avoid water pollution by understanding how our human activities affects the quality of water.

Fernando the Fish's Big Adventure

[Script]

NARRATOR: Fernando is a happy, healthy fish living in the clear, clean water of a stream on the mountain. It is a wilderness area — clean, unpolluted, and far from the effects of human activities. Fernando has lived here all of his life. One day, a big rain fell and Fernando decided to go with the flow and have an adventure. **HOW'S FERNANDO?**

SOIL: Fernando swam past a big field which was recently cleared for a housing development. All the vegetation was removed from the field and, after the big rain, there was nothing to keep the soil in place. It washed away, eventually reaching Fernando's stream. **Add "Soil" and ask HOW'S FERNANDO?**

LEAVES: Further down the stream, the vegetation which had been cleared from the fields had been dumped. The same rain which washed the soil away also washed the uprooted vegetation into Fernando's stream. **Add "Leaves" and ask HOW'S FERNANDO?**

PESTICIDES: The stream in which Fernando is swimming next flowed through an area where people were growing crops. There were cotton fields, grapes, and alfalfa. The insects loved the crops and were doing quite a bit of damage. The farmer hired a plane to fly over and spray pesticides on the crops to kill the bugs. The pesticides killed the bugs but was then washed off the crops in the next rain. The poison flowed with the rainwater off the field and down to Fernando's stream. **Add "Pesticides" and ask HOW'S FERNANDO?**

TRASH: A road leading to the edge of Fernando's stream goes to a pretty place with big cottonwood trees. Some people having a picnic near the stream did not bother to pick up their trash when they were through. The next wind blew the trash into the stream. **Add "Trash" and ask HOW'S FERNANDO?**

TOXIC WASTE: Fernando next swam through water which was polluted when a factory located near the stream dumped some of its toxic waste right in the stream. **Add "Toxic Waste" and ask HOW'S FERNANDO?**

BACTERIA: Fernando could hear it and smell it before he reached it. The cows were packed in, mooing loudly. The local dairy farm was poorly managed and all those cows in that small space created quite a stink of refuse. The refuse drained right toward Fernando's stream and before he knew it, he swam right into the runoff from the farm. **Add "Bacteria" and ask HOW'S FERNANDO?**

Fernando the Fish's Big Adventure

[Continued]

OIL: When people change the oil in their cars, it must be disposed of properly. Also, sometimes people don't properly maintain their cars and oil leaks out. Fernando was unfortunate enough to swim right into some oil, which washed into the stream from the gutters. **Add "Oil" and ask HOW'S FERNANDO?**

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HOT WATER: Sometimes water from streams and rivers is used to cool moving parts in big factories and energy generating stations. Unfortunately, some companies do not allow the water to cool before returning it to the stream where they got it. **Add "Hot Water" and ask HOW'S FERNANDO?**

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NARRATOR: You call this an adventure? It's amazing what people do to water! But maybe, just maybe, people like us can help save Fernando the Fish!

