



Water issues on Puerto Rico and Oahu: A Comparison of Two Islands

Summary:

This lesson compares the fresh water resources of Puerto Rico and the Hawaiian island of Oahu. We will explore how each island receives and uses fresh water. We will also address some of the threats to the fresh water supply on each island.

Background Information:

Students will have a basic understanding of island geography, including the concepts of mountain, valley and shoreline. Students will also understand that we use fresh water and salt water for different purposes.

Materials:

Model of islands - mountains, valleys, ocean

- Food coloring
- Sugar water, salt water, fresh water
- 3 Pitchers
- 3 Glasses
- Several Dixie cups
- Garbage bags and gloves
- Soap
- Toy car
- Sprinkler can or pitcher
- Topographical maps of Puerto Rico, Oahu
- Native Oahu plants
- Shovel
- Work gloves
- Buckets for water (when planting)
- Two bowls - one large, one small
- Printouts of government web pages
- Sink
- Stopwatch
- Handout on el Yunque
- Handout on Puerto Rican Parrot
- Handout on Oahu native plants
- Handout from Oahu DLNR regarding fresh water reserves in Ko'Olau Range
- Handout from USGS website on water lens diagram, salt water intrusion

Grade Level: 5th

Goal: Discuss water use and make wise decisions about how to use fresh water in their own lives.

Key Concepts: How islands receive fresh water from rainfall, and how island geography helps ecosystem store water. Addresses how people use/abuse fresh water resources. Discuss ways to protect water resources.

Objectives: Upon completion of this lesson students will be able to:

- 1) Describe how islands receive/store fresh water
- 2) Explain how islanders use water in daily life
- 3) Converse and critique ways people use water resources
- 4) Explain how pollution and over use threaten water resources
- 5) Derive ways to protect water resources
- 6) Plant native garden as model for protecting water and species resources

Teaching Location: Math or Science classroom and outside.

Lesson Time: Spans 7-8 days. Each activity designed to take 1-2 hrs.

Subject Areas for Infusion: Science, Math, Social Studies, Language Arts

Standards: (Hawaiian DOE Standards)
Domain II, Standard 3
Domain II, Standard 18

Set-Up and Procedure:

(4 Experiments)

Water Cycle Model/Experiment (Activity 1)

Materials: "mountains" of aluminum foil, some kind of

platform for the mountains (something that won't float),

basin, water, 3 sprinklers or spray bottle for each group:

one with clean water, one dyed yellow, one dyed blue

Procedure:

1. Prepare four or five "mountains" of aluminum foil.

They will be the mountains on your island. Platform them, perhaps on a sealed container of water, inside of

a basin. Fill the basin with water.

2. Discuss that as clouds get pushed up above mountains, the moisture gets heavier and precipitation occurs.

3. Demonstrate precipitation with the clean water. Groups do the same. Students will write observations with their groups and then discuss as a whole class.

4. Discuss a variety of ways we pollute the land. Post ideas on a chart. Have students predict how the yellow water (pollution) will affect the mountain and water in the basin. Students record predictions.

5. Spray the pollution all over the mountain. Students record and discuss observations. Connect it to the real world.

6. Introduce the idea of dilution. Explain how fresh water can naturally dilute pollutants, but can't get rid of them. Have students predict how the blue water (rain) might affect their mountain and basin). Predictions should be recorded.

7. Spray the mountains with blue water, representing rainfall. Students observe, record, discuss.

8. Students will formalize their experiment by writing up their experiment.

Warm Water Experiment (Activity 2)

Materials: sink, stop watch, pitcher, calculators, data on population of city, state/territory, country, large measuring bottle

Procedure:

1. Students list times when we wait for water to become warm. We come up with an average number of activities per day in which each of us turns on the faucet and wait.

2. Students predict how long it takes for our classroom faucet to get warm.

3. One student is the time keeper, while another is the water collector. The rest of the class observes.

Vocabulary

- windward
- leeward
- precipitation
- elevation
- water cycle
- watershed
- reserve
- conservation
- native species
- sustainability
- runoff
- water lens
- extrapolate
- grey water
- fertilizer
- pesticides
- slope
- dilution
- salt water intrusion

We will define these terms together as they are addressed in specific situations.

4. The water collector turns on the faucet, while the time keeper keeps a finger underneath the running water. The collector catches the water in the pitcher. When the time keeper feels the water getting hot, s/he yells stop and stops the watch. The collector immediately turns off the faucet.
5. We record how long it took for water to heat up. We also measure how much water we collected.
6. We then learn to extrapolate our data. Based on our average, we figure out how much water is wasted just waiting for it to heat up.
7. Using calculators, we extrapolate further to determine how much water our town, and island use. We compare our extrapolations for Oahu (800,000 people) to those for Puerto Rico (4 million). We could compare the city of Honolulu (600,000 people) to the city of San Juan (3 million people).
8. Students will create a poster of household activities that use water, and point out how much water each activity can waste in a day.

Water Pollution Experiment (Activity 4, Day 1)

Materials: Clear glasses (3), Sugar, Salt, Spoons, Dixie Cups (box), 3 pitchers (fresh, sugar and salt water)

Objective: To demonstrate that pollution can be colorless and that a little can affect a large amount of water.

Procedure:

1. Fill three glasses halfway with clean water. Pour some of each into a Dixie cup for a few students to sample and describe.
2. Pour sugar water into one of the glasses. Pour some for a few students to sample and describe.
3. Repeat step 2 with salt water.
4. Next, pour more freshwater into the two "polluted" glasses. Have same students from 2 and 3 sample and describe. Discuss "dilution" and how it works in nature.
5. Empty and refill all glasses with fresh water. Drop green food dye a glass and blue into another. Demonstrate how a little pollution can go a long way.
6. Empty about half of the polluted glasses. Refill with fresh water. Visually demonstrate the process of dilution.
7. Have students construct posters that visually describe how pollution and dilution work in nature.

Water Lens Experiment (Activity 4, Day 2)

Materials: One small bowl; one large bowl; several small rocks; Large pitcher of water; Basin for used water; blue food dye; scoop for water

Procedure:

1. Fill small bowl with rocks and fresh water. This is the "island's water lens." Place it into large bowl.
2. Fill large bowl with blue dyed water. Water line should only reach halfway up the small bowl.
3. Demonstrate how water leaves the island and enters the ocean. Scoop a little from the island bowl into the ocean bowl.

4. Empty the ocean bowl about the same amount with a similar scoop, mocking the effects of evaporation. Refill both to original levels, mocking the process of precipitation.
5. Repeat, but this time take more from the island than from the ocean. Have students predict what might happen. Refill again, but don't overflow the big bowl into the little bowl.
6. Take a few scoops from the island until the ocean is just at bowl level. Have students revise predictions. Discuss what might be happening in nature.
7. Refill the island bowl, but not to original level. If necessary, have students discuss why it isn't back up to the original level. Describe how the higher the water lens, the more protection against salt water intrusion.
8. Scoop more water into ocean until it overflows the bowl. This will visually represent how salt water can intrude onto fresh water.
9. Students will write in their science sourcebooks their predictions, the procedure, the results and how this might reflect happenings in nature.

Introduction:

Mr. Dorff recently took a trip to Puerto Rico. There, I learned many interesting things about the people and environment. Over the course of a week, we will study a very important issue to Puerto Rico- fresh water conservation. We will use what we learn about Puerto Rico to make connections to our own island, Oahu. These five activities, three of which include the above experiments, will introduce students to the concepts of water cycle, water use/abuse, and water conservation.

Activities:

1. How does an island receive fresh water?

Objective: Students will be able to explain and experimentally represent the water cycle on islands.

Hook: Where do we notice the most clouds and rain on Oahu (over the mountains)? What are the two sides of the island called (windward and leeward)?

Lesson:

- Puerto Rico, like Oahu, is an island. It also has mountainous geography and valleys.
 - Display maps of both islands. Students will predict where most clouds will be on Puerto Rico.
 - Explain how weather moves in from windward side and clouds are formed, pushed to tops of mountains.
 - Explain how water in clouds becomes more abundant and heavy until the cloud precipitates.
 - In Puerto Rico, the mountainous areas are prone to more rainfall.
- Explain how much agriculture takes place on mountains, especially coffee, bananas, and plantains.
- Ask students what goes into agriculture (fertilizers, machinery, pesticides)
 - Ask what might happen to the water that falls on the mountains?

What might happen to the chemicals we put on the land?

- Perform Water Cycle experiment

- Wrap up with discussion of how this cycle affects the land and ocean in Puerto Rico as well as our own Hawaiian islands.

2. How do islanders use fresh water?

Objective: Students will list ways we use fresh water. We will try to arrive at a gallon amount per day per person, and then extrapolate for the entire islands of Puerto Rico and Oahu just for water that is wasted as we wait for it to heat up.

Hook: How do we use water? (make a poster of student ideas) Are there ways we waste water? (New poster)

Lesson:

- Remind students how fresh water arrives on the island, and how natural aquifers store water on islands.
- Ask "What are some ways we learned Puerto Ricans specifically use water?" (agriculture: coffee, bananas, etc.)
- Begin warm water experiment, poster making
- End with presentations of posters

3: How do islanders conserve water? The example of El Yunque.

Objective: Students will learn what the governments of Puerto Rico and Oahu are doing to conserve water supply. They will be able to explain how such actions, as well as how personal actions can help protect water resources.

Hook: What would happen if an island ran out of fresh water? Address and discuss responses from around the room.

Lesson:

- On islands, people don't have access to limitless water supplies. On the island of Puerto Rico, the islanders are experimenting with ways to protect and conserve their water supplies.
- Distribute packet of information on el Yunque, printed from the official website. Explain that this is a place we visited on my trip to Puerto Rico.
- Read the information, stopping to discuss how preserving an area for wildlife also helps protect freshwater supplies from development, pollution, and overuse.
- Ask if there might be any areas on our island we are preserving or should preserve for the sake of wildlife and fresh water. (use the maps)
- Distribute sheet from Oahu Department of Land and Natural Resources explaining how parts of the Ko'Olau mountain range is set aside for the water needs of the island.
- Discuss ways we as individuals can preserve water. Again students will create posters, but we will finish by posting them in the school cafeteria.

4: Threats to Water Supply

Objective: Students will list threats to fresh water. They will derive personal and societal actions that cause these threats.

Day One: Pollution issues

Hook: Yesterday we discussed how we can conserve our water supply and keep it clean. What are some threats to that supply?

Lesson:

- Students list threats to water supply in their small groups. After 5 minutes of small group discussion, we come together as a class and make a class list on a poster. Teacher fills in any glaring gaps by asking questions and eliciting responses.
- Teacher explains that today we will use our senses of sight and taste to learn how easy it is for water to be polluted.
- Conduct Water Pollution Experiment
- Finish with students writing a response to this question: Who is responsible for the threats to our water supply?

Day Two: Water Lens

Hook: Yesterday we discussed some ways water can be polluted. Do you think that one kind of water could pollute another?

Lesson:

- Pass out handouts on the water lens problems that islands are facing. This handout includes a visual of the ocean level and fresh water lens.
- Puerto Rico is a densely populated island, especially in the San Juan area. With so many people, there is a lot of water being used. (Pull out data from water use extrapolation. Remind students that this is just how much is wasted when we wait for it to warm up).
- Read the handout together. Stop and discuss how the ocean is threatening to intrude on the water lens, and will do so if the islanders keep overusing water.
- Conduct water lens experiment.
- Finish with implications for the people of Puerto Rico and Oahu. What might happen if salt water begins to creep into the fresh water supply? Students will write responses in their science journals.

5. (2 hours): Choices: Steps we can take to conserve water locally and globally.

Objective: Students will decide on steps we can take to conserve our water supply.

Hook: How does a place like el Yunque help to conserve water resources in Puerto Rico?

Lesson:

- Discuss how el Yunque's ecosystem helps to protect the native species of the island, not just its fresh water.
- Pass out hand out on Puerto Rican parrot. Discuss how other species have gone extinct or become threatened because of loss of habitat.
- Explain that natural habitat is a good way to conserve water, because once established, it doesn't require sprinkling or fertilizing.
- If we take steps to protect our water, we can also protect our species
- Oahu has been experiencing extinctions, too. What are some ways we could protect our species and our water?

- One way to save both is to plant native habitat
- Pass out printout of plants that naturally grew on our side (leeward) of Oahu
- Explain that we have ordered some of these plants (make the students aware of this a couple weeks in advance- could even have them choose and budget for the plants)
- Today, we will go out and create a native plant garden
- Head outside and plant!

Conclusion:

On Day Seven, discuss with the class the key concepts and objectives of our lessons. Ask how they felt when planting the garden. Then assign the final assessment to be completed in class.

Assessment:

5 Paragraph student reflections: What we learned from our lessons on fresh water. Include how water arrives on the island, how islanders use and abuse it, how Puerto Rico is conserving its water supply, how conserving water helps conserve species, and how we can conserve our own supply.

Adaptations:

This lesson plan includes a lot of differentiation already (small group work, individual reflection time, sensory/kinesthetic experiences).

If the technology were available, I'd also like to include a video on el Yunque or Puerto Rican agriculture. Or, I would love to present a slide show of the sights we encountered. I also wanted to include a picture from a United States EPA site called "What's wrong with this picture." It shows many water-consuming activities, including some that waste water or produce runoff. Students can color and react to the picture. A teacher could also include more partner work, especially on the reading or writing. Students could build the mountain models, as long as the teacher felt they were responsible enough. Right now, mine aren't. More hands-on experiences, like garbage cleanup might be useful. I could incorporate a song about the water cycle. If I could get a speaker from the Oahu Sierra Club, Botanical Gardens or DLNR, that would be a great tie in to our community.

References

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