



## Water Resource Management: 45 minutes

**Objectives:** Students will assess the importance of water resource management through protection and distribution of water under contamination and limitation scenarios.

### Materials

- Map of Texas with major cities (Houston, Dallas, Austin, San Antonio, El Paso)
- Food coloring (red, blue, brown)
- 12 quart water container (total water)
- Graduated cylinder (glacial ice)
- Eye dropper/ disposable pipette
- 10 liters of water
- Small clear containers (e.g. cups - 5 per group)

### Background

- Class time: 45 minutes
- Purpose/Objectives:
  - To identify the finite water resources that are available for human consumption.
  - Students will assess the relative distribution of water that is relevant to Texas, and how these resources are subject to contamination risk.
  - Students will simulate scenarios that pose challenges to water resources in the face of climate change and population growth.
- Summary:
  - Student groups will represent five major Texas cities (listed below).
  - Students will use 10 liters (approximately 2.5 gallons) of water to represent all the water on the earth. They will be given the percentage and distribution for each water source in relation to the total amount and asked to divide the 10 liters of water to demonstrate this.
  - Each city will be faced with a water challenge, stemming from climate or human impact.
- Background: Approximately 72% of the earth is covered with water. Sources of water are the oceans, icecaps and glaciers, groundwater, freshwater lakes, inland seas and salt lakes, the atmosphere and rivers. See Table 1 for global water distribution.
  - In central Texas, humans rely on both groundwater and surface water to survive. These resources, however, are distributed different throughout the state.

<b>Reservoir</b>	<b>Approximate % of the total amount</b>
Oceans	97.25%
Icecaps / glaciers	2.0%



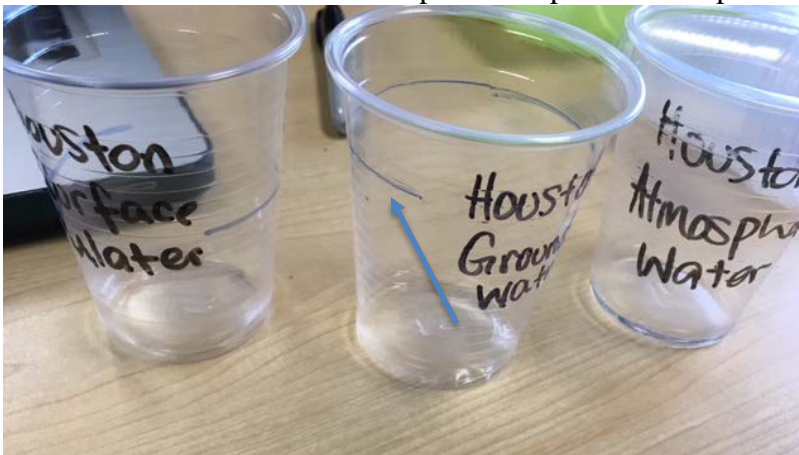
Groundwater	0.7%
Freshwater lakes	0.006%
Inland seas / salt lakes	0.004%
Atmosphere	0.001%
Rivers	0.0001%

The percentage of usable freshwater is reduced by pollution and contamination. Therefore, the actual amount of water that is usable by humans is very small (approximately 0.00003%).

- Before Activity Starts, Discuss the Following (10 minutes):
  - Ask the students to identify the various reservoirs of water on Earth, and have them estimate the total percent these make up (from Table 1).
  - Ask the student to identify which reservoirs of water are available for human use (only surface and groundwater).

**Activity and Instructions (35 minutes)**

1. Divide class into groups of 4-6 people. Each group represents a major city in Texas: Houston, Dallas, Austin, San Antonio, and El Paso
2. Each group will take water from the large tub labelled “all water on Earth”, and distribute it among their local surface water, groundwater, and atmospheric water. Local water will be filled to the water mark in respective cups. For example:



3. The instructor will fill an additional container with water to represent Global Ice Caps and Glacier (amounts TBD)
4. All the water remaining in the tub will represent Ocean Water, and the instructor will dye it with blue coloring.
5. Instructors will work with individual groups to make changes to water resources based on calamity cards. Each city has a respective calamity card that impacts their water resources, as shown below:



<b>Climate Card</b> (Immediately affects: No City)	<b>Climate Card</b> (Immediately affects: El Paso)
<b>Ice Caps Melt</b> this is due to increased average global temperatures	<b>Drought</b>
Action: 50% of the water stored global ice caps gets mixed with the ocean	Action: 100% of your surface water is evaporated into the atmosphere, AND 50% of your groundwater is depleted to sustain food production
<b>Climate Card</b> (Immediately affects: Houston)	<b>Human Impact Card</b> (Immediately affects: San Antonio)
<b>Sea Level Rise</b> this is due to the ice caps melting	<b>Pollution: Large Petroleum Spill</b> a local gas station reported a substantial leak in an underground gasoline storage tank
Action: 0.001% (~1mL) of ocean water contaminates your groundwater supply	Action: 100% of your surface and groundwater is contaminated
<b>Human Impact Card</b> (Immediately affects: Austin)	<b>Human Impact Card</b> (Immediately affects: Dallas)
<b>Pollution: Domestic Animal Waste</b> The people in your city do not pick up after their domestic pets, and the effects are starting to be measured in your surface water.	<b>Pollution: Trash</b> A large rain storm recently hit your city, and resulted in all the litter to be carried into your surface water
Action: 100% of your surface water is contaminated	Action: All the trash (rainbow sprinkles) is dumped into your surface water

6. Each city has undergone an impact to their water resources, and it is up to the students to work together to sustain the state's water demands. Open up a discussion session for the students to 1) share with the class the impacts to their water resources and 2) how the remaining water will be redistributed throughout the state. The students should keep population growth and climate change in mind during this discussion!



- a. Houston has 0% of groundwater left for human consumption due to saline contamination – no water is available for distribution, but they're in need of water
- b. El Paso has 0% of surface water and available groundwater left for human consumption– no water is available for distribution, but they're in need of water
- c. Austin has contaminated surface water and needs to rely on groundwater for human consumption– their groundwater is available for distribution
- d. San Antonio has contaminated groundwater and needs to rely on surface water for human consumption – their surface water is available for distribution
- e. Dallas has trash in their surface water, so work needs to be done to filter this out – they have both groundwater and surface water available for distribution

### Discussion

- What are some examples of natural versus human impacts that can negatively influence the availability of fresh water for human use? List 2-3 examples of each.
- List 3 behavioral actions that you can change to help reduce pollution.
- List 3 behavioral actions that you can change to help save the fresh water resources.
- Where is the majority of fresh water located on earth? Is it available for human use? (Answer = ice caps and glaciers, which is not available to humans)
- Is there enough fresh water resources available to sustain the growing human population?



## Science TEKS

### **§112.32. Aquatic Science**

(7) Science concepts. The student knows the origin and use of water in a watershed. The student is expected to:

- (A) identify sources and determine the amounts of water in a watershed, including rainfall, groundwater, and surface water;

(9) Science concepts. The student knows the types and components of aquatic ecosystems. The student is expected to:

- (A) differentiate among freshwater, brackish, and saltwater ecosystems;

### **§112.36. Earth and Space Science**

(11) Solid Earth. The student knows that the geosphere continuously changes over a range of time scales involving dynamic and complex interactions among Earth's subsystems. The student is expected to:

- (E) evaluate the impact of changes in Earth's subsystems on humans such as earthquakes, tsunamis, volcanic eruptions, hurricanes, flooding, and storm surges and the impact of humans on Earth's subsystems such as population growth, fossil fuel burning, and use of freshwater.

(13) Fluid Earth. The student knows that the fluid Earth is composed of the hydrosphere, cryosphere, and atmosphere subsystems that interact on various time scales with the biosphere and geosphere. The student is expected to:

- (D) discuss mechanisms and causes such as selective absorbers, major volcanic eruptions, solar luminance, giant meteorite impacts, and human activities that result in significant changes in Earth's climate;

### **§112.37. Environmental Systems**

- (5) Science concepts. The student knows the interrelationships among the resources within the local environmental system. The student is expected to:
  - (B) identify source, use, quality, management, and conservation of water;