

Water

CSU Stanislaus Quantitative Reasoning with Water
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A Story

- This module is designed for a Spanish Literature Class
- Read and analyze Costa Rican writer Carmen Naranjo's short story "Y vendimos la lluvia," published in 1989. English title: "And we sold the rain."
- The story satirizes the complexity and consequences of the economic dependency of developing countries.
- The core of the problem is that they have already exported all their primary resources: coffee, rice, sugar cane, vegetables, wood, etc., and the country and its people are still broke.

A Solution

- A middle-eastern Sultan hears of the land where rain abounds and a plan is hatched to sell the water to the Sultan for **10 dollars per cubic centimeter**.
- The consequences are economically and environmentally devastating for this developing country and its people, as they lose their main natural resources (due to the severe drought).
- How can we understand **10 dollars per cubic centimeter** as a price for water?

Activities

- **First Activity:** Have students make a square centimeter with a ruler to start to visualize the units in the story.
 - Discuss area and volume
 - Practice conversions
 - Inches
 - Meters
 - ...

Activities

- **Second Activity:** To get a notion of the difference between the level of rain in a tropical country in comparison with a non-tropical region, find out which is the average annual rainfall in Costa Rica, which is around 100 inches per year (with up to 25 feet in some regions), and in the State of California OR in the Central Valley.
 - Web search
 - Graphing of data
 - Scale

Activities

- **Third Activity:** Have students choose 3 personal activities (from a given list of five) which involve the use of water at home and calculate their daily, monthly, and yearly individual use.
- They may need to measure the flow per time unit for their faucet and then measure how long they have the water running to estimate their water useage.
- **Choose 3 activities out of 5 given to calculate water usage**
 - Shower
 - Teeth brushing
 - Hand washing
 - Toilet flushing
 - Dishwashing

Activities

- Activity 3 Continued
 - Students can bring their data to class and enter it into a Google Doc spreadsheet
 - Compute descriptive statistics for the class data
 - Raise questions
 - Make hypotheses
 - Discuss how to test them

Activities

- **Fourth Activity:** Calculate how much you waste when comparing with the average use. Calculate how much it would cost you per day, month, year, if you would have to buy that water from Costa Rica at the given price in the story. Working in groups according to matching "domestic" activities, have students compare their uses and expenses.

Sociology Focus

- Water Footprint Assessment
- Personal Water Footprint Calculator
- <http://waterfootprint.org/en/resources/interactive-tools/personal-water-footprint-calculator/>
- Footprint Calculator – the water footprint calculator in its most simplistic and basic form asks respondents to answer the following questions
 - Country of residence
 - Gender (closed-ended, male/female)
 - Individual portion of family income (open-ended, in dollars)
 - Vegetarian or meat consumer (closed-ended, vegetarian, average, and high meat consumption. “Average” and “High” are subjective)

Sociology

- Personal water footprint calculated from answers above. Compares their footprint to the global average. It also breaks their footprint in terms of the impact of different food categories (i.e. meat, dairy, fruits and vegetables, etc). Student can write down their calculated water footprint and use this information to do different activities focusing on building quantitative reasoning.

Sociology

- First activity
 - Can plot class members on a simple graph. Can look for estimates of averages and ranges on graph. Can also use global average (1243 m³ per year) as a comparison point.
 - Can calculate descriptive statistics (i.e. median, mean, range, and standard deviation)
 - Critical analysis. What does this information tell us about our water consumption? What other important variables are not included?

Sociology

- Second activity
 - Ask students to change their meat consumption choice. Record their footprint calculator. Ask them to change their gender. Ask them to change their income by increasing in by \$10k and then decreasing in by \$10k. Record all of their findings.
 - Have students compare their modified scores to their original score
 - What impact does gender have on water footprint and why?
 - What impact does meat consumption have on water footprint and why?
 - What impact does income (class) have on water footprint and why?
 - Critical analysis: Have students read articles about the impact of class and consumption on water footprint and incorporate

Pre-Assessment

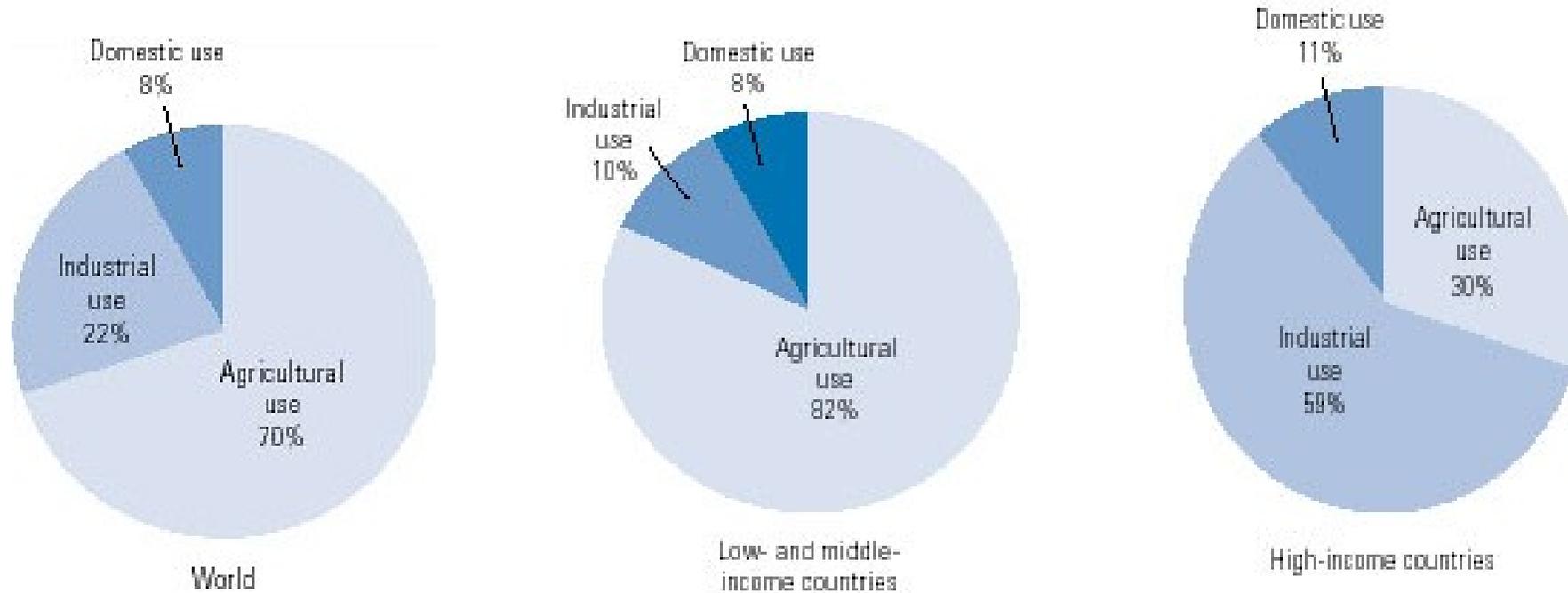
- Understanding the impact of class and wealth on water use.
- Testing: Rubric 3: Understanding Tables and Graphs (Questions 1-5)

Rubric 1: Estimation (Questions 4-5)

- Rubric 4: Algebraic/Symbolic Approaches (Question 3)

- The pie-charts below indicate water usage by country income level and sector usage. Compare water use information in the three charts. What is water used for primarily in terms of world global consumption.

Competing water uses for groups of countries



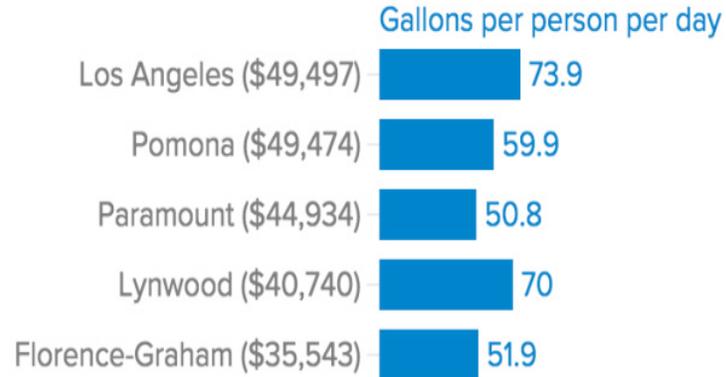
Extracted from the Executive summary of the WWDR. World Bank, 2001. . Washington DC.

- The table below also indicates water usage by country income level and sector usage.
 - Is the pattern of sector usage (agricultural, industrial, and domestic) similar to the data posted above across income categories? Explain your answer.
 - Compare the countries groups in terms of their overall water withdrawal. What pattern do you see?
 - What general information about differences in water usage does this table give you that is missing in the above pie charts?

Country income group	Annual withdrawals per capita	Withdrawals by sector		
		Agric.	Ind.	Dom.
	(...m ³ ...)	(.....%.....)		
Low-income	386	91	5	4
Middle-income	453	69	18	13
High-income	1 167	39	47	14

- The chart below looks at variations in per capita water usage in 10 different counties in Southern California.
 - What are the patterns you see here and are they similar or different from what you would given the information in the charts above?
 - What does the concept of median income mean?
 - If $1\text{m}^2 = 264.172$ gallons, how many gallons per day you would use based on your personal water footprint estimator.
 - Is your personal water footprint in gallons per day similar to what you would expect given the data below.

Water use by five lowest income communities in analysis (median income in parentheses)



KPCC using Quartz's Chartbuilder

Data: Census Bureau, State Water Resources Control Board

Water use by five highest income communities in analysis (median income in parentheses)

