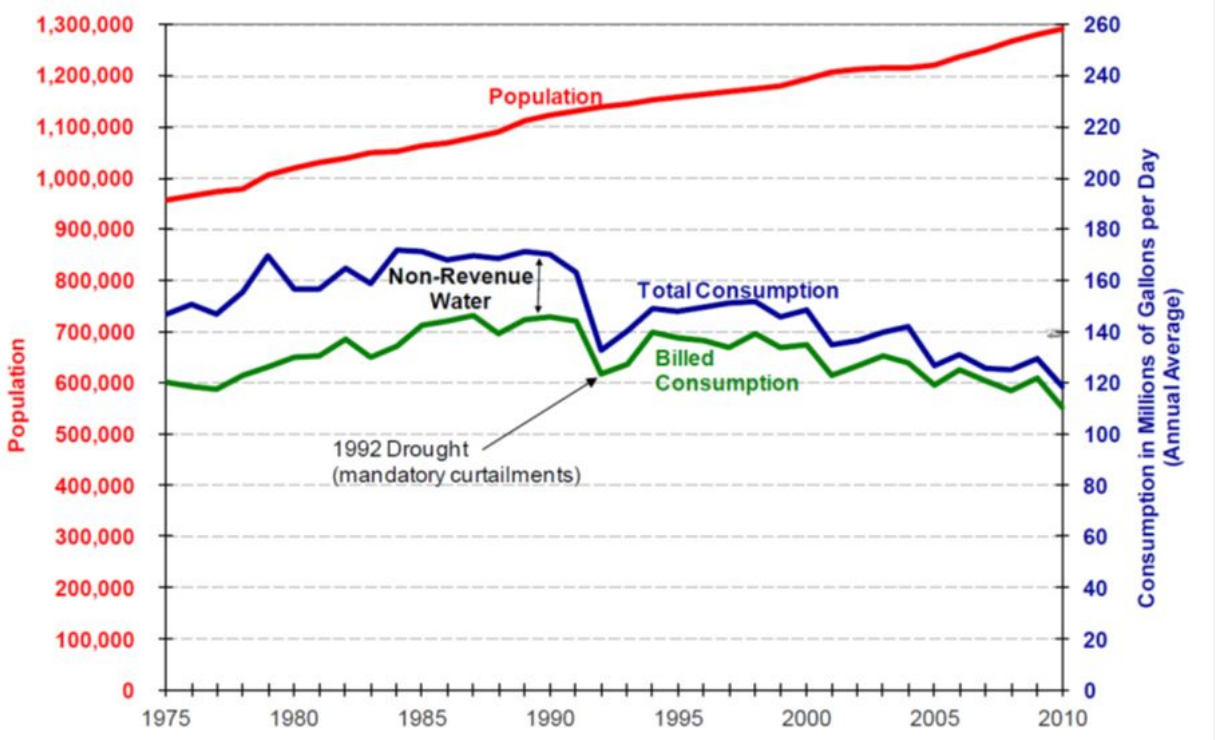
Analyzing Water Conservation Through Math Modeling

Algebra I

Problem Statement

"How can we use math to analyze local water conservation trends and inspire stewardship action?"



Teacher
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Grade 8, Algebra 1
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“How can we use math to analyze local water conservation trends and inspire action?”

Classroom Context

This project has been developed as a collaboration with my international studies and science colleagues. It is for a group of around 75 students in 8th grade. The International Community School values this cross curricular teamwork.

Project Summary (3 weeks)

Students will develop skills to analyze one sector of water sustainability and management (student selected). The outcome will be in two parts: (1) a written report, blog, training manual, or lesson, or (2) an application of the research done by students in their community that positively impacts stewardship awareness and action in the community.

Through the lens of mathematical data analysis, students will analyze and act on the issue of water sustainability in our community with respect to the sectors of ecology and the economy**.** Students will chose their own topic and be grouped by interests. Students will learn introductory skills in mathematical methods for taking data, research, mathematical writing, and technology for data analysis.

Entry Event

The teacher gives each student a clear glass of clean water as point of focus to reveal prior knowledge, practice systems thinking and catalyze new insights. Students choose how water is used from pre made categories such as: residential home use, farming, industrial use (factories, power plants), commercial business use (golf courses, water parks, etc.), public recreation (parks, lakes, rivers), environmental habitat preservation (water for salmon), or city landscaping.

Students discuss the systemic complexity of the situation and identify OTHER categories not in the above options. They calculate percentage of water out of the total given by students to each category.

Puzzling Math Problem

The sample story problem below is used after the entry event to preview the type of analysis students will complete.

> ***The population of our area is _____. Our current water use is _____. If population grows exponentially by _____% over the next 5 years, and water use per person decreases exponentially by _____% over the next 5 years, will we be using more or less water after 5 years? Start by finding the unit rate of water use for one person.***

Learning Products & Assessment Strategies

Learning Product: A written analysis of real world data in a student selected format: research report, blog with graphs and data, short lesson plan for younger students, or some other approved product.

Impact Project: Students link their math learning to an impact project that is managed in their science course. Through this collaboration, students share their product with the community: parents, other students, city or county staff and policy makers.

Re-Teaching Product: Word problems created and shared with younger students.

Assessment Strategy: Standards-based pre-test of CCSS, Homework quizzes, interim rubric self-evaluation (formative), CCSS practice performance task (formative), final summative self-evaluation of product and impact, Summative Quiz on CCSS.

Learning Skills Focus:

1. **21st Century Skills**
    a. Critical Thinking: How does water sustainability fit into our world?
    b. Creative Problem Solving: How can we respond to our data findings to contribute to sustainability?
    c. Collaboration: How can working with like-minded peers lead to a better outcome?
    d. Communication: How can we best communicate the result of our finding to have the biggest impact? Who needs to know?

2. **STEM Skills**: Students take scientific data and analyze it mathematically, using technology, to come up with a better understanding of its meaning. Then students come up with an impact action to contribute to a solution.

3. **Systems Thinking Skills:** Students study how water affects our whole society, economy, and environment.

Specific Math Standards

1. Summarize, represent, and interpret data on a single count or measurement variable. (HS.S-ID.1, HS.S-ID.2, HS.S-ID.3). The students will review as a group how to create dot plots, histograms, and box plots on real data. We discuss data skew and when to use Median versus Mean. Students in particular practice: median, mean, standard deviation, interquartile range, outlier, 5 number summary. This will be assessed with homework quizzes, and formative approaches.

2. Summarize, represent, and interpret data on two categorical and quantitative variables.(HS.S-ID.5, HS.S-ID.6). This will be completed through the main project. Students will develop these skills to analyze bivariate data from a water sustainability source. They will learn particularly: correlation versus causation, correlation coefficients "r", plotting and analyzing residual plots, solve problems in context using fitted functions, two-way tables and relative frequencies, and identifying association types

3. Interpret linear models (HS.S-ID.5, HS.S-ID.6). This will be a continuation of the linear equation unit, which students previously studied. We will begin by drawing lines of fit by hand. Then students will interpret the meaning of the slope and y-intercept in terms of the water sustainability context. The students will progress from hand-drawing to using technology to determine a more precise line of fit (least of squares method used generally). Students will test their data for a linear and exponential fit as part of creating their research written product.

   Source CCSS.Math http://www.corestandards.org/Math/Content/HSS/ID/

Authentic Audience

- Younger students (1 word problem for each group)
- Parents (Share final product and potential as part of the impact project)
- City or county staff and policymakers (students may choose to make contact as part of the impact project)

Alignment with Community Measures

Cascade Water Alliance Goals http://cascadewater.org/

Kirkland City goals:
http://www.kirklandwa.gov/Assets/Kirkland+2035/K2035+Comp+Plan+Principles+of+Sustainability.pdf

King County Goals

http://www.kingcounty.gov/services/environment/wastewater/education/goals-mission.aspx

- Increase the community's understanding of and connection to King County's wastewater system
- Create partnerships and collaborate with schools and community organizations
- Increase knowledge and create positive changes in behavior within the community that limit impacts on wastewater systems and the environment

http://www.kingcounty.gov/depts/dnrp/about/vision-mission-goals.aspx

- Environment: Minimize waste and emissions, maximize resource re-use and recovery, foster environmental stewardship, promote conservation, and protect and restore habitats, ecological functions and aquatic conditions.