How many people can the aquifer support?

Groundwater, Drought, and Natural Resource Management

Task 3: The Effects of a Drought on Your Groundwater Model

Task Overview

In this task, students continue using the Groundwater Education simulation (http://groundwater.cee.illinois.edu/) to explore the effects that drought and climate change have on an aquifer. In previous tasks, students learned how to use and collect data from the simulation. Students have selected indicators of aquifer sustainability and have started computational models. In this lesson, students will add to their models through the investigation of how a drought affects water resources available for human needs and activities.

Task Level NGSS Practices and Crosscutting Concepts

Disciplinary Core Ideas (DCI):

ESS3.A: Resource availability has guided the development of human society.

ESS3.B: Natural hazards and other geologic events have shaped the course of human history; they have significantly altered the sizes of human populations, and have driven human migrations.

Science & Engineering Practices:

Planning and carrying out investigations

Analyzing and interpreting data

Developing and using models

Crosscutting Concepts:

Patterns

Cause and effect

Materials:

Copies of National Geographic and Scientific American articles
Access to computers and Internet

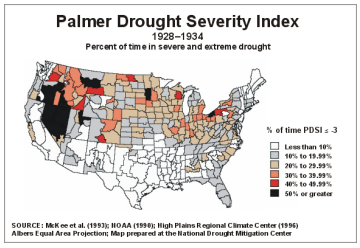
Safety Concerns:

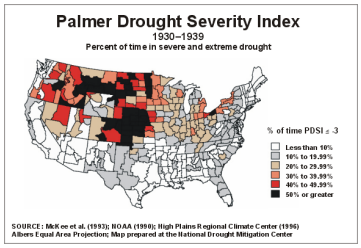
None

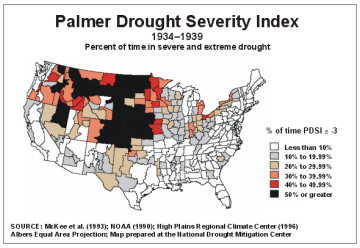
I. Opening Activity: Map Comparisons

Share one or both sets of the following maps with your students.

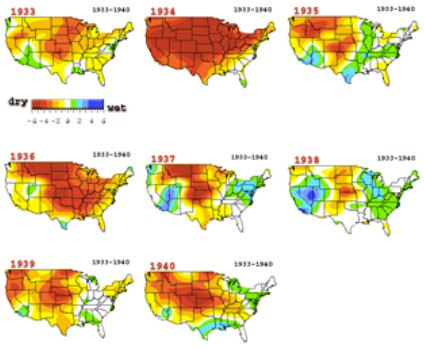
These images are taken from the National Drought Mitigation Center:
http://drought.unl.edu/planning/monitoring/historicalpdsimaps.aspx







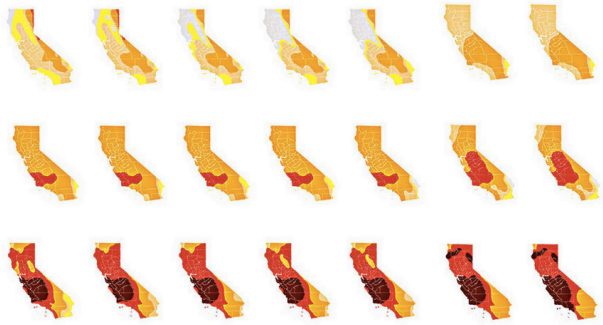
These images are edited from The National Climatic Data Center:
https://www.ncdc.noaa.gov/paleo/drought/drght_history.html



Ask students for observations about these images. Students may point out that the Dust Bowl drought came in three waves (peaks in 1934, 1936, and 1939-40), that Nebraska and Oklahoma were in severe drought the entire seven years, or that at times, the drought spread to most of the country.

After the Dust Bowl maps, share the California drought map images with students:

- 6-second animation: http://www.latimes.com/la-me-g-california-drought-map-gif-htmlstory.html
- Images only: http://www.latimes.com/science/la-me-g-california-drought-map-htmlstory.html



Spend 2-3 minutes sharing ideas about the similarities between these droughts, time scale, and possible causes of drought. Spend an additional 2-3 minutes having student groups brainstorm what they perceive the effects of a drought to be, and potential solutions for coping with a drought.

II. Current Event Articles

Students read one or both of the articles:
National Geographic: *They've Seen Lots of Droughts, But This One's Different*
Scientific American: *Drought Takes $2.7-Billion Toll on California Agriculture*

Note: Rather than having every student read both articles, assign one article per student group. Half of the groups read the National Geographic article, which focuses on residential water consumption. The other half of the class reads the Scientific American article, which focuses on the economic toll drought takes on agriculture. The perspective of each article may influence the outcomes of the groups' computational models and become the basis for rich class discussion in regards to how many people this particular aquifer could support in a drought scenario.

Allow students time to discuss the article with their group members.

III. Revisit Graphs and Computational Models

Each groups' graphs should be posted on poster paper around the classroom from the previous task. Ask students what data they might need to collect in order to revise or change their models in the event of a drought. Whiteboard student responses.

IV. Drought Scenario in Simulation and Computational Model Revision

Students should observe what the drought looks like in the *No Development, City,* and *City + Farm* scenarios. Ask students what changes in patterns they observed as a result of adding a drought, as compared to the first time they used the simulation.

Note: For comparison, students could record their observations on their *Aquifer Exploration* handout.

Students should repeat the data collection procedures that they developed in Task 2, selecting the drought option in the simulation. Students add another column of data to their computational models in their spreadsheets or in lab notebooks, and plot the new data on the same graphs from Task 2, if possible.

Students should extrapolate their best-fit line for the drought for another two years (using dotted lines for extrapolation), modeling the effects of a prolonged drought.

Students update their posters to reflect the drought data.

IV. Closing

Student groups write a summary comparing and contrasting their no-drought and drought data in lab notebooks or on posters.