Using an Aquifer Simulation to Investigate Relationships between Groundwater, Human Activity, and Drought (P12 Resource Exchange)

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Jana Sebestik received a B.S. in mathematics and M.Ed. in mathematics education from the University of Illinois, Urbana-Champaign. She has 34 years of classroom experience teaching mathematics in grades 7-12. She is currently Assistant Director of STEM Curriculum Design in the Office for Mathematics, Science, and Technology Education (MSTE) in the College of Education at the University of Illinois, Urbana-Champaign. For the past ten years she has been Education Lead for the DOE/DHS funded Trustworthy Cyber Infrastructure for the Power Grid (TCIPG) project. MSTE works with mathematics and science teachers to integrate technology into K-12 classrooms. TCIPG researchers address the challenge of how to protect the nation's power grid by significantly improving the way the power grid infrastructure is built, making it more secure, reliable, and safe.

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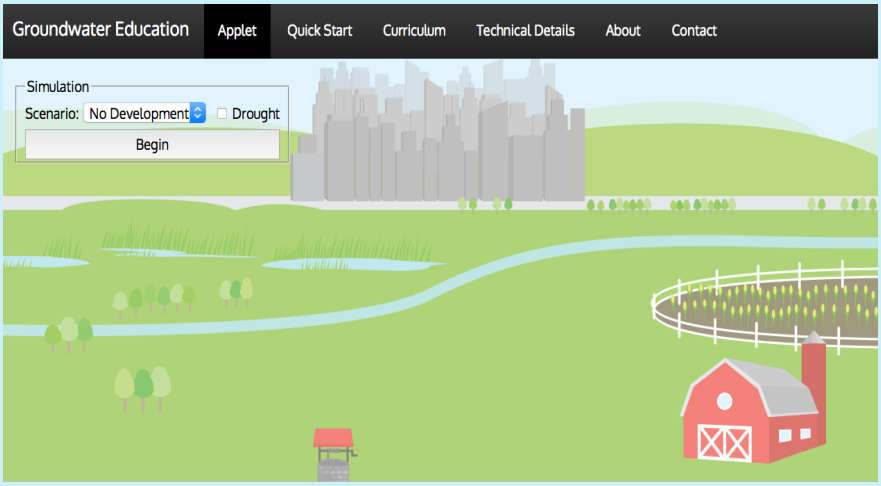
Albert J. Valocchi received his B.S. in Environmental Systems Engineering from Cornell University in 1975 and did his graduate studies at Stanford University in the Department of Civil Engineering, receiving his M.S. in 1976 and Ph.D. in 1981. He has been on the faculty of the Department of Civil and Environmental Engineering at the University of Illinois since 1981, and currently holds the rank of Professor. He teaches undergraduate and graduate courses in water resources engineering, groundwater hydrology and contaminant transport, groundwater modeling, and numerical methods.

Aquifer Sustainability: An Online Investigation

How many people can the aquifer support?

The Groundwater Education project is an engineering curriculum that uses an online simulation to answer this driving question, "How many people can the aquifer support?" This series of activities can be embedded into a high school earth or environmental science unit, integrating science and engineering education. This unit asks students to investigate the relationships between human activity, surface water and groundwater. Students make decisions about the reasonable management of natural resources – in times of rain, and in times of drought—by collecting and analyzing authentic data to develop computational models.



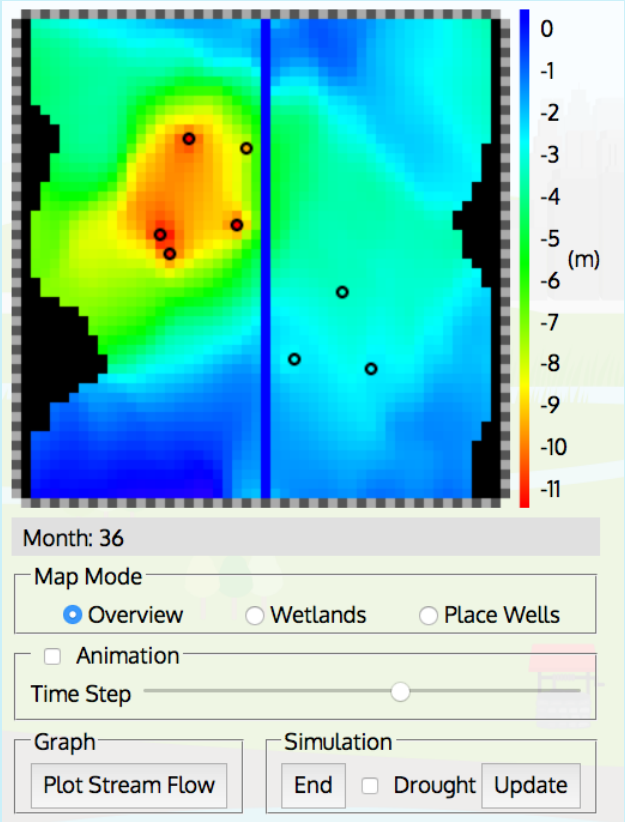
The Groundwater Simulation

In an online simulation, students investigate the connections between surface water and groundwater.

As students add wells to the city and/or farm, observations, in the form of animations and data, can be made over the course of five years.

Students examine stream inflow and outflow, area of wetlands, water table depth, and rates of pumping.

The simulation runs MODFLOW, a modeling program developed by the USGS.



Simulation Results and Data

Students observe changes to the aquifer over time. The colors in the map, as shown above, represent the depth of the water table below the surface.

Students can analyze graphs of individual cells and cross-sections.

Graphs of stream inflow and outflow can also be plotted and compared to the stream outflow prior to human activity.

The changes in the area of the wetlands can be observed while running the animation.

Groundwater Education Curriculum

This unit of study consists of four tasks which may take up to eight class periods to complete. Students compare the current drought events of the Western United States to the Dust Bowl of the 1930s to provide context for this curriculum. Students collect data within the simulation to develop computational models in order to predict how many people the aquifer can support. Throughout the tasks, students are required to use evidence to support claims, develop and refine a model based on data, and communicate scientific information while behaving as engineers. This unit provides an example of how to formatively assess students while integrating engineering into the science classroom.

This curriculum is aligned to the Next Generation Science Standards and emphasizes the Science and Engineering Practices of Developing and Using Models, and Analyzing and Interpreting Data.

More Information can be found at http://groundwater.cee.illinois.edu/ or contact Samantha Lindgren at the Office for Mathematics, Science & Technology Education at the University of Illinois Urbana-Champaign: salindgr@illinois.edu

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