

Investigating Watershed Dynamics in the Classroom

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Watershed Dynamics

Watershed Dynamics is one of four GLOBE Earth System Science Projects (ESSP) writing inquiry-based curriculum materials. Students use My World GIS and the web-based FieldScope GIS to study water availability and human impacts on the watershed.



Curriculum developers at Northwestern University and the GLOBE Program have partnered with scientists from CUAHSI (Consortium of Universities for Advancement of Hydrologic Sciences) to create student investigations of watershed behavior for local, regional, and national scales. Using specialized GIS tools, students access live scientific datasets to investigate complex earth system science issues like water availability and human impact on flood frequency.

To ensure successful integration of My World GIS and the curriculum into the classroom, there have been two teacher professional development workshops. Through these workshops, the Watershed Dynamics curriculum has reached forty-four teachers and over 700 students.

Curriculum Materials

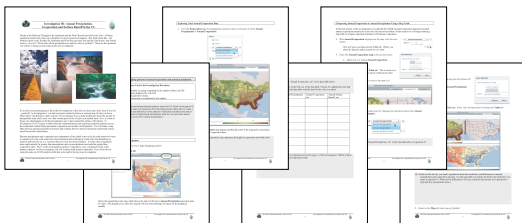
Two 1-2 week-long modules have been developed, targeted at middle and high school earth and environmental science classes.

Module 1 - Water Availability

In the Water Availability unit students ask two fundamental questions:

- When does precipitation come?
- Where does it go?

Students use the North American Regional Reanalysis (NARR) data to analyze annual and seasonal precipitation, evaporation, and surface runoff data across the US.

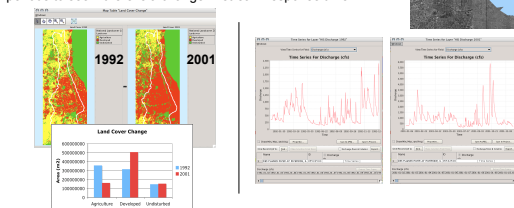


Module 2 - Human Impact on the Watershed

In the Human Impact unit students ask the following driving questions:

- What is a watershed?
- How do humans impact the watershed?
- As land cover changes over time, how does streamflow respond?

In a case study of the Des Plaines watershed in Illinois, students analyze the National Land Cover Dataset from 1992 and 2001 and quantify the change in land cover over time. They import USGS stream discharge data (via a CUAHSI HIS) from different time periods to see if there is a change in stream response time.

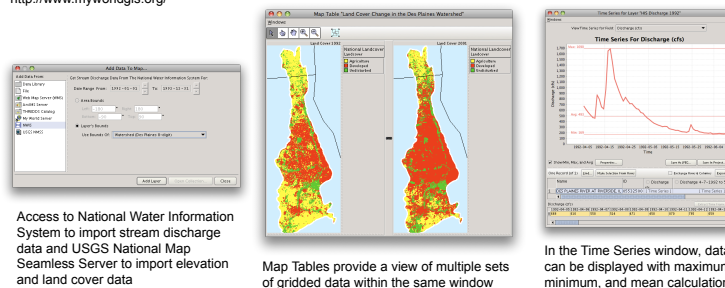


GIS Tool Development

My World GIS™

In the first round of the project, advancements were made to My World GIS™, a GIS designed specifically for use in educational settings by the GEODE Initiative at Northwestern University. Its intended audience is middle school through college geosciences and geography courses where investigations involving geographic data can support the learning goals of the course. My World is designed to meet the needs of students and teachers while keeping the constraints of educational settings in mind. It combines the power of a full-featured GIS environment with the support and structure required by novice users in an educational environment. This project uses My World GIS 5.0 which is being tested for public release.

<http://www.myworldgis.org/>



Map Tables provide a view of multiple sets of gridded data within the same window

In the Time Series window, data can be displayed with maximum, minimum, and mean calculations

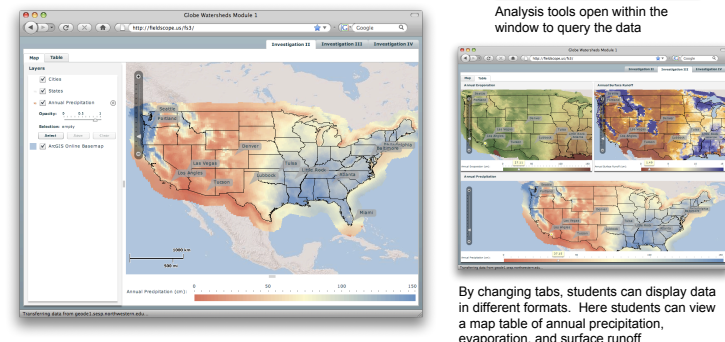
National Geographic FieldScope

The second version of the curriculum utilizes the National Geographic FieldScope web-based GIS. National Geographic FieldScope is a web-based mapping, analysis, and collaboration tool designed to support geographic investigations and engage students as citizen scientists investigating real-world issues - both in the classroom and in outdoor education settings. FieldScope enhances student scientific investigations by providing rich geographic context - through maps, mapping activities, and a rich community where student fieldwork and data is integrated with that of peers and professionals, adding analysis opportunities and meaning to student investigations. FieldScope is a Flex based tool which accesses an ArcGIS Server.

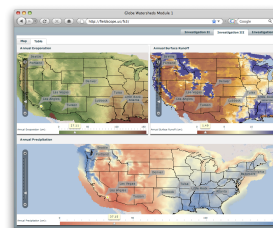
<http://www.fieldscope.us/>

A version of the National Geographic FieldScope has been created to fit the needs of the Watershed Dynamics project. The tool contains the data the specific analysis tools needed to complete the curriculum. The project is served through a web browser, freely available to students and teachers with an internet connection.

The FieldScope tool can be accessed at <http://fieldscope.us/fs3/>



Analysis tools open within the window to query the data



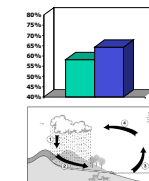
By changing tabs, students can display data in different formats. Here students can view a map table of annual precipitation, evaporation, and surface runoff

Professional Development

	Water Availability	Human Impact on the Watershed
Teacher Training Workshops	August 7-9, 2007	August 12-14, 2008
Participants	23 teachers	21 teachers 2 teacher trainers
States represented	12	13
Number of Students	422	354

Learning Gains: Module 1 - Water Availability

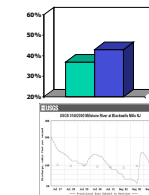
- Score gain for 402 students
 - Pre-test average=58.2%
 - Post-test average=64.3%
 - significant 6.1% gain
 - t-statistic = 5.13, p<.0001
 - effect size = 0.27
- 6-item assessment
 - Students' knowledge of the water cycle and patterns in the U.S.
 - Reliability levels of 0.30 (pretest) and 0.47 (posttest), using Cronbach's Alpha



Item 5: Which part of the water cycle is represented by arrow 3 in the diagram above?

Learning Gains: Module 2 - Human Impact on the Watershed

- Score gain (n=354)
 - Pre-test score average = 37%
 - Post-test score average = 43%
 - significant 6% gain
 - t-statistic = 7.02, p<.0001
 - effect size = 0.36
- 24-item assessment
 - Knowledge of watersheds and interpretation of hydrographs
 - Reliability levels of 0.53 (pretest) and 0.71 (posttest), using Cronbach's Alpha



Item 7: On which date did the discharge rate on the Millstone River increase the most in one day?

GLOBE: Global Learning and Observations to Benefit the Environment



GLOBE (Global Learning and Observations to Benefit the Environment) is a worldwide hands-on, primary and secondary school-based science and education program. GLOBE's vision promotes and supports students, teachers and scientists to collaborate on inquiry-based investigations of the environment and the Earth system working in close partnership with NASA and NSF Earth System Science Projects (ESSPs) in study and research about the dynamics of Earth's environment.

<http://www.globe.gov/>

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