



# EcoMOBILE

## *Ecosystems Mobile Outdoor Blended Immersive Learning Environment*

EcoMOBILE is an exciting new extension of the EcoMUVE curriculum. In EcoMUVE, students explore a virtual representation of a pond ecosystem. In EcoMOBILE, students have the opportunity to extend their learning as they embark on a field trip to a real pond environment. Their experience in the real world is enhanced by using two forms of mobile technology for science education – mobile broadband devices and environmental probeware. The EcoMOBILE research is exploring how ecosystems instruction can be more engaging and effective by combining immersive virtual environments and real ecosystems infused with virtual resources.



EcoMUVE virtual pond environment



EcoMOBILE activities at a real pond

### *In the field*

## Augmented reality to enhance ecosystem science field trips

EcoMOBILE (<http://ecomobile.gse.harvard.edu/>) is a research project at the Harvard Graduate School of Education, supported by the National Science Foundation and Qualcomm's Wireless Reach initiative, and with resources from Texas Instruments, Inc. EcoMOBILE explores the unique affordances of augmented reality, as well as the capabilities of data collection probeware, to support setting-enhanced learning in environmental science education. Two forms of technology for science education enhance student experience in the real world: probes and mobile broadband devices.

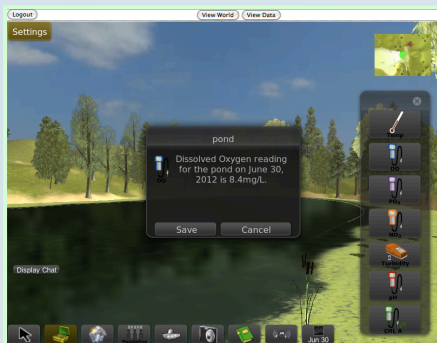
**Probes** (Texas Instruments NSpires with Vernier probes) allow collection of real-time environmental data similar to the kinds of data real scientists use to monitor water quality in lakes, rivers and wetlands. These probes allow students to collect some of the same data (dissolved oxygen, temperature, turbidity, and pH) that they collected in the companion virtual environment.



**MBDs** (Mobile broadband devices, or smartphones) allow students to access and collect additional information and clues. Students use EcoMOBILE activities developed with FreshAiR™, an augmented reality application, to navigate between "hotspots," view information, answer questions, and observe virtual media overlaid on the physical pond. Students can capture pictures, video, or voice recordings and take these back to the classroom to help make sense of school lessons. Through augmented reality we provide students with visualizations that would not otherwise be apparent in the natural environment (for example, virtual x-ray vision so that they can "see" a virtual carbon atom as it moves through the processes of photosynthesis and respiration). These augmented reality experiences allow students to conceptualize and discuss processes and complex relationships that are otherwise difficult to describe or visualize.

## In the classroom

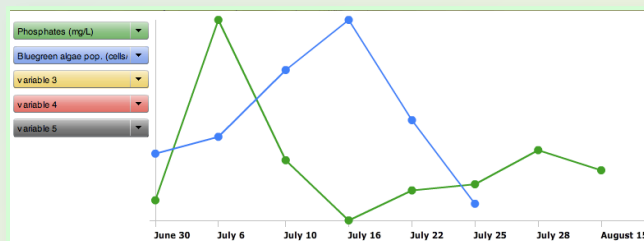
### Inquiry-based exploration of virtual ecosystems



population data, take water measurements (e.g., temperature, dissolved oxygen, phosphates), talk with virtual residents, make observations, and even track specific atoms over time. Working in teams, students collect and analyze data to solve the mystery and learn about the complex causality of the pond ecosystem.

EcoMUVE (<http://ecomuve.gse.harvard.edu/>) is a curriculum that was developed at the Harvard Graduate School of Education with funding from the Institute of Education Sciences, U.S. Department of Education. It is a multi-user virtual environment (MUVE)-based curriculum that is designed to support middle-school learners developing an understanding of complex causality in ecosystems. It consists of two two-week MUVE-based modules, Pond and Forest. Each module centers around an immersive, simulated ecosystem that represents a complex ecological scenario.

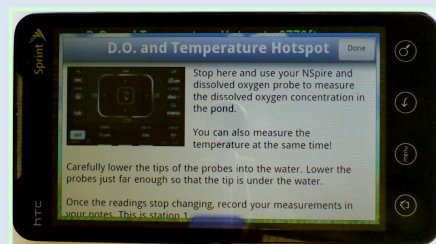
For example, in the Pond module, students visit the pond over a number of virtual "days" and discover on one day that many fish in the pond have died. Within the virtual environment, students collect weather, and



By offering authentic tools, augmented views of complex relationships, and guidance through inquiry activities in natural environments, EcoMOBILE activities can provide students with an experience that helps them understand ecosystem concepts and relate to the work of real scientists.

*It's much better than learning from a textbook because it's more interactive... because you're in... you're in it, you can see everything instead of just reading, and the questions are related to what you can physically do, instead of what you just know from your knowledge.*

~ 6<sup>th</sup> grade student using EcoMOBILE during a field trip.



EcoMobile is funded by the National Science Foundation and Qualcomm's Wireless Reach initiative and is supported with resources from Texas Instruments, Inc.

For more information about EcoMOBILE, visit our website at [ecomobile.gse.harvard.edu](http://ecomobile.gse.harvard.edu)

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