How Immersion in Virtual and Augmented Worlds Helps Students in the Real World

Chris Dede

Harvard University

Chris_Dede@harvard.edu

http://isites.harvard.edu/chris_dede

Perennial Challenges in Classrooms

- Classrooms are barren places without rich resources or ways to simulate the real world
- Students are bored compared to the many forms of engagement they have in the rest of their lives
- Teachers are the only way increasingly large numbers of students can get help personalized to their needs
- Paper and pencil, item-based assessments cannot measure deep knowledge and sophisticated skills

Situated Learning and Transfer

- constellations of architectural, social, organizational, and material vectors that aid in learning culturally based practices
  - apprenticeship (the process of moving from novice to expert within a given set of practices)
  - legitimate peripheral participation (tacit learning similar to that involved in internships)
  - high fidelity is not important unless essential for task (e.g., interpreting photographic images)

Next Generation Interfaces for "Immersive Learning"

- **Multi-User Virtual Environments:**
  Immersion in virtual contexts with digital artifacts and avatar-based identities
- **Virtual Reality**
  Full sensory immersion via head-mounted displays or CAVES
- **Ubiquitous Computing:**
  Wearable wireless devices coupled to smart objects for "augmented reality"

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EcoMUVE

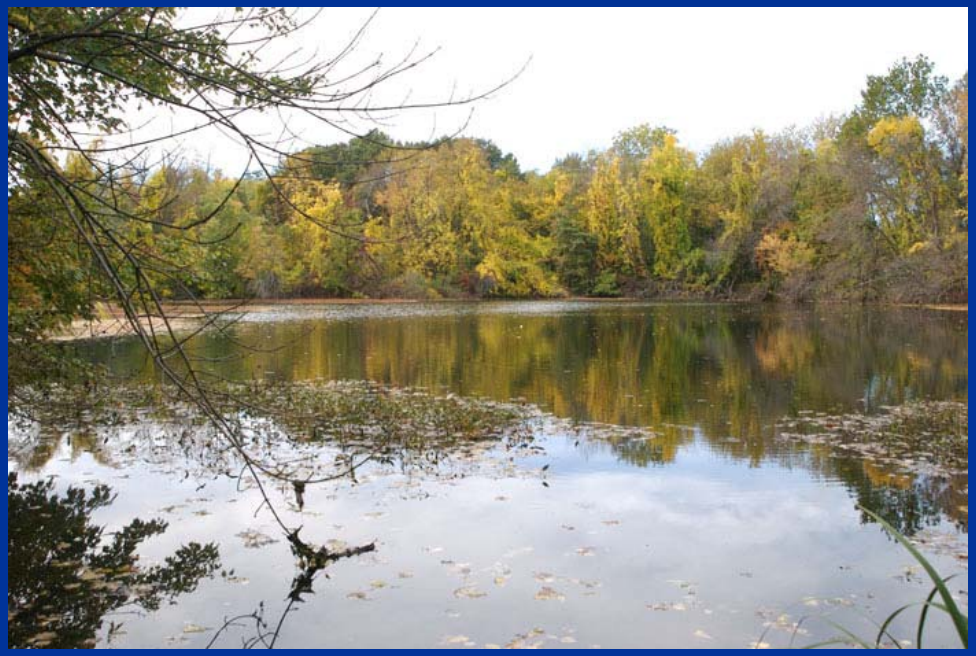
- Funded by the Institute of Education Sciences of the U.S. Department of Education.
- Middle school science
  - Ecosystems, Causal complexity.
- Two MUVE-based modules implemented over two weeks within a four week ecosystems curriculum.
- Timeline: July, 2008 - July 2011

Project Overview

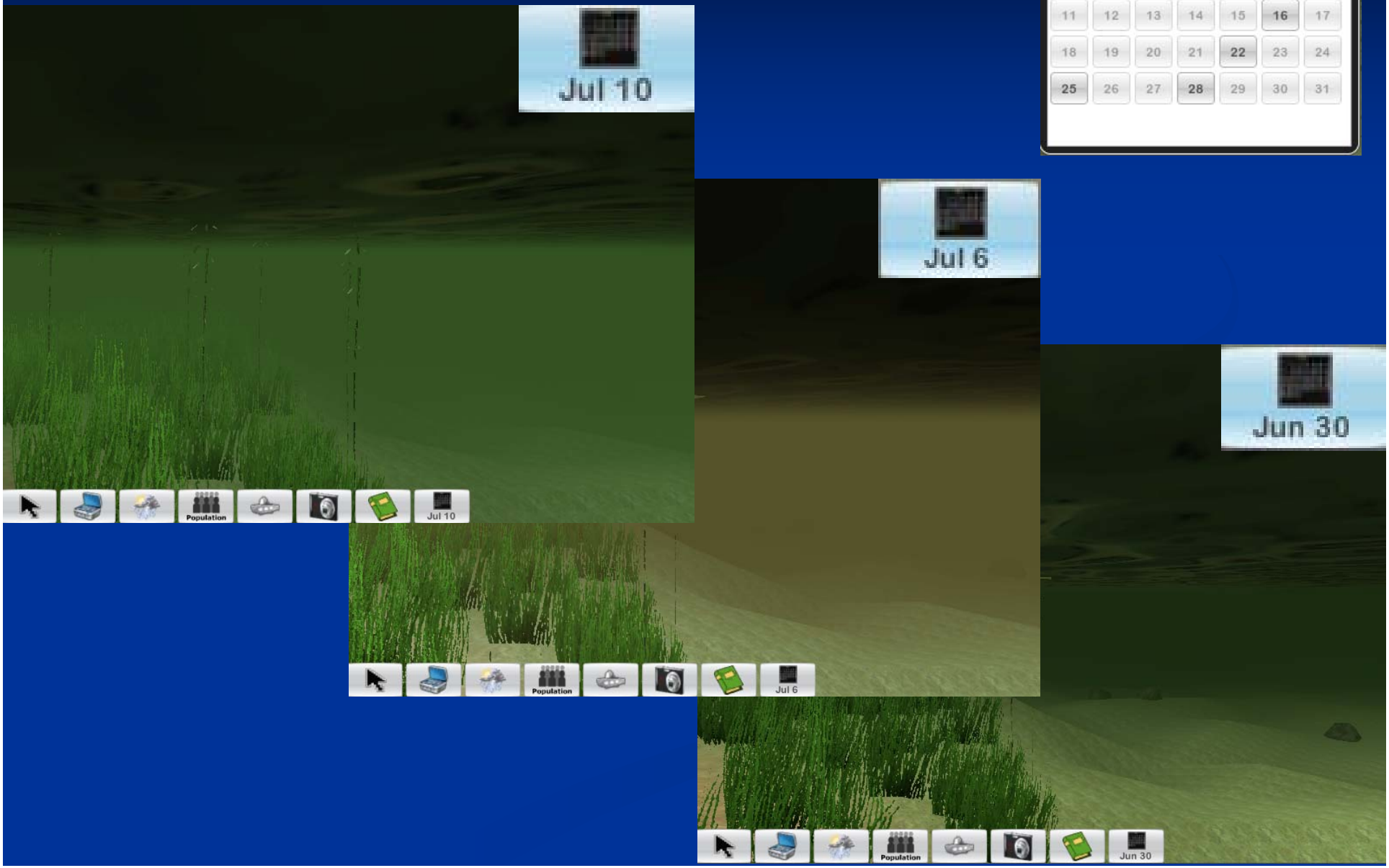
- Ecosystems have complex causal dynamics.
- Even after instruction, students often retain misconceptions.
- In our experience, MUVEs can help students engage in authentic science inquiry and gain deeper understanding.
- Our goal is to develop EcoMUVE as a MUVE that, as part of a larger curriculum, will enable a richer understanding of ecosystems and complex causality.

Module 1: Pond Ecosystem

Modeled after Black's Nook Pond in Cambridge, MA



Change over Time



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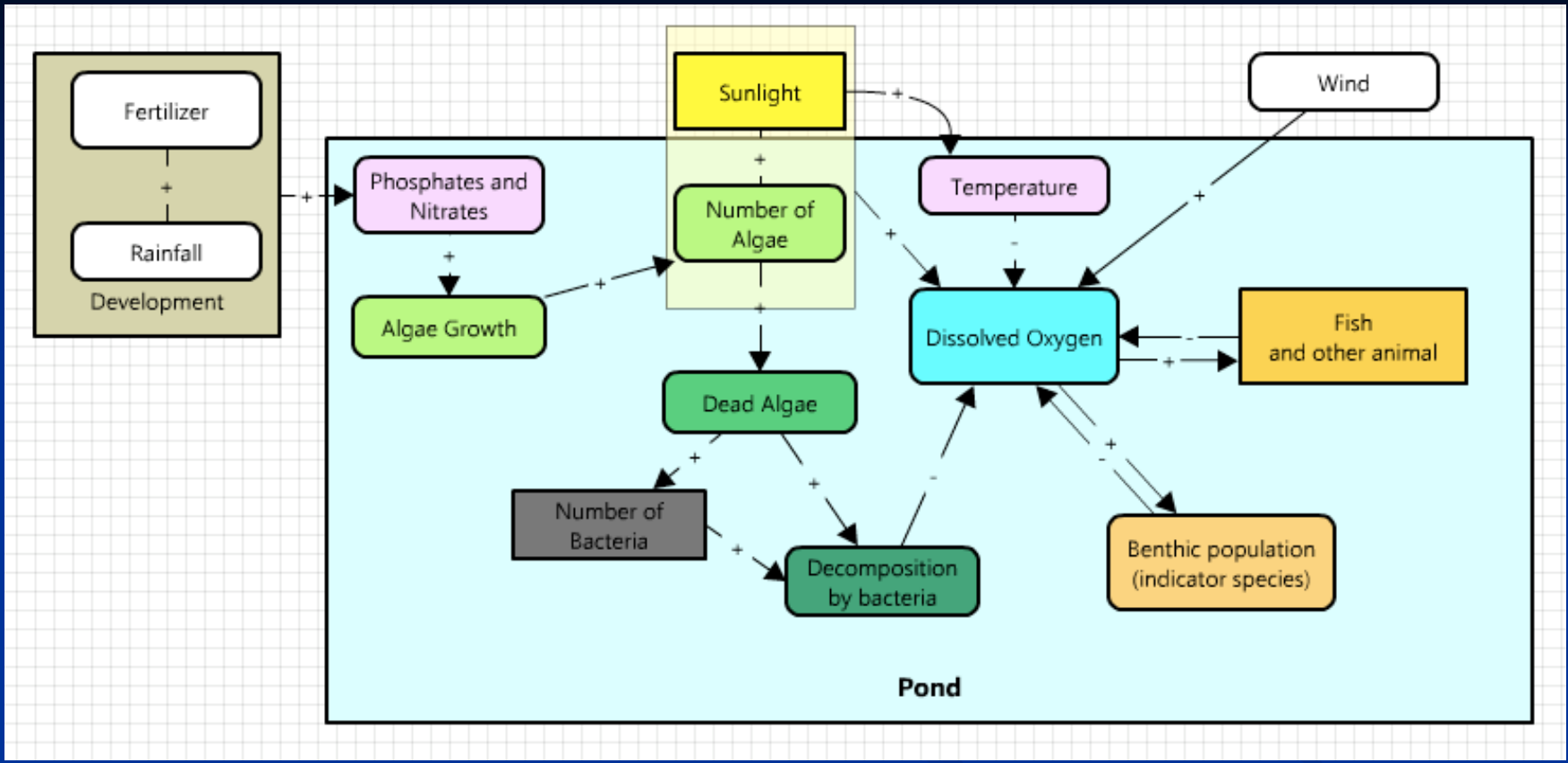
Non-Obvious Causes

Unintentional Agency

Naturalist	Microscopic Specialist	Water Chemist	Private Investigator
Observe pond for similarities to EcoMUVE	Observe duckweed	Observe pond for similarities to EcoMUVE	Talk to virtual golfer
Observe virtual fish	View 3D model of duck	Measure dissolved oxygen	Observe storm water pipe overlay
Calculate fish population size	Video of starch decomposition by bacteria	Video of how oxygen dissolves in water	Find inlet and outlet of pond
Collect macroinvertebrates	Observe virtual bacteria	Measure water temperature	Talk to young girl about what a watershed is
ID macroinverts and calculate tolerance index	Measure pH	Measure phosphates	Measure turbidity
Work together to create video that summarizes the health of the pond based on whole team's observations			



Interaction between Biotic and Abiotic Factors

Runoff causes increased phosphate levels, leading to increased plant growth. Plant decomposition by bacteria consumes oxygen, causing the eventual fish kill.

http://ecomuve.gse.harvard.edu

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1976

2012

The Evolving Mobile Experience

Always On, Always Connected Devices

ALWAYS-ON CONNECTIVITY

ALL-DAY BATTERY LIFE

SECURITY

LOCATION AWARE

MULTIMEDIA PERFORMANCE

UNPRECEDENTED POWER & SPEED

snapdragon by Qualcomm

Beyond "Old Wine": Augmented Reality

Augmented realities utilize *mobile, context-aware* technologies that enable participants to interact with digital information, videos, visualiazations, and simulations embedded within a physical setting.

- Location-aware AR presents digital media to learners as they move through a physical area with a GPS-enabled smartphone or similar mobile device
- Vision-based AR presents digital media to learners after they point the camera in their mobile device at an object (e.g., QR code, 2D target).


上環
西 W
九龍(西)
康樂廣場
機場快綫站
愛丁堡廣場
九龍

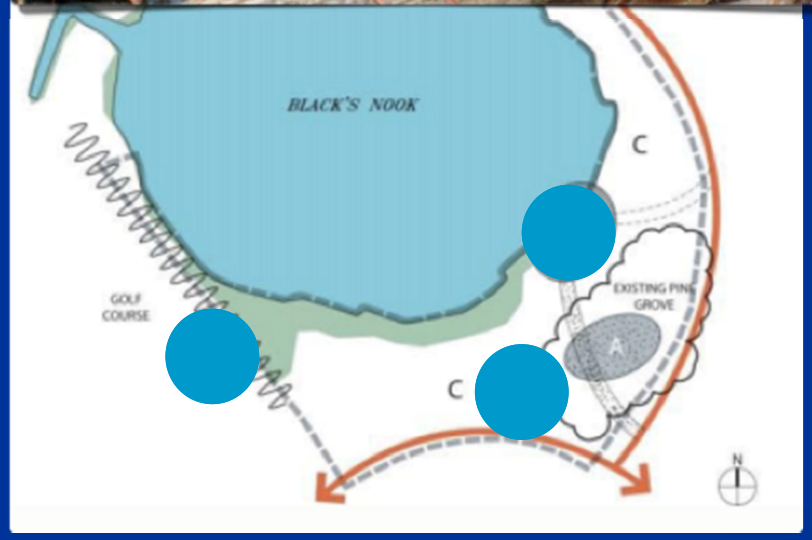

Sheung Wan
西 W
Kowloon (W)
Connaught Place
Airport Express Station
Edinburgh Place
Kowloon

(Conner Flynn)

EcoMUVE is going Mobile

http://ecomobile.gse.harvard.edu


678k
TALK
INFO
Beds: 4 Baths: 2.5
Floors: Hardwood, Carpet
Walkable Rating: 98
SEND
(Zonkio.com)


BLACK'S NOOK
C
GOLF COURSE
EXISTING PINE GROVE
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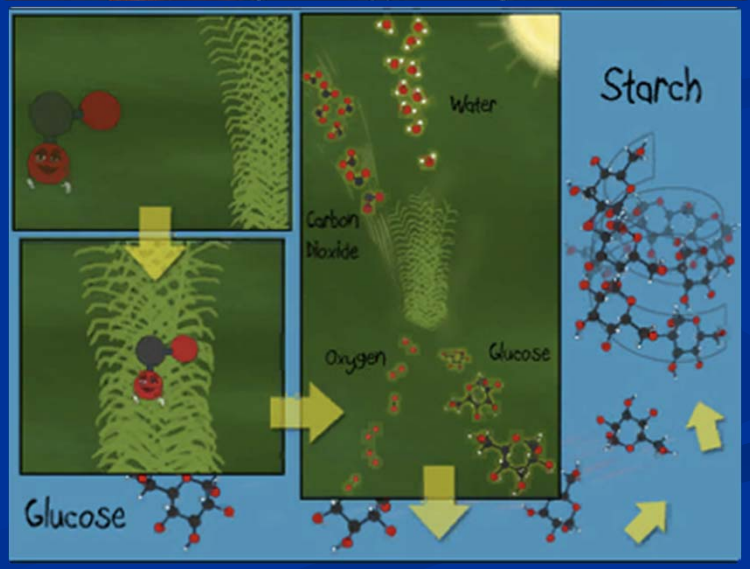
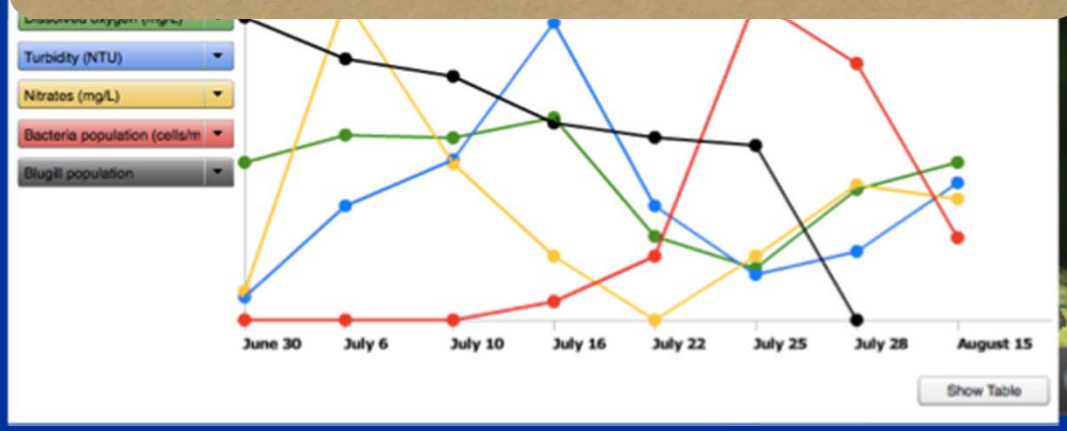
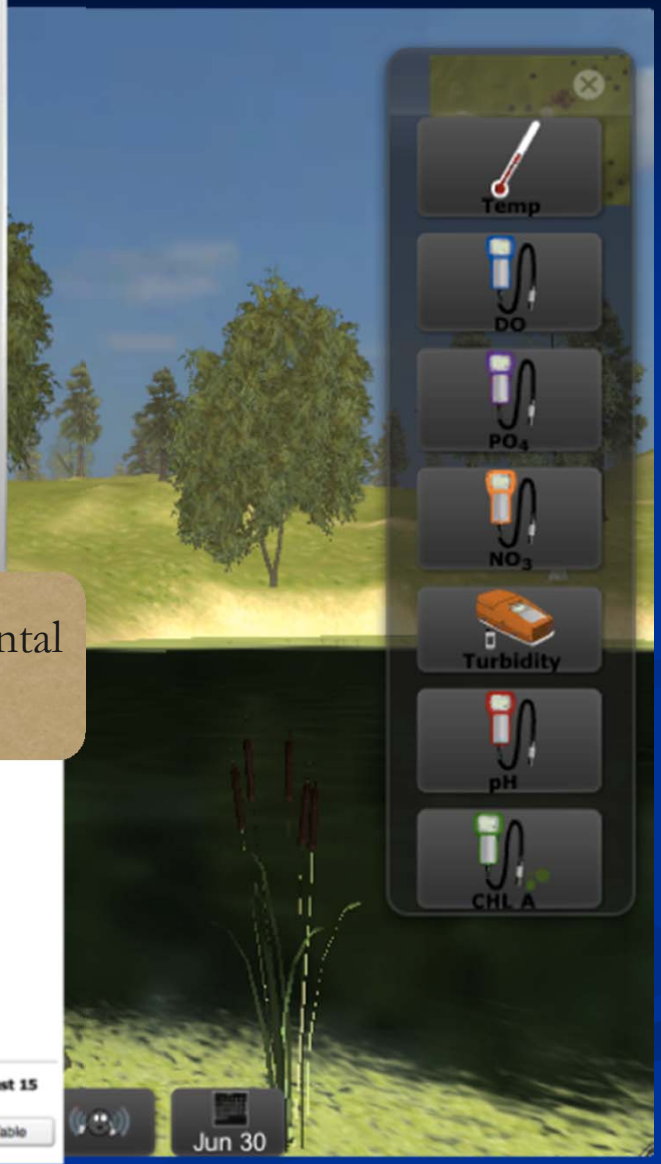
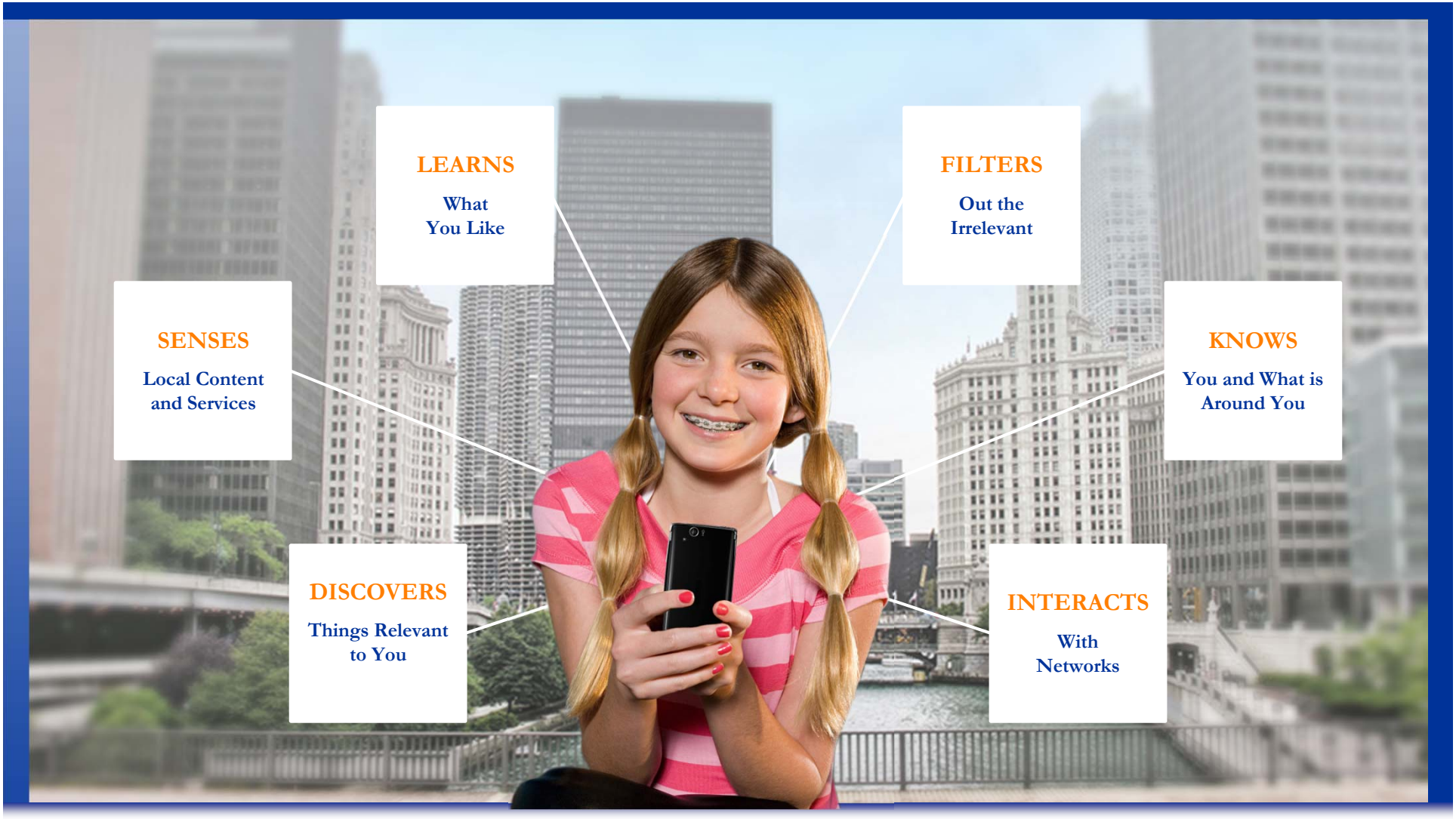

Water
Starch
Carbon Dioxide
Oxygen
Glucose
Glucose

Texas Instruments NSpires with Vernier Environmental Probes







Interface for Your Digital Life

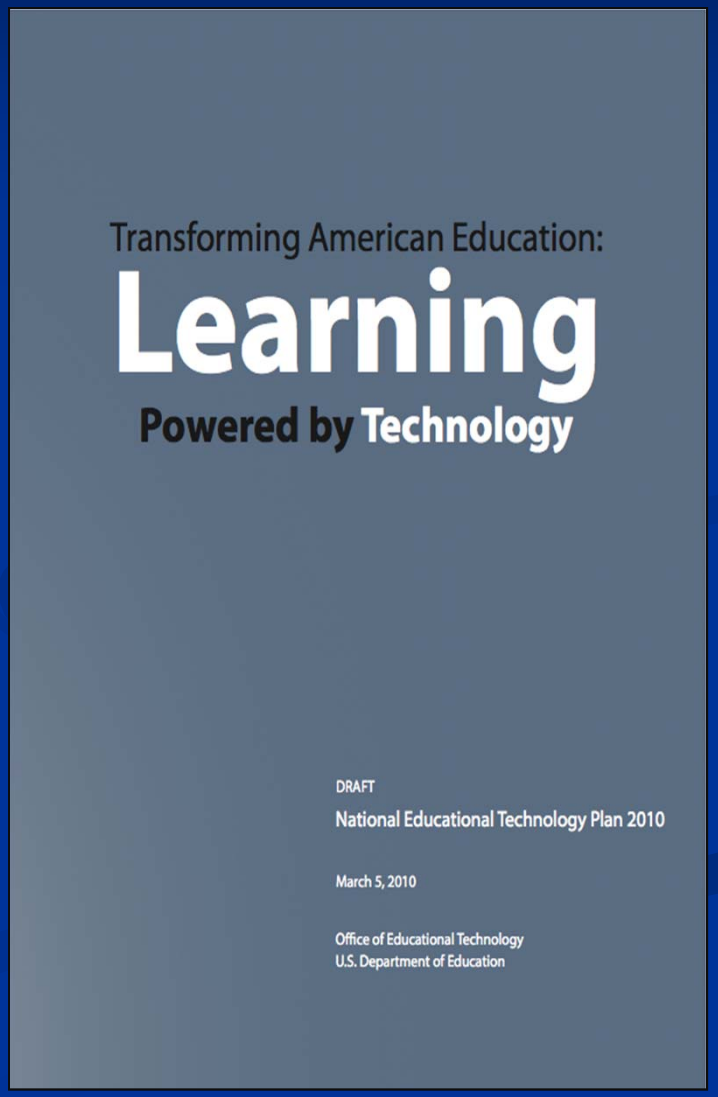
IN THE FUTURE YOUR MOBILE PHONE WILL ACT AS YOUR DIGITAL "6TH SENSE"

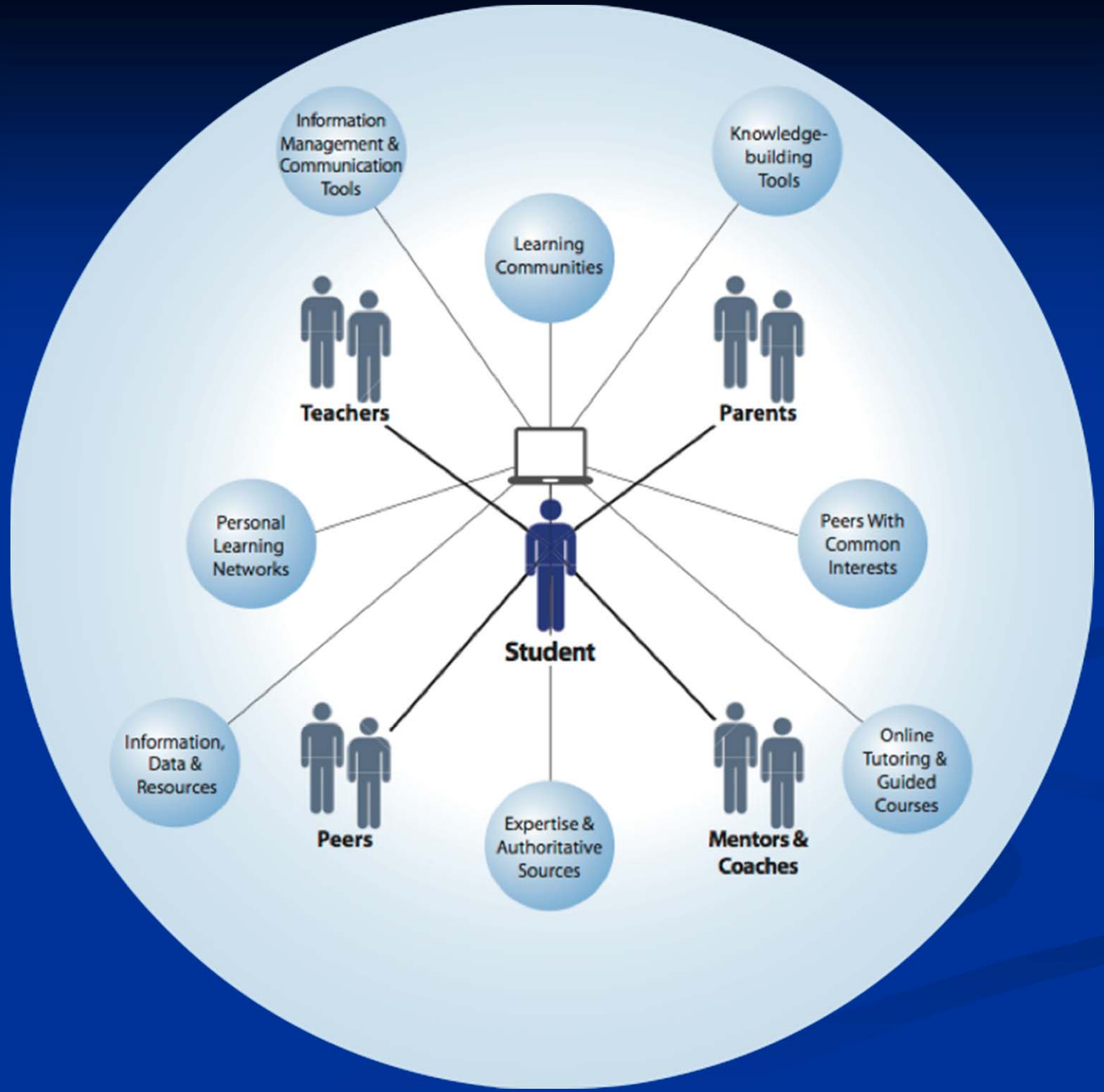
Why Immersion for Learning?

- allow simulated experiences otherwise impossible to deliver.
- increase engagement in learning by allow students to immerse themselves in a virtual world.
- support new forms of interaction and collaboration
- enable embedded hints and tutoring delivered via situated, just-in-time processes.
- Increase – *and assess* – learner's knowledge, skills, and self-efficacy.
- promote transfer to the real world more than other forms of instruction

The 2010 NETP

- Response to Congressional mandate for five-year plan for educational uses of technology
- Plan for *transforming* education with technology in response to urgent need to remain competitive in a global economy
- Reflection of increased understanding of how to support learning and of growing capabilities enabled by technology




Information Management & Communication Tools
Knowledge-building Tools
Learning Communities
Teachers
Parents
Personal Learning Networks
Peers With Common Interests
Student
Information, Data & Resources
Peers
Expertise & Authoritative Sources
Mentors & Coaches
Online Tutoring & Guided Courses

Transformation of Formal Education

A Different Model of Pedagogy

- Experiences central, rather than information as pre-digested experience (for assimilation or synthesis)
- Knowledge is situated in a context and distributed across a community (rather than located within an individual: with vs. from)
- Reputation, experiences, and accomplishments as measures of quality (rather than tests, papers)

Core Principles of Professional Development

- Teachers teach as they were taught.
- The important issue is not technology usage, but changes in content, pedagogy, assessment, and learning outside of school.
- Continuous peer learning is the best strategy for long-term improvement.

Professional Development: Communities of "Unlearning"

- Developing fluency in using emerging interactive media
- Complementing presentational instruction with collaborative inquiry-based learning
- Unlearning almost unconscious assumptions and beliefs and values about the nature of teaching, learning, and schooling

Crucial issue for professional development