# "Wired, Webbed, Windowed"

# ¿Y Ahora Qué?

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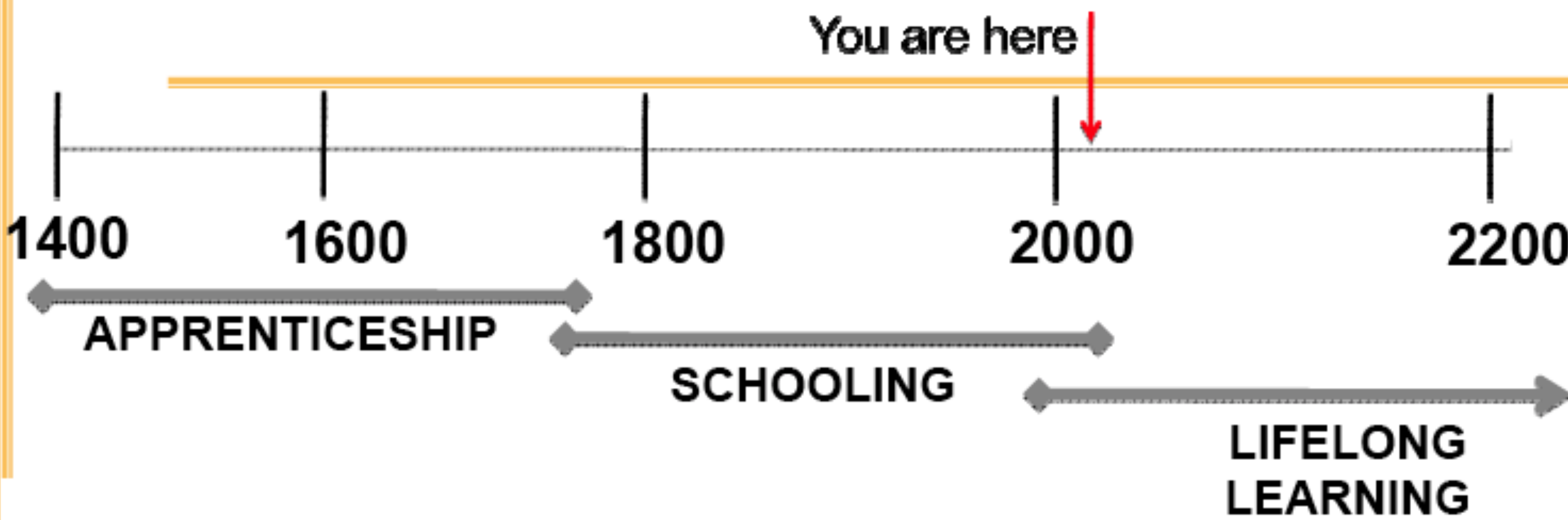
**Policy Division; SRI International**

**LIFE NSF Science of Learning Center**
**Learning in Informal and Formal Environments**

Center for Technology in Learning

# A New Era in Education




| | Apprentice | Schooling | Lifelong-Interactive learning |
|---|---|---|---|
| Responsibility | Parents | State | Individual |
| Pedagogy | Apprenticeship | Didacticism | Interactivity |
| Assessment | Observation of student | Testing Student | Embedded and work-related |
| Culture | Adult (Tasks that adults want done) | Peer | Mixed |
| Relationships | Personal, bonding | Authority figure | Computer-mediated, interactive |

Collins and Halverson, 2009

# ¿Qué cambió?

**Everything has changed but our thinking**
**Albert Einstein**

- ¿Porqué C,T,E,M?
- ¿Porqué ahora?
- ¿Porqué hace falta que tecnólogos y educadores colaboren?
- ¿Cual es el rol de los tecnólogos?

# Desde fines del Siglo XX

¿Qué ha cambiado?

- La información y el conocimiento están avanzando mucho mas rápido que en ningún otro momento histórico

- El sentido de "SABER" (*KNOWING)* cambió de:
  'recordar y repetir' información a:
  'buscar y utilizar' información *(y generarla…)*
  (Herbert Simon, Cognitive Psychologist and Nobel Laureate Economics)

# *'Technological FITness'*

Fluidez con IT (*Fluency with Information Technology, FIT*) es el conocimiento que permite explorar, interactuar, y vivir en una sociedad que es cada vez mas dependiente no solo de tecnología en general, pero de tecnología de la información (IT) en particular.

Committee on Information Technology Literacy.
National Research Council, USA. **(1999**).
Being Fluent with Information Technology.
National Academy Press

## The Components of Fluency with Information Technology
*Intellectual Capabilities*
*Information Technology Concepts*

### Information Technology Skills

1 Instalar una computadora personal
2 Utilizar funciones básicas del sistema operativo
3 Utilizar un procesador de palabras para crear un documento
4 Utilizar un programa gráfico o artístico para crear ilustraciones, presentaciones, u otras imágenes que expresen ideas.
5 Conectar una computadora a una red
6 Utilizar una computadora para comunicarse con otros
8 Utilizar una spreadsheet para modelar procesos simples o tablas financieras
9 Utilizar una base de datos para organizar y acceder a información
1 Utilizar manuales para aprender como utilizar nuevas aplicaciones

# "Computational thinking" es integrar el poder del pensamiento humano con la capacidad de las computadoras

La esencia del (pensamiento computacional?) es pensar acerca de datos y de ideas, y utilizar y combinar estos recursos para resolver problemas. Los maestros pueden ayudar a los alumnos a "pensar computacionalmente" utilizando proyectos tecnológicos que vayan mas allá del uso de herramientas e información y que ayuden a que ellos mismos creen herramientas e información.

## Ejemplo

En el transcurso de estudiar abejas con estudiantes de escuela primaria, los llevó al patio y los hizo actuar como abejas: salir de la colmena a buscar néctar, encontrar el néctar, compartir la información con las otras abejas. Después en el aula fué al pizarrón y los hizo participar de actividades que yo calificaría como modelamiento, debugging, y desarrollar diagramas del proceso. Sin llamarlos así, pero eso es lo que eran.

*Sí, les estaba enseñando ciencia, pero la manera en que analizaba el concepto y como los hacía analizar la solución, involucraba ciertamente una serie de procesos computacionales.*

# "Pensamiento computacional" en ciencias:

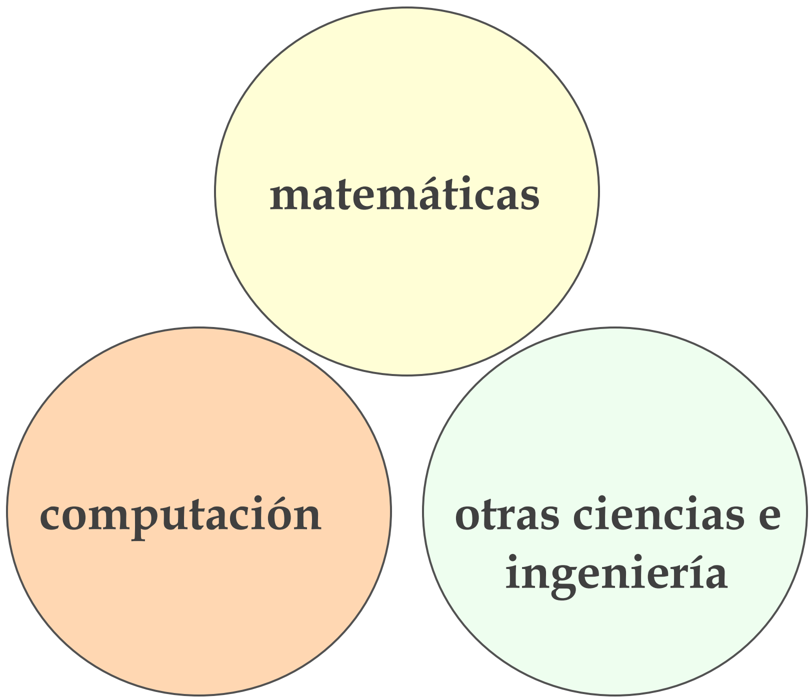
Crear nuevas herramientas y nueva información requiere pensar en procesar datos, manipular datos, usar abstractiones, y otros conceptos familiares en ciencias de la computación.

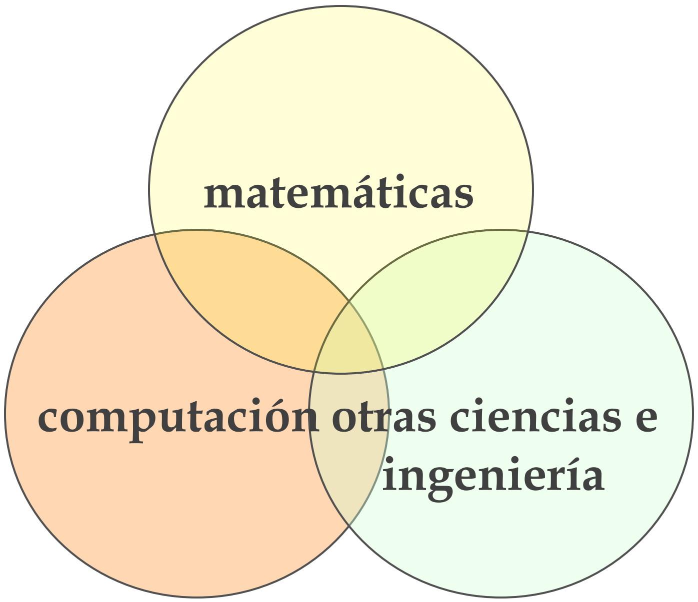
***Computational (Science Education)*: usar un modelo para enseñar un concepto**

***(Computational Science) Education*: enseñar como diseñar el modelo**

***Computational Thinking* construir el modelo**

# Era de las "hyphenated sciences" (*biomatemáticas, bioinformática, neurociencia computacional, ciencia del diseño, etc.)*



# COMPUTATIONAL THINKING

## A PROBLEM-SOLVING TOOL FOR EVERY CLASSROOM

By: Pat Phillips

csta Computer Science Teachers Association

Microsoft

csta.acm.org/Resources/sub/highlightedResources.html

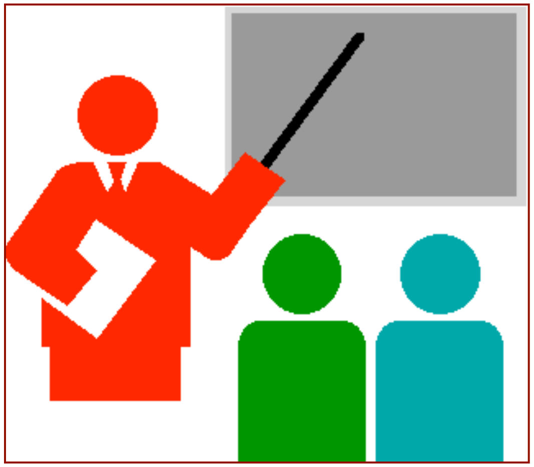
# Cuando hablamos solamente de TICs y competencias

Hablamos principalmente comunicación y sus herramientas (incluídas las del Siglo XXI) cambian el panorama laboral

Cuando hablamos de TICs *y contenidos* analizamos como estas mismas herramientas han cambiado las ciencias tanto naturales como computacionales y sociales.

*Como se reflejan esos cambios en la pedagogía del Siglo XXI?*

*Y que sabemos sobre sus efectos en el aprendizaje?*



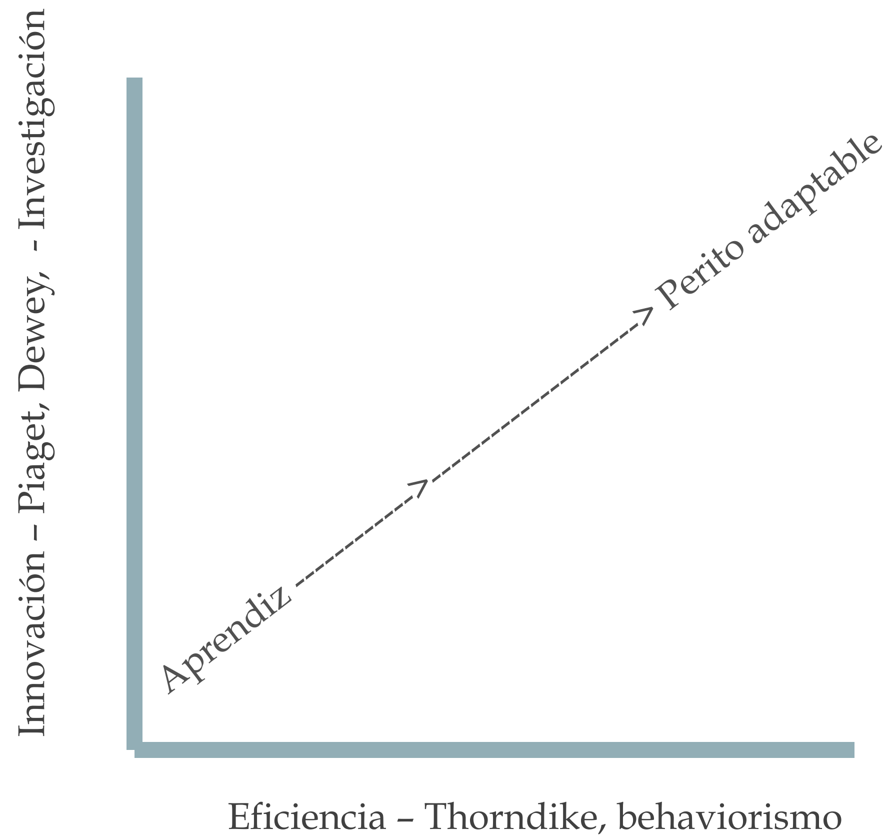
# ¿Buscamos eficiencia?


## Eje horizontal

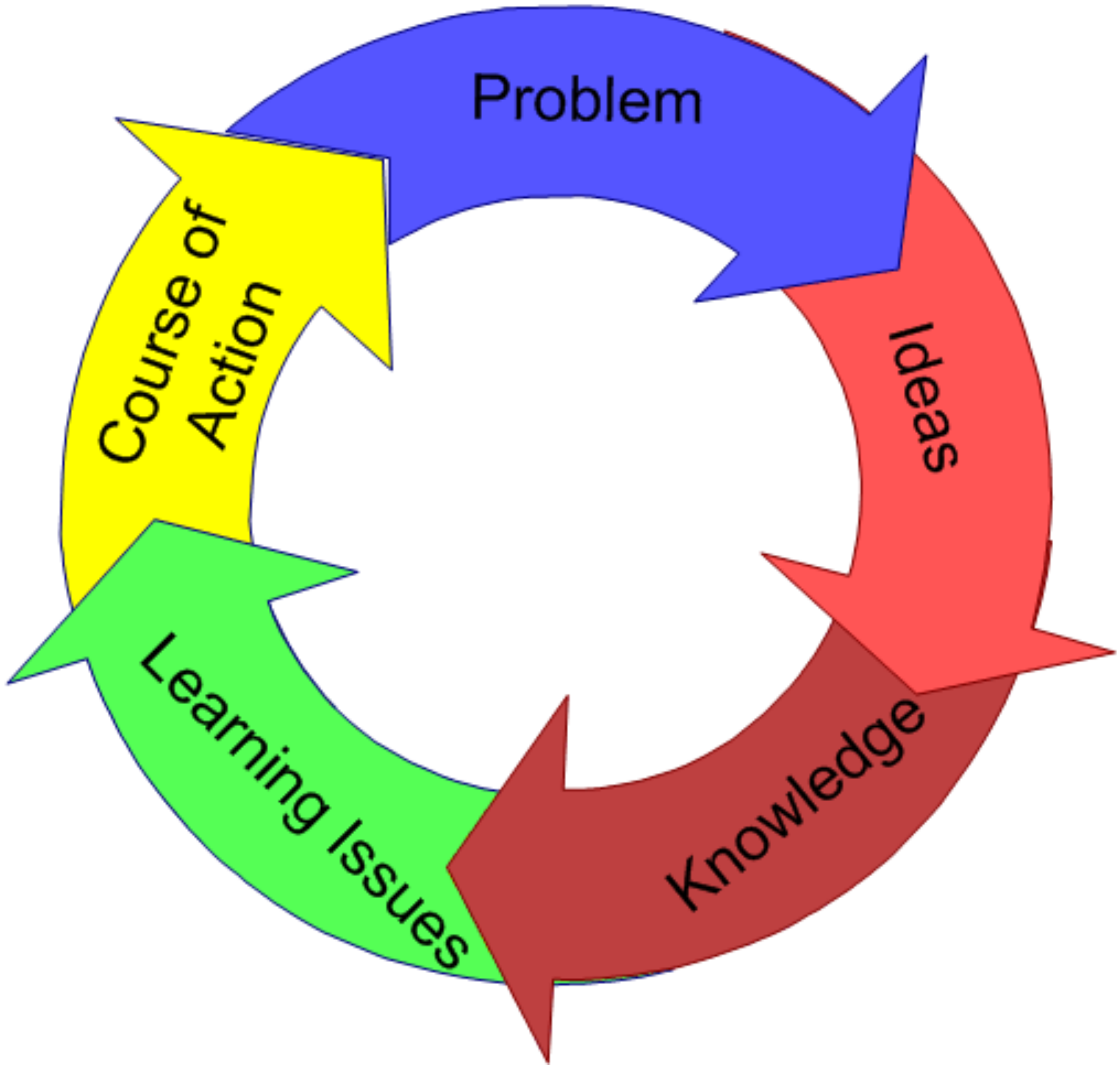
- **Eficiencia**
  - Pericia rutinaria
  - Larga lista de objetivos
  - Memorización

## Eje vertical

- **Innovación**
- Creatividad
- "Constructive Failure"

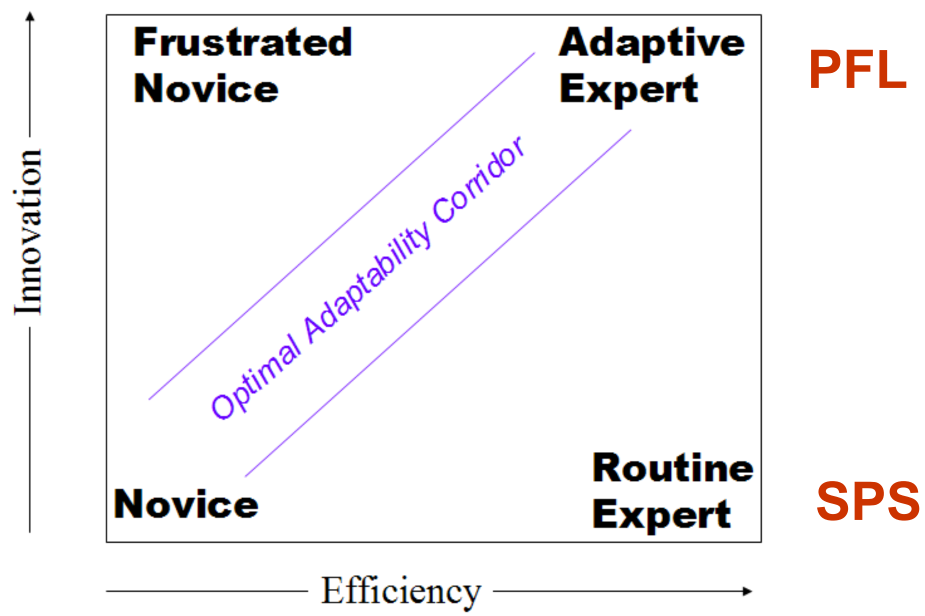


# Problem-Based Learning Process

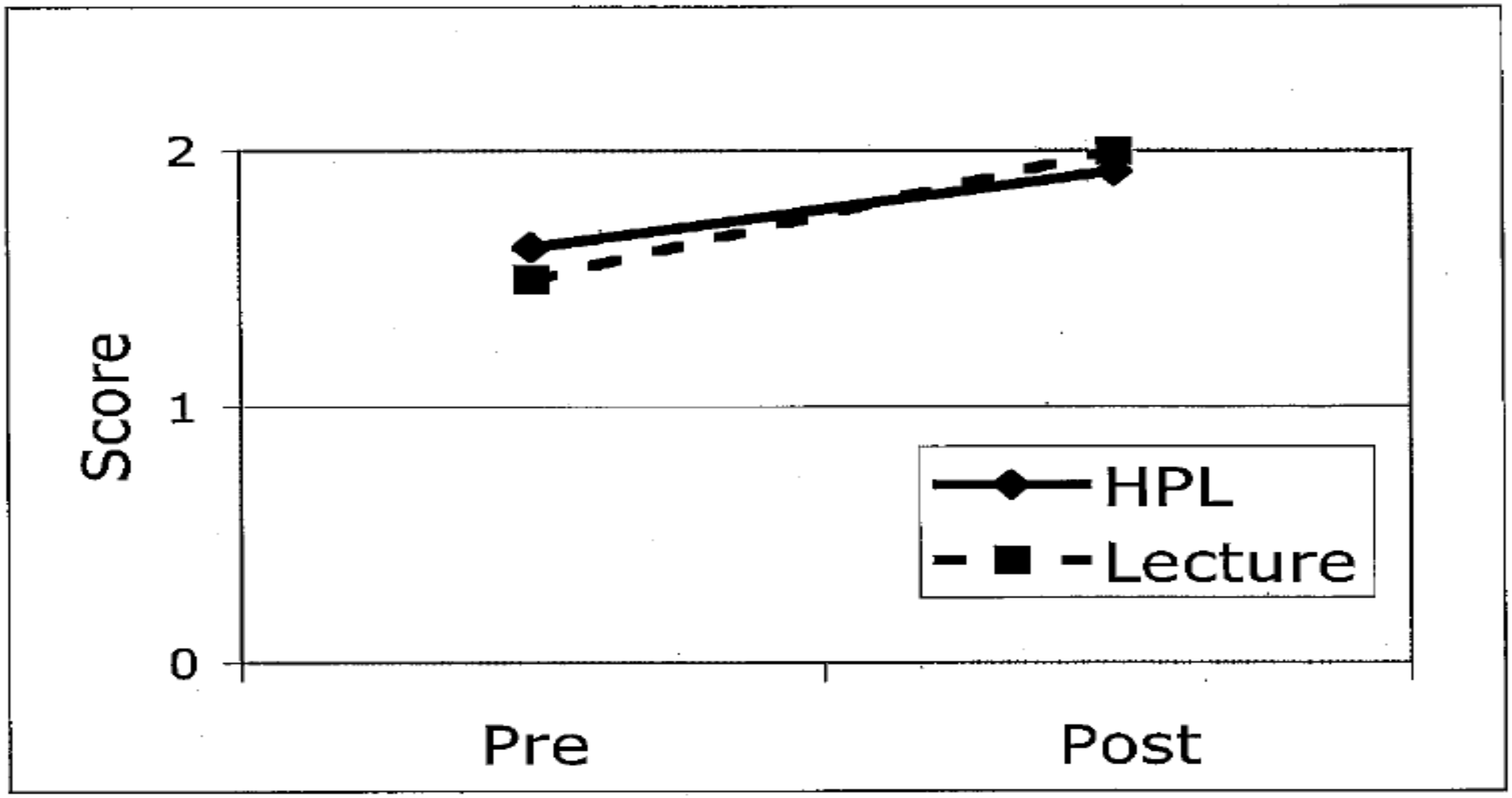


# *Need new assessments*

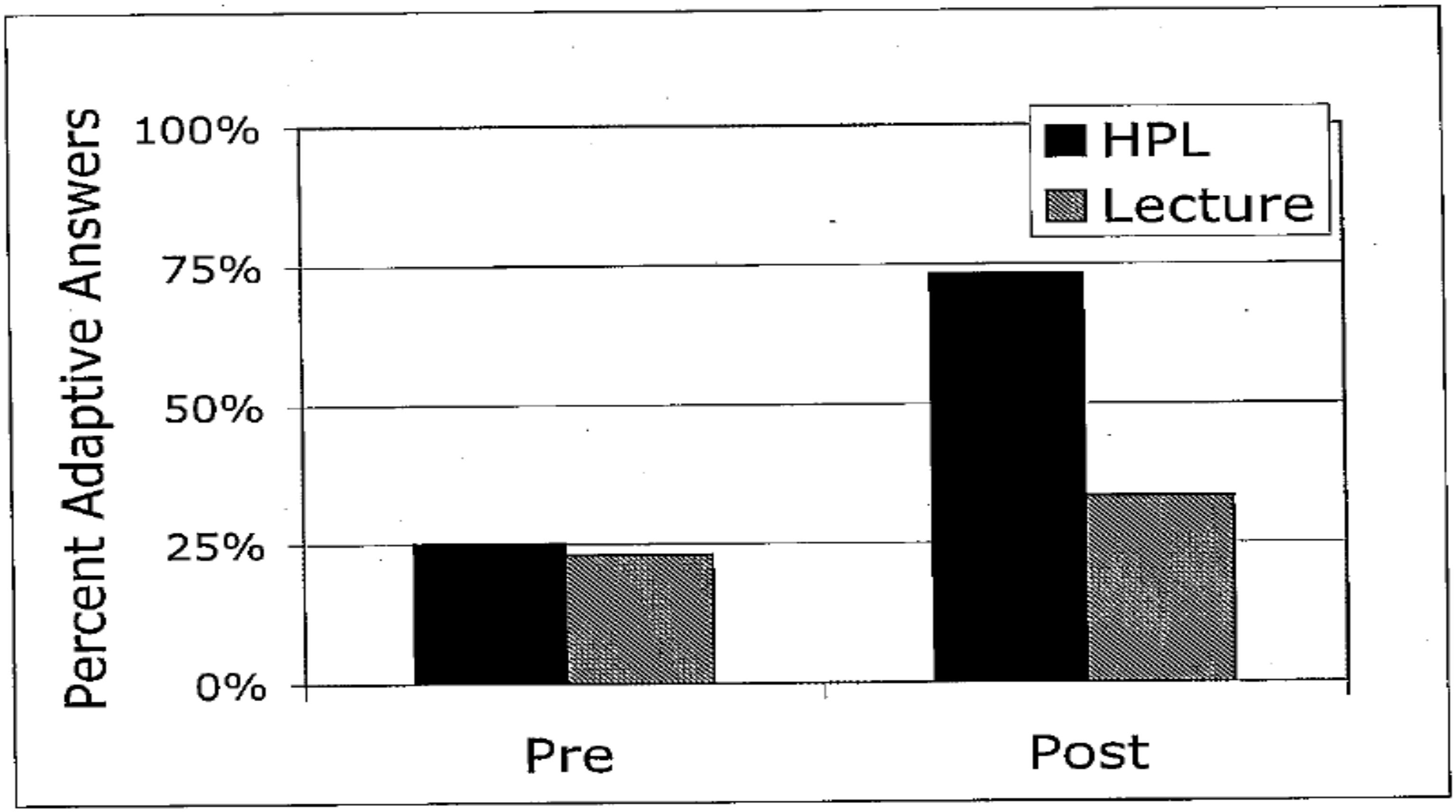
- Evaluating efficiency
  - Sequestered Problem Solving (SPS)
- Evaluating adaptivity
  - Preparation for Future Learning (PFL)



# Factual Knowledge



# Adaptive Expertise

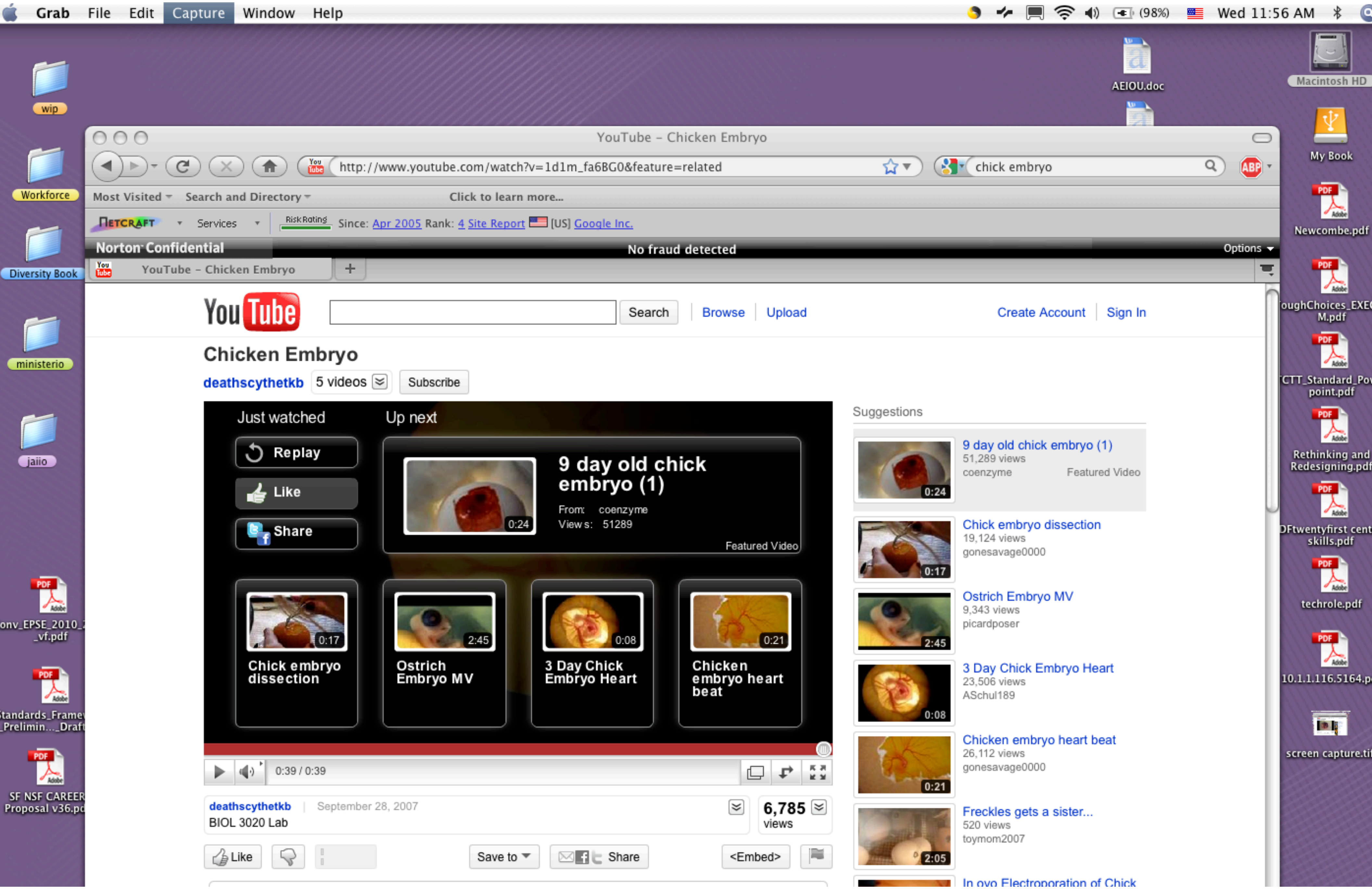


## *Se puede tener veinte años de experiencia*
## *o*
## *un año de experiencia veinte veces*

Estudios demuestran que simplemente observar demostraciones, estudiar analogías gráficas, etc. ayudan muy poco a comprender conceptos básicos.

El desarrollo de "pericia adaptable" requiere interacción (i.e. autoalimentación) con el entorno, incluyendo pares

**Vamos a los ejemplos**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Norton Confidential
No fraud detected
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9 day old chick embryo (1)
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coenzyme
Featured Video
Chick embryo dissection
19,124 views
gonesavage0000
Ostrich Embryo MV
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3 Day Chick Embryo Heart
23,506 views
ASchul189
Chicken embryo heart beat
26,112 views
gonesavage0000
Freckles gets a sister...
520 views
toymom2007
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AEIOU.doc
Macintosh HD
My Book
Newcombe.pdf
techrole.pdf
screen capture.tif
wip
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Diversity Book
ministerio
jaiio

*http://chickscope.beckman.uiuc.edu/*

**What is Chickscope?**

Using computers in the classroom with access to the Internet, students and teachers are able to access data generated from the latest scientific instruments. The goals include an increased understanding of the process of gathering scientific data and the opportunity to interact with scientists from several disciplines and students in other classrooms The access to unique scientific resources and expertise provides motivation for learning science and mathematics and stimulates interest in the scientific world.

**Join Bugscope!**

Bugscope is an educational project of the Imaging Technology Group. ***Participating classrooms have the opportunity to control an Environmental Scanning Electron Microscope to image insects at high magnification.*** Bugscope has been underway since 1999: join us for the fun!

# River City Research Project.

Welcome to the River City Research Project. With funding from the National Science Foundation, we have developed an interactive computer simulation for middle grades science students to learn scientific inquiry and 21st century skills.

River City has the look and feel of a videogame but contains content developed from National Science Education Standards, National Educational Technology Standards, and 21st Century Skills.

## The River City Project concentrates on the areas of **epidemiology, scientific inquiry, and experimentation**.

### The River City Curriculum supports students as they:

* Learn the principles and concepts of science;
* Acquire the reasoning and procedural skills of scientists;
* Devise and carry out investigations that test their ideas; and
* Understand why such investigations are uniquely powerful.

River City is a 17 hour, time-on-task curriculum that includes a pretest and a research conference at the end of the unit. Teachers are not expected to find extra time in the school year in order to implement River City. On the contrary, the River City Curriculum is designed and intended to replace existing lessons. The River City Curriculum is interdisciplinary in scope, spanning the domains of **ecology, health, biology, chemistry, and earth science, as well as history**.

*Thinking with Data* is a series of dynamic, flexible, and Web-based tools that support data analysis across the curriculum.

The aim is to help learners *with diverse skills and interests* develop inquiry and data analysis skills to understand and use online data sets in ***mathematics, science (ecology based), and social science***. The approach makes statistics come alive by emphasizing cutting-edge, learner-centered data visualization tools; relevance through customization of datasets; dynamic interaction with data, and collaboration and community as teachers and learners investigate compelling social science topics using existing international databases.

In parallel with this development we will conduct research on increasing the data literacy of teachers and students. In the process, the team will research how an interdisciplinary approach to data literacy can deepen students' conceptual understanding in the content areas and improve their problem-solving skills.

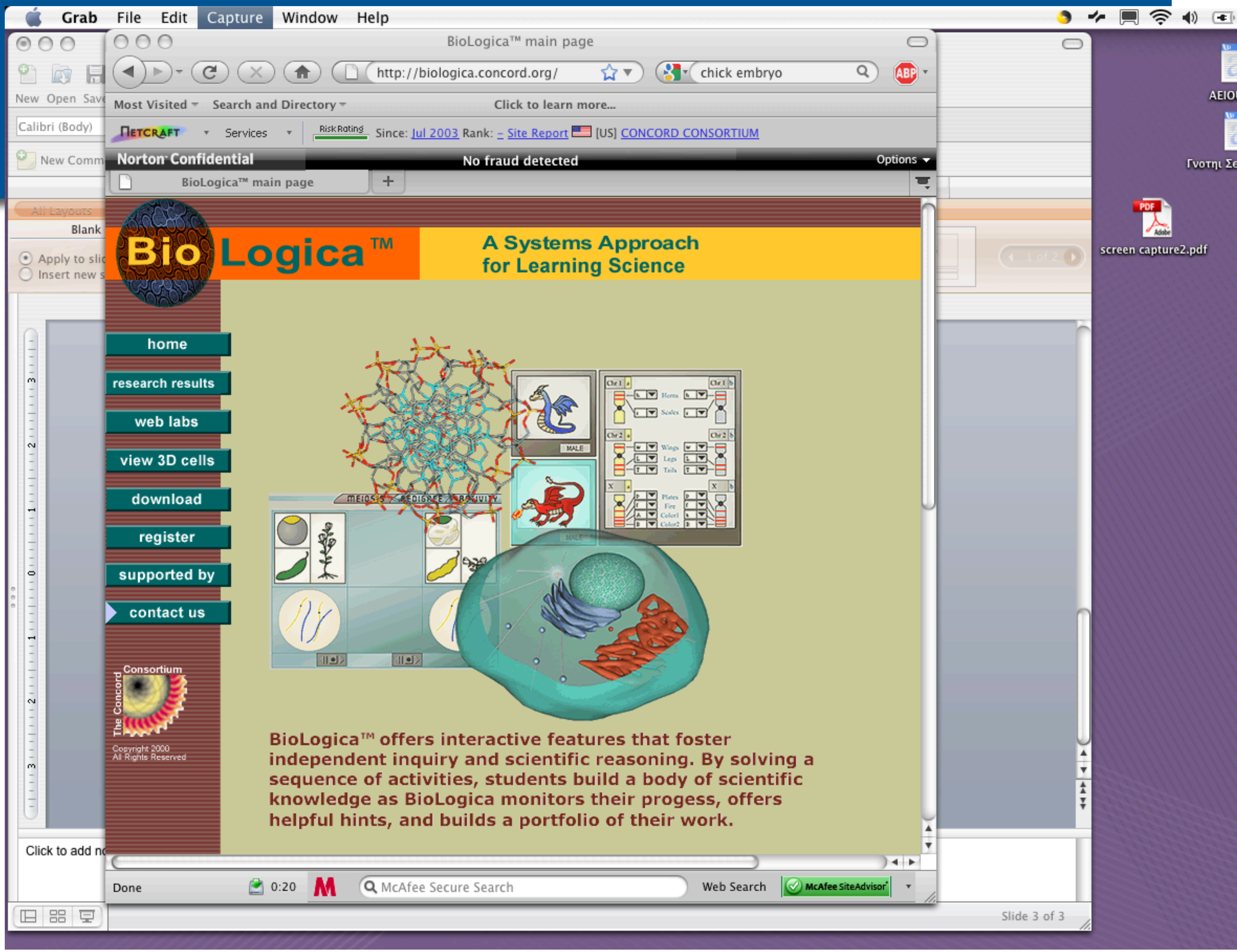
# Designing Geospatial Exploration Activities to Build Hydrology Understanding in Middle School Students

We designed activities that gave students map-based data relevant to the water cycle processes of evaporation, condensation, runoff, and infiltration.

We wanted students to generate informal and causal explanations about the water cycle's role in water distribution and salt pollution. In designing map activities, researchers used layered and parallel data representations.

Students used both everyday knowledge and scientific knowledge fragments to answer key questions.

Statistical analysis (*based on consumption per capita*) was integrated into the mathematics classes, since the topics is part of the mathematics curriculum standards.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for Learning Science
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research results
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BioLogica™ offers interactive features that foster independent inquiry and scientific reasoning. By solving a sequence of activities, students build a body of scientific knowledge as BioLogica monitors their progess, offers helpful hints, and builds a portfolio of their work.
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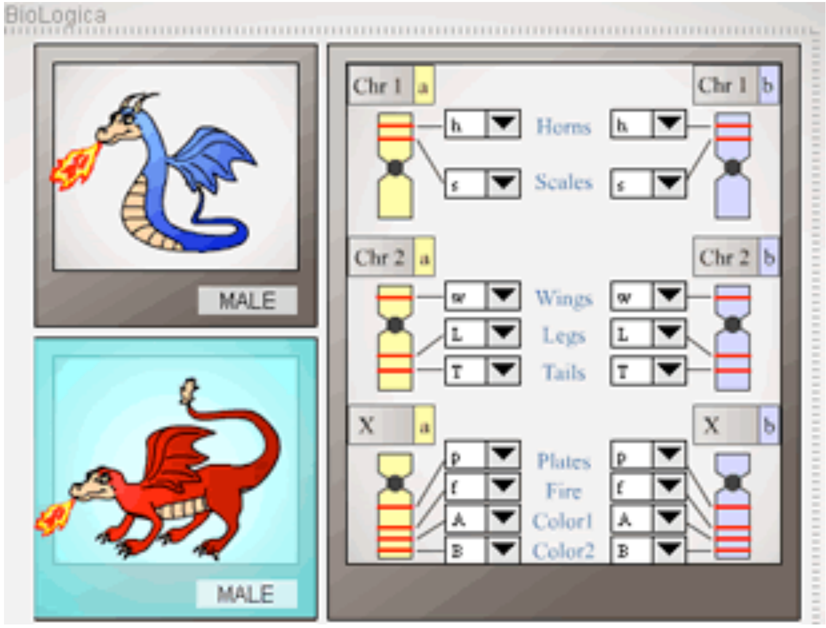
screen capture2.pdf

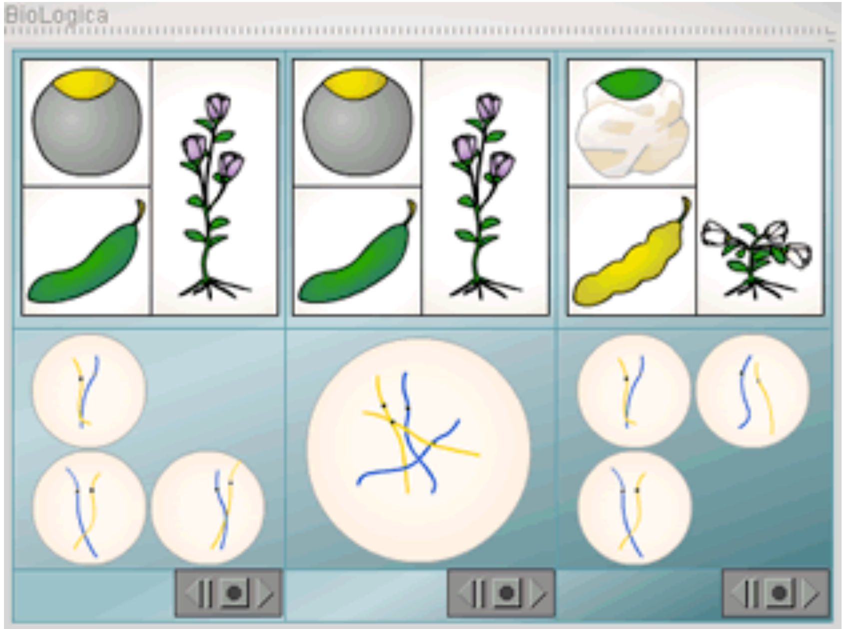
# BioLogica & Genscope

http://genscope.concord.org/

BioLogica es un “hypermodel” para enseñar genética en la escuela secundaria. BioLogica le permite a los estudiantes manipular procesos genéticos a niveles diferentes de función en el organismo pero relacionados dinámicamente.

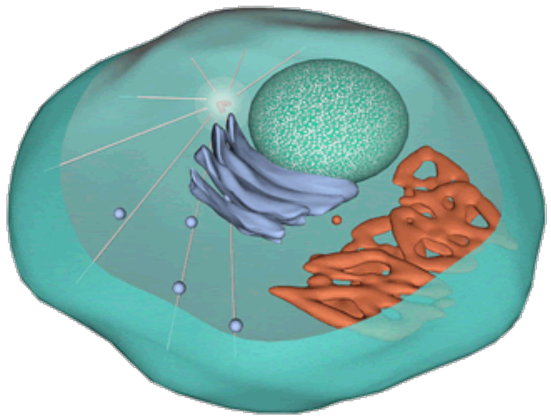
BioLogica incluye herramientas y representaciones enfocadas en genética. Basándose en ellas, BioLogica ha desarrollado módulos y actividades que involucran modelos cada vez mas elaborados de las partes, procesos y mecanismos de genética, *Dragon Genetics* explores the relationship between genotype and phenotype, using both sex-linked and autosomal dominant and recessive traits. Manipulating alleles (genotype), creates corresponding changes in the dragon's appearance (phenotype).



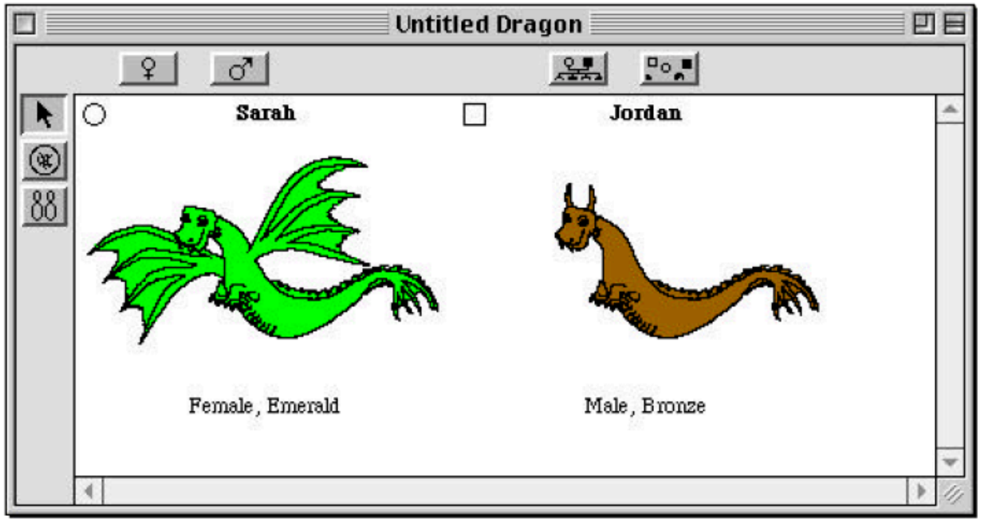

***Mendel's Peas*** demonstrates basic principles of meiosis, fertilization, and inheritance using the same pea traits that Mendel studied. Start at the beginning to brush up on the basics. But if you just can't wait to play the game, skip ahead to part 3, The Princess and the Wrinkled Peas.

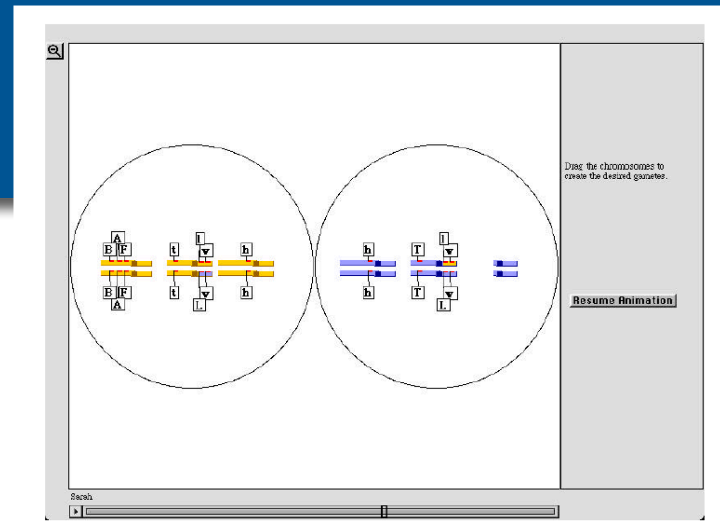
## Learn about cell structure and function by viewing QuickTime movies and interacting with 3D worlds.

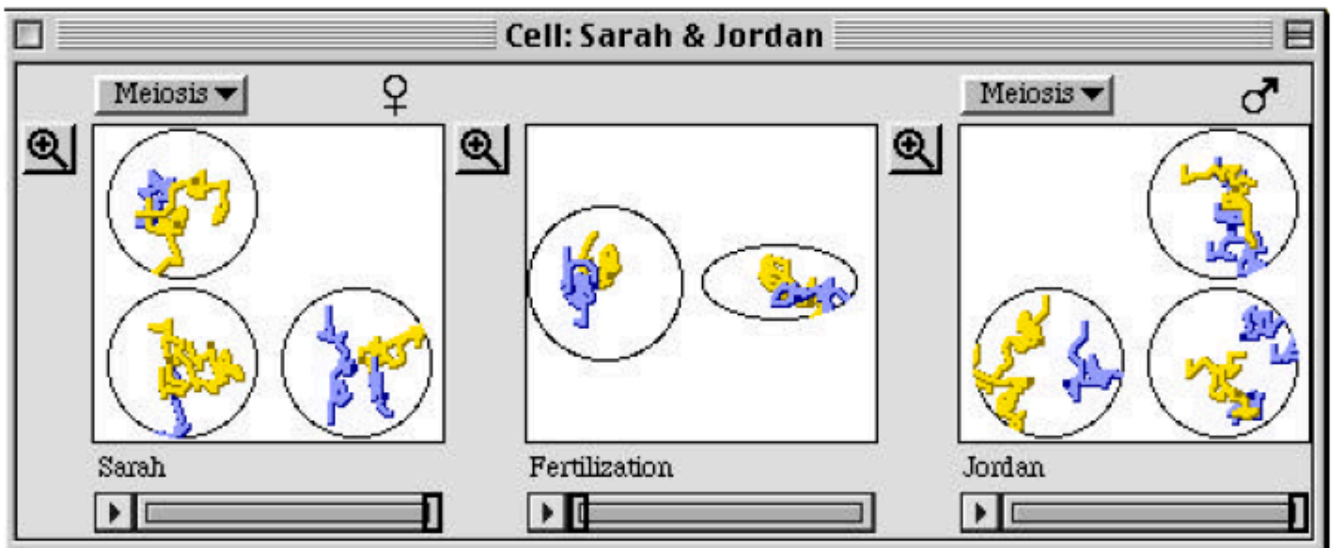


QuickTime movies. View the dynamics inside a cell. Choose whether you have a slow connection or a fast connection.

***Interactive 3D cells. Explore and manipulate a 3D-Cell using a java-based technology developed by Shout Interactive.***


Untitled Dragon
Sarah
Jordan
Female, Emerald
Male, Bronze




Cell: Sarah & Jordan
Meiosis
Meiosis
Sarah
Fertilization
Jordan

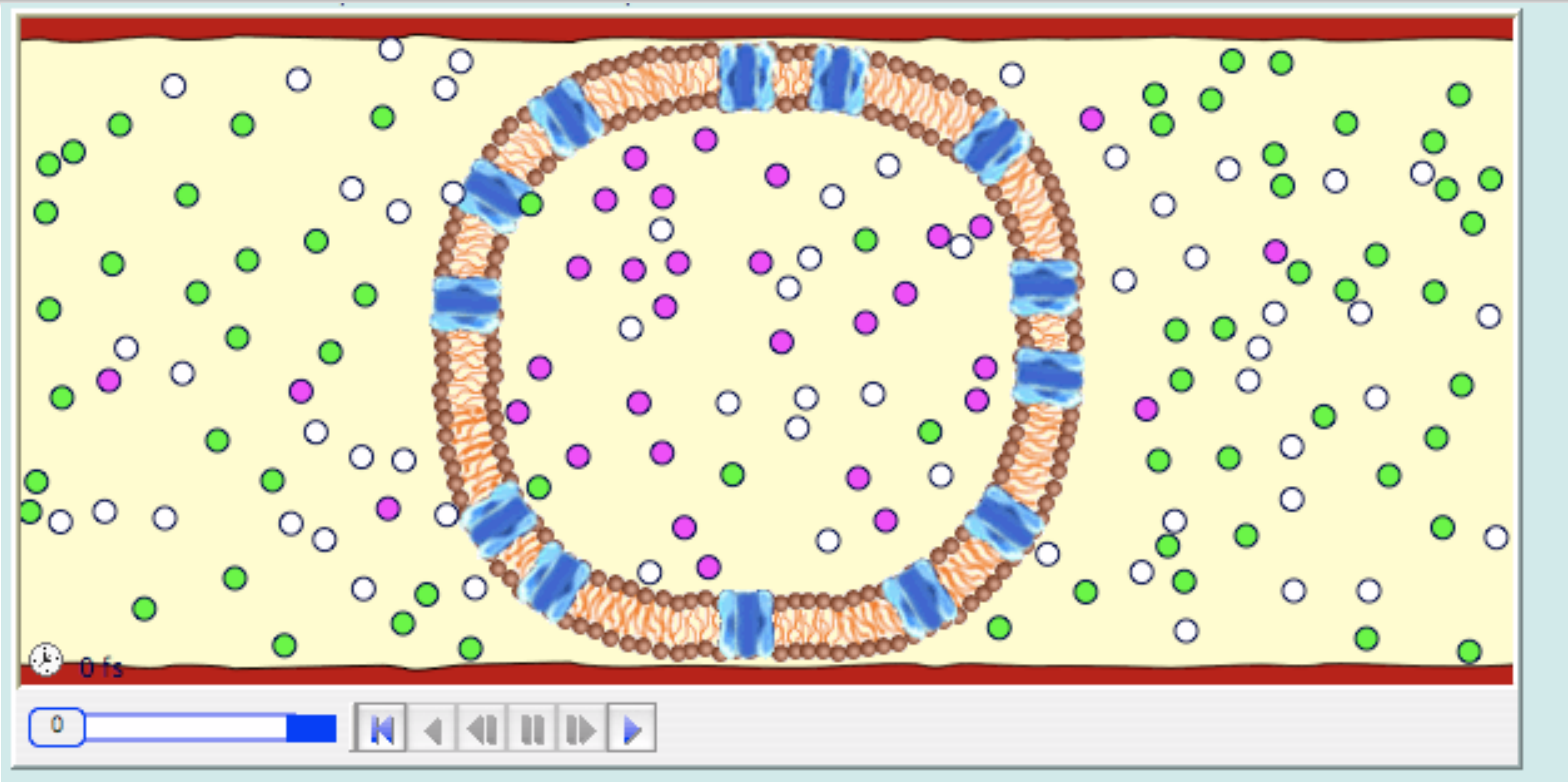
# THE MOLECULAR WORKBENCH

mw.concord.org

National Science Foundation
WHERE DISCOVERIES BEGIN

- Use simulations to demonstrate concepts and enrich your lectures.
- Use curriculum modules published in the Molecular Workbench.
- Track student learning progress across curriculum modules.
- Design simulations and curriculum materials for teaching.
- Challenge students to create their own simulations to solve problems.
- Study how effectively computer simulations can help students learn.

# Diffusion, Osmosis, and Dialysis
# Interactive, scaffolded mode

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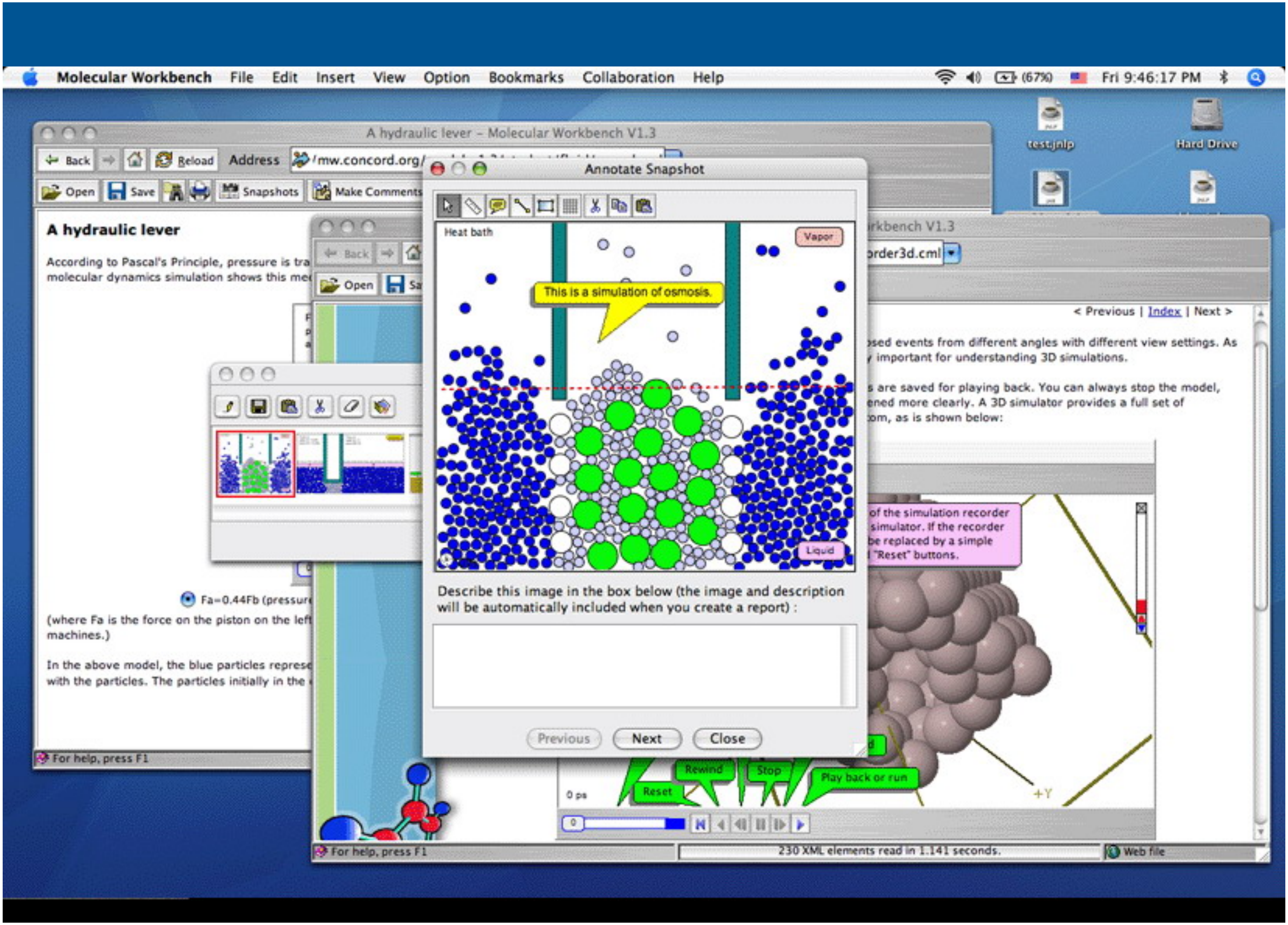
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Heat bath
Vapor
This is a simulation of osmosis.
Liquid
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s are saved for playing back. You can always stop the model,
ened more clearly. A 3D simulator provides a full set of
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of the simulation recorder
simulator. If the recorder
be replaced by a simple
"Reset" buttons.
Rewind
Stop
Play back or run
Reset
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Web file

# Porqué selecciónè BioLogica & Genscope

Concepto de ciencia de niveles múltiples

El trabajo que involucró desarrollar el curriculum y los materiales

Investigación y evaluación (e investigación en evaluación)

Su uso en la preparación de maestros

Combinación de simulación de meiosis con visualizaciones reales (concepto de hypermodel)

***Y sus diferencias con River City***

# A Brief Description of the SAIL Environment
# Stephen Bannasch and Robert Tinker
# July 31, 2008

SAIL (the ***Scalable Architecture for Interactive Learning***) es tanto una estructura como una colección de aplicaciones y bases de datos que permiten que quienes no saben de programación puedan crear, modificar, descubrir y aplicar, dinámicamente a través de la red, actividades curriculares que incluyan componentes de simulaciones interactivas, modelamiento, "probeware" y análisis.

Todas las actividades que un estudiante realiza en sus interacciones con el cliente local de SAIL—las páginas que visita, las preguntas que contesta, los gráficos que crea, los modelos que investiga, los datos que colecciona—son archivadas a traves de la red y accessible al estudiante mismo cuando vuelve a la actividad. También estaán disponibles al maestro y al investigador para analizar y evaluar.

# “State of the Art”

**(sort of)**

# SETTING A COMPUTER SCIENCE RESEARCH AGENDA FOR EDUCATIONAL TECHNOLOGY

*www.cc.gatech.edu/gvu/people/faculty/mark.guzdial/EDTECH.pdf* (2005)

**Information technology, research and education, teaching, and learning. Report on two NSF-funded workshops (2004)**

*ctl.sri.com/projects/displayProject.jsp?Nick=itrworkshp*

**"A Roadmap for Education Technology"**
**GROE final project report**

*www.cra.org/ccc/groe.php* (2010)

# *Putting the Lessons to Work: Implementation in and out of the Classroom*

## ***Depth of Understanding: Students' understanding learning science concepts in some depth.***

If there is a lesson that seems hard to learn, it is that only so much intelligence can be incorporated into the software. How software is interpreted and how it gets used are of paramount importance, and the ways are as varied as the number of teachers who will use it. ***Developers often look for solutions in the technology itself,*** when learning technology researchers have found that it is better to think in terms of inevitable changes (i.e., make the technology flexible and adaptable) than to expect a high level of fidelity to envisioned practices during use

## *Putting the Lessons to Work: Implementation in and out of the Classroom*

The Importance of Mixed Expertise: Form design teams with expertise in both technology and learning.

Recommendation: Support the development of informal curricula and online courses for designers of learning technology.

Recommendation: Consider ways of building the infrastructure that is integral to scaling learning technology use.

## Grand Challenge Problems *(from the National Educational Technology Plan)*

*www.ed.gov/sites/default/files/NETP-2010-final-report.pdf*

1.0: Design and validate an integrated system that provides real-time access to learning experiences tuned to the levels of difficulty and assistance that optimizes learning for all learners and that incorporates self-improving features that enable it to become increasingly effective through interaction with learners.

2.0: Design and validate an integrated system for designing and implementing valid, reliable, and cost-effective assessments of complex aspects of 21st century expertise and competencies across academic disciplines.

## Grand Challenge Problems *(from the National Educational Technology Plan)*

*www.ed.gov/sites/default/files/NETP-2010-final-report.pdf*

3.0: Design and validate an integrated approach for capturing, aggregating, mining, and sharing content, student learning, and financial data cost-effectively for multiple purposes across many learning platforms and data systems in near real time.

4.0: Identify and validate design principles for efficient and effective online learning systems and combined online and offline learning systems that produce content expertise and competencies equal to or better than those produced by the best conventional instruction in half the time at half the cost.

## 6.1 Help Build a Vibrant Cyberlearning Field by Promoting Cross-Disciplinary Communities of Cyberlearning Researchers and Practitioners

*Based on the recommendations of*
*www.nsf.gov/od/oci/ci-v7.pdf*

## 6.2 Instill a Platform Perspective Into NSF's Cyberlearning Activities

1) *Technology: lowering barriers to the use and adoption of advanced cyberinfrastructure;*

- Tools for teaching about data, middleware, and computation
- Tools for facilitating collaboration
- Tools for teaching workflow engineering
- Data-Intensive applications
- New tools for instrumentation (assessment and evaluation techniques)

# 6.3 Emphasize the Transformative Power of ICT for Learning, From K to Gray

2) *Pipeline: attracting new students to STEM and broadening participation from diverse communities;*

- Supported Collaborations
- Integrated Training and Education Programs in CI and STEM disciplines
- Integrating learning into the workplace
- New, well-designed learning materials
- Role of labs (real or computer) in cyberlearning

# 6.3 Emphasize the Transformative Power of ICT for Learning, From K to Gray

3) *Training: facilitate learning through assessment and evaluation instrumentation of cyberlearning environments*

- New instrumentation (assessment) techniques
- Aggregation centers (hubs and intermediaries)
- CI Learning goals
- Understanding levels of expertise needed
- Quality assurance issues re user as producer

# 6.4 Adopt Programs and Policies to Promote Open Educational Resources

4) *Policy: impact and use of requirements and policies (federal and state); guidelines and peer-reviewed knowledge base.*

- Benchmarks
- Integration of learning and work
- Public awareness and life-long learning
- Governance
- Role of the private sector