

## The Challenge in K-8 Science Education: Teacher Content Knowledge

### The Professional Development Landscape

A significant, **positive** correlation exists between **student achievement and teachers' content knowledge** (subject matter AND pedagogical content knowledge).



Detrimental classroom effects when teachers do not feel confident in their knowledge of science.

American, Barne and Sander. 2003. Research Briefs, Clemons & Berke. 1994. Cochran-Smith and Zeichner. 2005. Cooney, Davison, & Pellegrini. 2000. Darling-Hammond. 2006. Darling-Hammond and Bransford. 2005. Economic Policy Institute. 2003. Gohbauer. 2002. Gohbauer and Brewer. 1996. Gohbauer and Brewer. 2000. Jovan. 2004. Kane, Rockoff and Hauger. 2005. Kim. 1999. Maki. 1996. Rivkin, Hanushek, and Kain. 2005. Rockoff. 2004. Sanders and Means. 1996. Shuman. 1990. 1997. Strimling. 2002. Wilson, Faden and Ferris Mandy. 2001. Council of Chief State School Officers. Blank, K.A., Allen, T., & Smith, C. 2000. Moore & Cooney. 2002. Veenburgh, Smith, & Clark. 2006. Whitehead. 2002. Wilson Faden, & Ferris Mandy. 2002

### Bridging the Gap between Research and Practice in PD

What we know—Local Systemic Change Core

Evaluation: K-8 Weaknesses (75,000 data points)

"Teachers of Science" with **less** than 16 hours of PD in Science in last year

- What % at K-4 level? **76%**
- What % at 5-8 level? **57%**
- What % at 9-12 level? **32%**



Clearly need to address the K-8 level at national scale

Looking Inside the Classroom: A Study of K-12 Mathematics and Science Education in the United States—10 yr longitudinal national classroom observation study. Horizon Research, Weiss. 2003

### Statistics Regarding Professional Development



• What is return-on-investment for face-to-face Professional Development?

**2006 US Math/Science Partnerships: Funded 501 projects at \$181M. Average award: \$337,000. Average # teachers impacted/project: ~110 teachers. Total Teachers Impacted: 56,000. Total in US: 3 Million**

• How many have completed an online professional development course?

**You are not alone: In 2008 over 3.9 million learners in the US took a course online...**

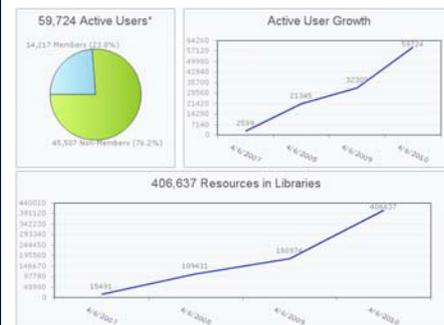
(The Sloan Consortium: Staying the Course. 2009. Project Tomorrow; National Survey on Internet Use. 2008).

## On-Demand Self-directed Electronic Professional Development that reaches Scale and Sustainability

During our summer institutes teachers build their library of SciPacks based on their individual content goals. Besides adding to their own content knowledge, teachers have found this resource especially helpful for giving them ideas on how to present the content to their students. We will continue to use SciPacks in our Institutes as well as feature this resource in professional development workshops conducted across our state. Thanks so much for making this wonderful professional development resource available to our teachers.

Jim Woodland, State Science Supervisor, Nebraska Department of Education

## Learning Center Overall Growth and Usage



Over 200 state and district deployments across 50 partnerships as of April 2010

- Nebraska DOE
- New Hampshire DOE
- West Virginia DOE
- Anaheim Public Schools
- Atlanta Public Schools
- Cincinnati Public Schools
- Fairfax County Public Schools
- Texas Regional Collaboratives for Excellence in Science and Mathematics
- Twin Harbors Science Consortium
- University of Maryland, BC
- University of Texas, Tyler
- Montana State University

E-PD Opportunities tagged by learning preferences and state standards and comprise:

- Live Web Seminars
- Asynchronous Podcasts
- Selected NSTA E-books, e-chapters & e-Journal Articles
- University online short courses and degrees
- SciPacks/Science Objects: On-demand, self-directed learning from 2 to 10 hours in duration

# The NSTA Learning Center



## 10 Hour On-Demand, Self-Directed Online Learning Experience



- 4-5 two hour inquiry-based learning objects focused on key science concepts
- Incorporate embedded simulations and questions to facilitate learning
- Include Pedagogical Implications component by grade levels
- Individualized support via Content Mentor (unlimited email)
- Final Assessment Opportunity



## Science Topics (16 done)

- Force and Motion
- Cell Structure and Function
- Chemical Reactions
- Earth, Sun and Moon
- Earth's Changing Surface
- Electric and Magnetic Forces
- Energy
- Gravity and Orbits
- Nature of Light
- Ocean's Effect on Weather and Climate
- Plate Tectonics
- Rocks
- The Solar System
- The Universe

## On-Demand Self-directed Electronic Professional Development that reaches Scale and Sustainability

Our experience with SciPacks was valuable, and impact high. Teachers indicated how much they enjoyed and learned. I was very impressed with the content depth and in how it was presented; it was accessible to all grade 5-9 teachers. None felt overwhelmed. We plan to include this training as a standalone option and as a component in a content professional development course that includes face to face sessions. This is a powerful tool to help teachers grow in their understanding of the content and pedagogy we expect them to be teaching.

Bob Sotak, Science Specialist, Everett Public Schools, WA

The screenshots illustrate the user interface of the NSTA SciPack, including:
 

- Simulation windows for 'NSTA SCIENCE SIMULATION Air Track' showing a cart on a track with data points.
- Assessment questions such as 'What type of motion do you observe?' and 'What is the acceleration in the ball?'.
- Instructional content with diagrams and text, such as 'Hints on Activity' and 'Before You Begin'.
- Progress tracking and assessment results screens.

## Free Access to over 1,300 e-PD Resources and Opportunities

### Dramatic growth in overall accounts and usage of assets

- Over 59,000 active accounts
- Over 400,000 assets used from 4,300+ available

### Learning Center Growth: Free Science Objects Resource



#### Dynamic Tracking by Resource Type

2007: 16,555 objects in 4,757 accounts.

2008: 51,442 objects in 8,090 accounts.

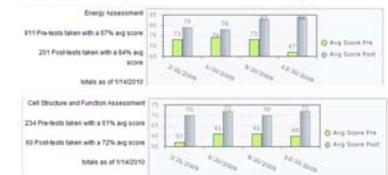
2009: 112,165 objects in 21,000 accounts.



### Dynamic Web Generated SciPack Teacher Learning Data



#### Pre/post Assessment Scores for District/State deployments after completing SciPacks



**Additional Data Tracked for Administrators:**

- Which resources are added and shared across libraries
- Frequency of usage and percentage of completion
- Assessment Pass/Fail Data for Every SciPack

### SciPack Evaluation Results Three District Pilot



#### Participant Feedback: Confidence in teaching subject matter:

- 7%: **Very Confident Before** completing F&M SciPack
- 60%: **Very Confident After** completing F&M SciPack
- 98%: Found SciPack content relevant to their needs
- 96%: Would recommend SciPack to their colleagues
- 98%: Found interactive simulations worthwhile to their learning

#### Pre/Post Assessment and Final Assessment Results

- Horizon Research Instrument: Positive **significant gains in learning** between pre/post test
- Final assessment: **92% passed the final assessment**