Developing Sustainable Online Learning Communities at Scale to Accommodate Diverse Learning Preferences and Needs in Science Education

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e-Learning and Government Partnerships
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Where we are in Science in US:
2009 NAEP: The Nation’s Report Card

• 4th Grade: 34% scored “Proficient” or above
• 4th Grade: 28% scored below “Basic”

• 8th Grade: 30% scored “Proficient” or above
• 8th Grade: 37% scored below “Basic”

• 12th Grade: 21% scored “Proficient” or above
• 12th Grade: 40% scored below “Basic”

NOTE: Proficient represents solid academic performance, Basic shows partial mastery of skills
Where we are in Science in US:
2009 NAEP: The Nation’s Report Card

• Representative student sample:
  46 states and U.S. DOD schools
• ~318,000 students took exam: Spring of 2009
• Measures students' knowledge in:
  physical, life, earth and space sciences
• Recall of facts and application of
  science knowledge across disciplines
• Test considered tougher than state exams
• Updated with advances in science, can’t baseline 2005
• Assess Grades 4, 8, and 12. Achievement Levels:
  Advanced, Proficient, Basic, and Below Basic.
Importance of Teacher Content Knowledge in Science

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.

Elementary and Middle Level Teachers of Science in the US

Vast majority of K-8 teachers have general education degree, not in science or science education  
Horizons Research (2001)

There are approximately 1.7 million elementary teachers in United States  
NCES (2009)

At middle school level (grades 5-8), large percentages of teachers “within-field” teaching “out-of-field”  
Ingersoll (1999)
Vast majority of K-8 teachers expressed need to deepen their own science content knowledge (67-71%).

Only 18-29% of K-4 teachers felt well prepared to teach science.

Content-related PD top priority requested by teachers in 03-04 NCES SASS survey

Horizons Research (2001); NSDC (2008) pulled from 2004 NCES SASS national survey
The US Professional Development Landscape

What we know—Local Systemic Change K-8 Evaluation: (75,000 data points -10 yr NSF Longitudinal study)

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

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

Research calls for 50-80 hours per year to effect a change in practice.

The Fiscal Case for Blended Professional Development

• What is the scalability and sustainability of face-to-face Professional Development?


• How many have completed an online course?

In 2008 over 3.9 million learners in the US took a course online...

(The Sloan Consortium: Staying the Course: 2008; Project Tomorrow; National Survey on Internet Use; 2008).
A Critical Piece of the Solution

- On-Demand Access
- 5,800+ resources
- Free tools to help teachers organize, personalize, and document their growth over time.
- Immediate access to online advisors and colleagues through chat and discussion
Nearly 72,000 Individual accounts with over 539,000 resources being used across all teachers’ personal libraries as of Jan 2011.
Dec. 2010 Collection: 5,800+ PD Resources and Opportunities Available

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http://learningcenter.nsta.org
Learning Center Tools
Welcome to Your Professional Development Web Space!

You’ve already earned 695 Activity Points!
You’ve recently earned the following Recognition Badges:

- **Disseminator:** Shared an LC Collection
- **Aggregator:** Added Your Resources

Be sure to update your profile and review your points and badges!

With these resources you can build your professional development plan, track your activities and assess your progress. You can start at “Explore Learning Opportunities” below or by creating your game plan with the PD Plan and Portfolio tool. You may also review an archived Web Seminar or a multimedia overview of the Learning Center.

:: Explore Learning Opportunities
- Advanced Search

:: See all FREE Lesson Plans
:: See all FREE Resources
PD Indexer

• NETP Goal 2.0
• Diagnose gaps in Content Knowledge Understanding
• View Recommended Resources and Opportunities for Consideration
Calgary (Canada) is located at a latitude north of the equator similar to London (England), as indicated in the map above. However, the winter climates in both cities are very different. Which of the following is part of an explanation for this phenomenon?

- Warm Atlantic Ocean current transfer heat energy to regulate in more rainfall and cooler winter temperatures.
- Calgary is surrounded by large land masses that do not large masses of water, keeping inland temperatures cooler.
- London is closer to large, cold bodies of water that keep the winter months.

Category: Earth and Space Science Indexer
Date: 11/21/2009

About Your Feedback
Oceans Effect on Weather and Climate
Your score: 4 out of 10 correct

- Recommended Resources
- All Resources for this Subject
### Content Knowledge Assessment: Sample Cronbach α Internal Consistency

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<th>No. of Cases</th>
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### NETP Goal 3.0: Career Long Growth

**Category:** My Content Knowledge  
**Goal:** Review/Improve Physical Science Understanding  
**My Tasks:**
- Define Evidence
- Edit Goal
- Delete Goal

#### Instructions and How-To Animations

#### Identified Professional Development Resources

<table>
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<tr>
<th>PD Resource to Address Goal</th>
<th>Note</th>
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<tr>
<td>Perspectives: Action Research: Inquiring into Science Teaching and Learning</td>
<td>NSTA Learning Center Resource</td>
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<tr>
<td>Online Courses: NSTA Online Short Course: Force and Motion</td>
<td>Looking for a formal online and collaborative experience</td>
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#### Expected Date of Goal Completion
3/16/2010

#### Goal Statement
I plan to improve my understanding and comprehension of major physical science concepts by participating in online courses and experiences relating to force and motion.

#### Why I chose this goal, and where I am now
- Empty - Add information
Selected e-PD Resources
Science Objects and SciPacks

NETP Goal 1.0
Tech-based Online Learning Resources
Free two hour online learning experience in a particular topic
Interactive simulations of phenomena
Questions to promote interaction and learning via inquiry
Based on science literacy goals in science education standards
Animation Analysis

The following animation shows a ball rolling along a track. Replay the motion a number of times and then answer the multiple-choice questions that follow. In answering those questions, feel free to replay the animation if necessary. Select the icon to launch the animation in a new window.

Figure 5.2. Ball on Complex Track
Animation
For those unable to engage with the interactive component, select this link for a long text description: Text Description

Practice

Okay, now that those mental wheels are turning, see if you can answer these questions. If you miss an answer or two or three, it might be worth your while to review the appropriate sections of this Science Object.

Q What is the approximate position of Point E in relationship to Point A?

- E is about 350 centimeters away from A, at an angle of about 80 degrees with respect to Line Y.
The ball has zero acceleration at...

- Point E, because the ball is at rest at that point.
- Point B, because the direction is constant there.
- Point D, because it's slowing down at that point. It is decelerating but not accelerating.
- Point A, because neither its speed nor its direction are changing there.

**Answer Feedback**

Incorrect!

If the ball is at rest, that means the instantaneous velocity is zero. Acceleration, however, is measured by changes in velocity. An object at rest does not necessarily have zero change in velocity.

For more information:
- For help revisit the One More Definition section.
- To see how this information relates to each position in the

D. The ball is moving fastest at those Points. It depends only on the magnitude of the velocity, and it is changing its speed the fastest at that point.

The speed has to be largest at the beginning in order for anywhere.

The ball is slowing down at Point D, it can't have a there.

Check
What type of pattern did you observe?

- I didn’t run the simulation, but I can imagine what will happen.
- The more the track changed in shape, the higher the ball rose in vertical height at the end of the track.
- The ball would rise to a different vertical height at the end of the track depending on the track chosen.
- The ball rose to approximately the same vertical height no matter what track was used in the simulation.

Check

Tries Remaining: 3

Hands-On Activity

You can do this simulation in real life. All you need is a section of Hot Wheels® track, a marble or ball bearing, a ruler, and a friend to help. Then select the link to go to the Activity:

Hands-On Activity

Press “Next” at the top of this window to go on to What’s the Point?
Hands-On Activity

Grab a ruler or meterstick, a marble or a ball bearing, and about a meter-long section of Hot Wheels® track. If you don’t have access to kids’ toys, just use anything you can find that’s flexible and will allow a marble to roll along it. What works well is a section of clear plastic tubing (try the hardware or plumbing supply store) and a ball bearing that’s small enough to roll freely inside the tubing.

Find a friend or family member to help you with this next part. Hold the track in a U shape so the lowest part just touches a table top or a floor, as seen in Figure 3.10.

Figure 3.10

Now measure the vertical distance from the floor or table to one end of the track. For the directionally challenged, that vertical distance is shown in Figure 3.11.

If your memory isn’t great, write this distance down. You’ll need to keep this one side of the track at that same vertical distance as you do the next few things. With your accomplice helping you, hold the track in a U shape with the bottom of the U touching the table or floor; holding your end at the vertical distance you’ve measured, drop the marble at the top of that end of the track.
Learning About Earth, the Sun and the Moon: Grades 6–8

Middle school teachers have a tremendous challenge and opportunity. Students at this level are sufficiently mature to envision the “space view” and “Earth view” at the same time. So it becomes possible for students to fully understand and distinguish the reasons for Moon phases and eclipses, as well as the more complex reasons for seasons. Nonetheless, astronomical ideas still need to be built up, step by step. Just as mathematical skills build on each other, students’ understanding of such phenomena as moon phases and seasons builds on their previous understanding of Earth’s spherical shape and gravity.

As shown in Figure 3, the Atlas of Science Literacy identifies five benchmarks that students need to learn at the grade 6–8 level in order to advance their understanding of Earth, moon, and sun.

1. Everything on or anywhere near Earth is pulled toward its center by gravitational force. Students develop surprising misconceptions about the nature of gravity. One of the most prevalent is that gravity is caused by air that pushes things down. It is likely that this misconception arises from videos that show astronauts floating around in the Space Shuttle as it orbits Earth, or by inappropriately applying the concept of atmospheric pressure.

A first step in helping your students unravel their misconceptions is to ask them to discuss such questions as: Is there gravity in space? Why or why not? Is there gravity on the Moon? You might also ask students for their ideas about what causes meteorites to fall to Earth, and why space satellites stay in orbit, rather than fly off into space. Students will be led to question their understanding of gravity after they hear alternative explanations from other students.
District Scale and Impact

NETP Goal 4.0
Over 200 unique deployments across 65 State/District Partnerships as of December 2010

- West Virginia Department of Education
- New Hampshire Department of Education
- Hawaii Department of Education
- Fairfax County Public Schools, Fairfax, VA
- Cincinnati Public Schools, OH
- Jefferson County Public Schools, Louisville, KY
- Shelby County Public Schools, TN
- Oregon Science Teachers Association, OR
- LASER Alliance, Mountain to Harbor Alliance, WA
- Orange County, CA
- Prince George’s County Public Schools, MD
- Montana Status University, Bozeman, MT
- Fulton County Public Schools, GA
- NOAA Climate Stewards
- FDA’s Teachers Academy for Food Science
- Texas Education Service Center, University of Texas
- Texas A&M, Texas Centers for Excellence in Science and Mathematics (36 centers across Texas)
- PRISM Grant Program, MT
- Stamford County Public Schools, Stamford, CT
- University of Maryland Baltimore County, MD
- Atlanta Public Schools, Atlanta, GA
NSTA captures pre- and post-assessment data to demonstrate learning gains by teachers as part of formal district and state deployments.
Three Recent Studies: Significant Gains in Learning

- Quasi-experimental design study across 3 districts finding *significant gains in teacher content knowledge and self-efficacy.* (2008)

- One 2 pretest-posttest delayed-treatment control group design with random assignment finds *significant gains in teacher content knowledge, teacher self-efficacy, and students’ learning for grades 5-8 in treatment group.* (2010)

- One descriptive study using repeated measures ANOVA and paired-sample *t*-tests found *significant gains in teacher learning* for pre-posttest and pretest-final assessment for 85 teachers in grades 3-6 across 7 SciPacks. (2010)
SciPack 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**

**Evaluation of Online, On-Demand Science Professional Development Material Involving Two Different Implementation Models (Sherman & Byers)**

*Journal Science Education and Technology*
February, 2008 (Vol. 17, No. 1)
District SciPack Efficacy Study: Third Party Evaluation Report

• Two pretest-posttest delayed-treatment control group design involving random assignment

• 56 teachers from grades 5-8 across (2 SciPacks completed)

• Significant gains in teachers’ content knowledge in treatment group vs. control (Repeated Measures ANOVA)
  (SciPack 1: $F(1, 24) = 20.680, p < .01$; SciPacks 2: $F(1, 26) = 5.877, p < .05$)

• Significant gains in feelings of preparedness to teach concepts

• Significant gains in students’ learning across both groups with significantly higher gains scores in treatment group

• Qualitative Teacher Comments: I have a better understanding of Newton’s Law, so I can envision the things I see. The Force and Motion, I thought the interactives were really, really good.
Independent SciPack Study

- Quantitative Descriptive Study (Correlation, Paired-Samples T Test, and Repeated Measures ANOVA using pretest-posttest, Likert Scale interaction preference survey and Kolb LSI 3.1)
- 85 teachers from grades 3-6 complete pre/post and final (Analysis across 7 different Sci Packs)
- Teachers’ scored significantly higher on the posttest (M=82.39, SD = 7.04) then the pretest (M= 61.31, SD, = 18.45), t (101) = 11.63, p < .001
- Teachers’ scored significantly higher on the final assessment (M=79.14, SD = 12.91) than on the pretest (M=61, SD = 18.45, t (101) = 10.84, p < .001
- Collectively, for 3 separate studies, this seems to suggest when Sci Packs are part of a blended PD solution teachers demonstrate and retain significant gains in content knowledge
District Administrator Reports: PD Resource Preferences

Anaheim CEMSS 7th grade Admin Page

Welcome to your NSTA resource administrator page.

Data below is provided to assist you in tracking activity and progress of your program participants. The URL for the Teacher Access Page is: [http://learningcenter.nsta.org/cemss-7](http://learningcenter.nsta.org/cemss-7), The Promo Code is cemss-7

Overview

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Total Products Added by Type

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10 Most Recent Additions

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Learning Center Community
NETP Goal 3.0

- Person at center of online experience, not the product
- Three primary “strategies”
  - Psycho-emotional roles
    - recognition
    - self-actualization
    - coaching/mentoring
  - Content Knowledge
    - compelling & valuable to learner (teacher)
    - subject matter, PCK & pedagogy
  - Social Engagement
    - personal aspect
    - extended connectedness
    - worthwhile dialogue with like-minded colleagues and access to experts
Learning Center Community

• Professional Growth Trajectories
• Three primary “strategies”
  • Consume/Engage/Excite
    • Just-in-time resources from a trusted source and/or colleagues
  • Consume/Contribute/Extend
    • Resources/Strategies support local student-driven data
    • Professional Learning Community
  • Consume/Mentor/Facilitate/Enlighten
    • Elevate stature in community
    • Serve in leadership capacity
    • Contribute to improvement and generation of resources
    • Refine strategies, support others

Early Career/Novice
Increase Knowledge, Confidence, and Pedagogy

Mid Career
Hone practice and PCK

Master Teacher
Contribute (coach/mentor)
Teacher indexes PD needs → object(s) & resources suggested

Teacher chooses resources/objects →

- self directed study
- "Help desk" online
- joins others
- discussion group online
- takes mediated course
  - Expert facilitator online

content/knowledge assessment →

institute research database →

into teacher portfolio
Learning Center
Online Advisors

- 30 educators provide support
- live chat and asynchronous
- 7 days/week; ~60 hours/week

Wendy Ruchti
Wendy Ruchti has been part of the Educational Foundations Department at Idaho State University's College of Education since 2008. She received a PhD in Education from the University of Idaho in 2005 with an emphasis in curriculum and instruction in STEM education. At ISU, she has taught several educational foundations courses. Her research interests include elementary science education and creating collaborative online learning environments. Before coming to ISU, she taught middle school science and math.

Lara Smetana
Lara Smetana is an assistant professor of science education at Southern Connecticut State University. She brings classroom experience as an 8th grade physical science teacher and has worked with a variety of informal education programs across the country. Lara teaches courses in elementary science methods and educational technology and mentors student teachers. Her research interests include pre- and in-service teacher education and the use of educational technology in science teaching and learning.

Kathy Sparrow
Dr. Kathy Sparrow is currently an adjunct professor at Florida International University (FIU), teaching Elementary Science Methods. She previously worked as a middle and high school science teacher as well as the Science Supervisor for Akron Public Schools. She was a Regional Director for SECO, served on the NSTA Board of Directors and was president of the National Science Education Leadership Association (NSELA). Kathy was also awarded the Outstanding National Science Supervisor Award in 1999.
My Library: Uploaded Resources

Welcome to your collection of professional development resources. Select from the links and tabs below to access your NSTA resources, your uploaded items, organize them into collections, and then share your collections with others.

My NSTA Resources  My Uploaded Resources  My Resource Collections

Resource Upload

New to the Learning Center! Enjoy the convenience of having all your electronic resources in one location. Upload up to 1.5 GB of your resources to your Learning Center library, add them to your collections, create notes about them, and e-mail them to your friends. File formats include PowerPoint presentations, Word documents, Excel spreadsheets, PDF files, image files, and more. Each file must be 10 MB in size or smaller. Please read the Terms and Conditions.

Upload a Resource

You are currently using 0.2% of your 2 GB
You have 2.00 GB of available space

My Uploaded Resources

NSTA Learning Center
This is the URL for the NSTA Learning Center.

NSTA Learning Center Marketing Brochure.pdf
PDF file of the NSTA LC Marketing Brochure.

Sample Agenda for APS implementations.doc
Sample agenda created for APS administrators to run implementation workshops.

Sample PPT for APS implementations.ppt
Sample PPT created for APS administrators to use at their implementations.
Collections enable you to group together and organize your NSTA resources. You may also share collections with friends and colleagues.

To create a new collection:
- Click "Start a New Collection" below, fill in the brief form and click "Submit"
- Choose items from your library, our resource search page, or upload your own files to add to the collection
- NOTE: NSTA resources must first be added to your library before they can be added to a collection
- For more help view the My Library Help Guide (1.24 MB PDF) to see screen shots and step-by-step instructions

### My Collections

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### Collections Shared With Me

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<td>Sue Leelan</td>
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</table>
Over 600 collections already publicly shared in first 2 months of release

Rank and rate public collections
Below are group forums that you may join. Post to existing topics or start your own! All NSTA resources, personally uploaded resources, and collections may be shared and commented upon within these discussions.

40 people currently online

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<th>Public Forums</th>
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<td>by Flavio Mendez, Today, 6:15 PM</td>
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<td>Physical Science</td>
<td>by Carolyn Mohr, Today, 4:29 PM</td>
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<td>Earth and Space Science</td>
<td>by Rachel Engle, Today, 7:11 PM</td>
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Who is Online
Discussion Forums

- Linked to User Profile
- Display Recognition Badges
- Integrate content
User Profile

- Learn about others in community
- Badges and points awarded for community building activities:
  - Comment
  - Aggregate
  - Advocate
  - Disseminate
Through online learning systems, teachers may enhance their learning through blending the best of onsite PD with online PD that provides immediacy, convenience, self-direction, and collaboration with other colleagues and experts via professional learning communities. For teachers to effectively facilitate using interactive resources, learning systems, and connectedness to online communities, teachers need to experience it firsthand as part of their own learning and professional development.
The NSTA Learning Center is an outstanding resource that has proven to be invaluable to our teachers! We have utilized this resource for both beginning teachers as well as more experienced teachers. All of our teachers have found this to be a convenient way to enhance their science content knowledge, an invaluable resource to assist in explaining specific concepts in class, a useful tool for sharing resources with colleagues, and a central location for compiling their lesson plans, examples of student work, and annual progress. The assistance provided in getting started and training teachers how to use the Learning Center is outstanding. Once established, the help and support for the Learning Center is also outstanding. All of the Help Desk staff has been extremely helpful, providing the highest level of service achievable! Once teachers experience the online learning and utilize the extensive resources available, they never want to stop using the NSTA Learning Center! I highly recommend it!

Marguerite A. Sognier, Ph.D.
Director, Educational Outreach
Texas Regional Collaborative, Galveston, TX
I am writing to praise NSTA for your creative efforts in providing online professional development resources for teachers and to let you know that at The University of Maryland, Baltimore Campus we are using the resources with our pre-service elementary science teachers to boost their content understandings and help them gain insights into high quality professional development. As the professor of the UMBC elementary science methods course and as a professional development researcher, my belief is that the day you decide to become a science teacher you start on your professional development journey. So, one of the main goals in my course is to help my pre-service teachers become aware of the resources that will serve them across their careers as lifelong learners. The online professional development resources on the NSTA website are a perfect fit for helping us reach this goal. I encourage other university science educators to get their students involved in Learning Center activities. Our pre-service teachers deserve the opportunity to experience NSTA’s innovative, high quality, online professional development learning experiences as these are the types of activities they will be doing as practicing science teacher.

Susan M. Blunck, Ph.D.
Associate Clinical Professor
Science Education
Director UMBC Center for Excellence in STEM Education
I utilize the NSTA Learning Center for my Pre-service Teachers enrolled in my science methods courses at The University of Texas-Tyler. I utilize the Learning Center because it is much more comprehensive than a methods text. The NSTA Learning Center allows me to develop (preload) a library of materials I can share with my students to serve as their text. It allows the students to build upon the library by adding their own resources as they learn about science teaching and learning. In the EC-6 and 4-8 grade level certification programs too many students do not have the content backgrounds they need in science. The Learning Center allows me to evaluate my students’ science content knowledge using the free PD Indexer tool and develop a remediation plan using SciPacks to address their gaps in knowledge. The best part is that students complete the modules outside of class rather than taking limited class time. Students also seem to like the SciGuides that are coupled with the SciPacks and Science Objects, as they provide vetted web-based resources, lesson plans, and access to the simulations found in the SciPacks for use in the classroom.

Michael Odell, Ph.D.
Roosth Chair in Education
Executive Director, The Ingenuity Center
University of Texas at Tyler
The goal of the Teacher Academy in the Natural Sciences (TANS) project is to enrich the science content of Mississippi’s middle school science teachers. To accomplish this goal, the TANS leadership team at Mississippi State University (MSU) relies on the over 5,000 resources in the NSTA Learning Center throughout the academic year to extend and enhance our TANS summer institute content instruction. SciPacks are in-depth online science modules that our participating teachers can access and complete at their convenience. With an assortment of SciPack topics available, the TANS leadership team was able to choose appropriate and relevant modules in chemistry, physics, and the geosciences. Not only does the NSTA Learning Center provide a multitude of convenient online resources, but the support provided by the NSTA Learning Center team is superb. The NSTA Learning Center is an integral component of the Teacher Academy in the Natural Sciences Mississippi Mathematics-Science Partnership at MSU. We look forward to working closely with the NSTA Learning Center over the next three years.

Renee Clary, Ph.D.
Director, Teacher Academy
Mississippi State Mathematics-Science Partnerships
Mississippi State University

See more at: http://learningcenter.nsta.org/Testimonials.aspx
A Critical Piece of the Solution

Questions

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