VOL. 10, NO. 2

r&d alert®

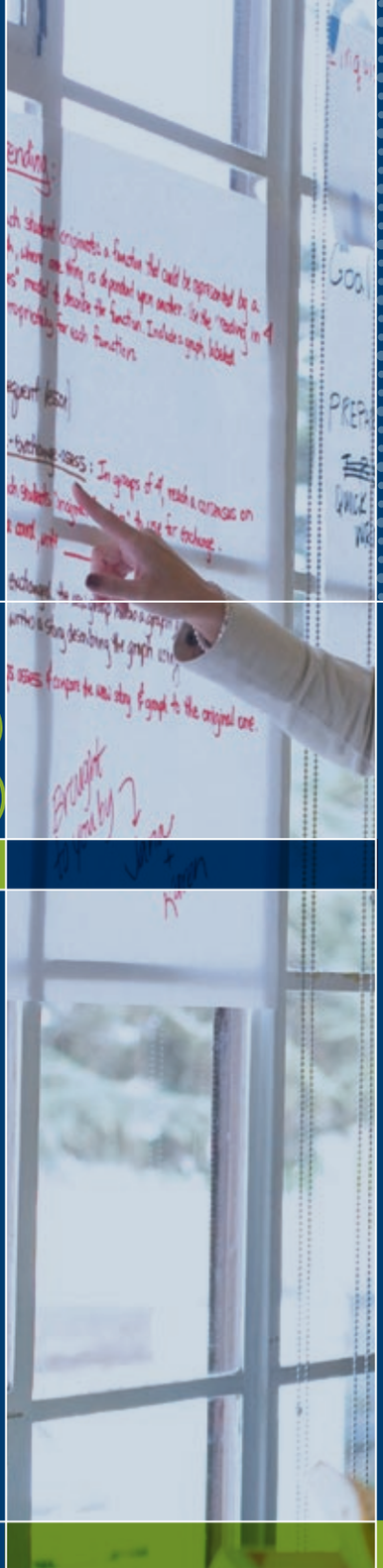
timely knowledge for education and human development

ISSUE FOCUS

Professional Development

a publication of WestEd®

contents



Science Teaching Geared to How Students Learn 03

Turning to the Evidence: Research shows the value of using artifacts in professional development > 06

Teacher Externships: Connecting the classroom to the workplace > 09

Systemwide Improvement Through Professional Development > 12

A Resource to Help Science Teachers Work with English Learners > 15

18 Playing for Real: How a simulation game can improve professional development

More Professional Development Information Online > 21

What's New & Useful: WestEd products & services > 22

r&d*alert*

R&D Alert covers issues affecting schools, communities, and human development professionals throughout the United States. Current and previous issues are available at WestEd.org/R&DAlert. Your letters are welcomed. Please send comments to Noel White at nwhite@WestEd.org or by regular mail to: Noel White, WestEd, 730 Harrison Street, San Francisco, CA 94107-1242.

Chief Executive Officer
Glen Harvey

Chief Policy & Communications Officer
Max McConkey

R&D Alert Editor
Noel White

Contributors
Linda Broatch
Holly Holland
Carl Nagin
Priscilla Pardini

Copy Editor
Colleen Montoya

Proofreader
Rosemary De La Torre

Graphic Designer
Christian Holden

Photographs
Christian Holden

WestEd

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Science Teaching GEARED TO HOW Students Learn

>> By helping teachers take a fresh look at how students think about science ideas, a WestEd professional development process transforms how those teachers teach science, leading to improved science achievement for their students.

WestEd's Understanding Science project enhances the knowledge and skills of elementary and middle school teachers, with a particular focus on improving instruction for English learners and those with low literacy skills. Research has shown that the project contributes to improving both teacher knowledge and student achievement in science.

Over the past two years, the Understanding Science project conducted nine Leadership Academies across the country to prepare district and regional service staff and teacher leaders to provide professional development for some 800 elementary and middle school teachers. Each set of professional development sessions focused on a specific science topic and grade span, such as electric circuits for grades 3—5, force and motion for grades 6—8, and matter and chemical change for grades 6—8.

Developing "pedagogical content knowledge" to improve teaching

"The Understanding Science approach focuses on the intersection of teachers' knowledge about science and their understanding of how students learn," says WestEd's Mayumi Shinohara, who directs the project with Kirsten Daehler. "Research tells us that teachers who have strong content knowledge *and* science-specific pedagogical skills are more effective than other teachers — they ask students higher-level questions, for example, and are better at helping their students apply science concepts."[1]

PAGE 4

[1] W. S. Carlsen, "Teacher Knowledge and Discourse Control: Quantitative Evidence from Novice Biology Teachers' Classrooms," *Journal of Research in Science Teaching* 30 (1993): 471–481; W. S. Carlsen, "Subject-matter Knowledge and Science Teaching: A Pragmatic Perspective," in *Advances in Research on Teaching, Vol. 2* (Greenwich, CT: JAI, 1991), 115–186; C. A. Druva & R. D. Anderson, "Science Teacher Characteristics by Teacher Behavior and by Student Outcome: A Meta-analysis of Research," *Journal of Research in Science Teaching* 20, no. 5 (1983): 467–479; M. Hashweh, "Effects of Subject Matter Knowledge in the Teaching of Biology and Physics," *Research and Teacher Education* 3 (1987): 109–120.

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To address this dual focus on content and pedagogical content knowledge, each Understanding Science session engages participants in a carefully designed sequence of activities. First, educators conduct their own hands-on investigation of a science concept, such as electrical circuits. Later, they discuss a "teaching case," an expert educator's journal-like description of teaching this same science concept to a class of students. The written cases include student work samples, descriptions of materials and activities, dialogue, and teacher thinking.

A case focused on an electrical circuit lesson, for example, includes a fourth-grade teacher reflecting on what students were getting out of the lesson:

> *"While the Bulb-Battery-Wire Activity definitely helped students learn how to light the bulb, it misled many to think that light is pretty much the same thing as electricity.... I think it's important for students to have a more nuanced understanding of light and electrical current.... I still think the activity is a great way of teaching those ideas, but I wonder what additional scaffolding is needed...."*

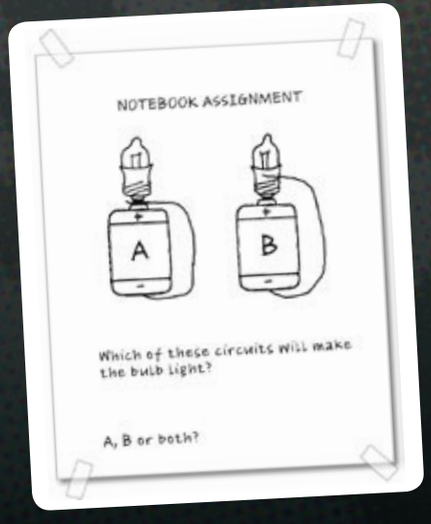
Professional development workshop facilitators guide participants to carefully analyze how students in the case understand and misunderstand the science idea, as revealed in their explanations and questions and in how they represent concepts such as "complete circuit" or "current" in drawings. Facilitators also encourage participants to critically analyze the instructional decisions that the case teacher makes when students become confused or need reinforcement on important concepts.

For example, participants might evaluate the effectiveness of a teacher's series of questions about student drawings and comments about circuits:

> *"Is there always a circle connection between the two ends of the battery?" I asked (students).... "Remember what you learned about bulbs yesterday. When you look at these circuits that light up, what patterns do you see?"*

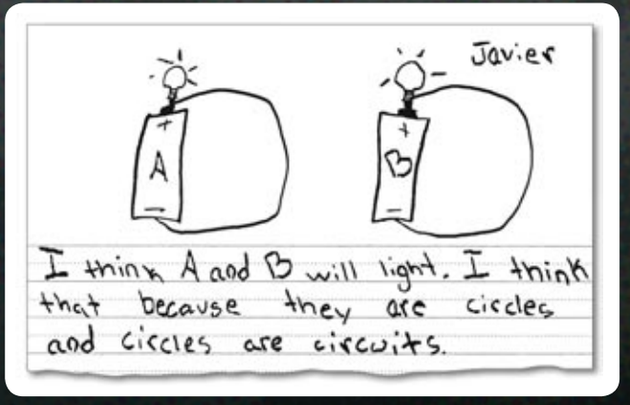
Through discussing the various instructional perspectives and solutions that arise in their own science investigations and in the cases, participants in Understanding Science sessions develop ideas for improving instruction.

Between professional development sessions, participants complete "Classroom Connection" assignments, in which they use the approaches they're learning in the sessions to explore science ideas, language, and thinking with their own students. Debriefing this homework with other participants offers educators a deeper look at how various strategies apply across classrooms and grade levels.



This notebook assignment for fourth-graders, from an Understanding Science teaching case, asks them to make a prediction about which circuit will light a bulb.

One student mistakenly predicts that both bulbs will light.



Supporting literacy skills for science learning

Understanding Science participants come to recognize the importance of students' ability to understand the academic content *and* their capacity to represent what they know through speaking and writing. An important goal of the Understanding Science initiative is to narrow the science achievement gap between English learners or students with low literacy skills and their grade-level peers. To help narrow this gap, the professional development sessions model a learning environment of collaborative inquiry, one filled with talk and writing about science concepts that are grounded in participants' hands-on investigations.

When classroom conversation and writing are promoted as ways to understand science concepts, academic language and vocabulary can be continually taught and reinforced in meaningful ways. For example, one of the teaching cases includes the following analysis of how students' drawings and writing about electrical current reflected their understanding of this difficult concept:

> *Students' work pointed out some things I hadn't noticed before. Even though I was careful to talk about "electrical current," they all used the word "electricity." I also don't know where they're getting the idea that current is "used up" or "shared." Are they actually talking about "energy"? We don't really get into energy at this grade level, but it would be correct to say the bulbs transform the electrical energy into heat and light. In that way, it is okay to say that energy gets "used up."*

Strong results for teachers *and* students

The focus on how students think about science concepts and on the teaching needed to improve their science literacy has proven effective. With support from the National Science Foundation, the Institute of Education Sciences, the Stuart Foundation, and the Stone Foundation, the Understanding Science project has worked with more than 1,000 teachers over the past decade. An extensive multi-year study of the project demonstrated that:

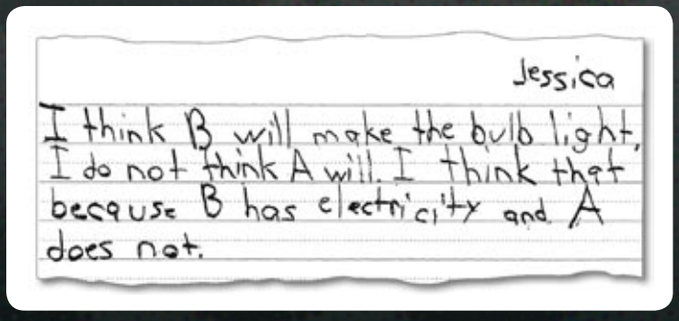
- Teachers learned science, developed more sophisticated understanding of pedagogical content knowledge, and maintained these gains over time.
- Teachers reported changes in their general classroom practices, not just for the course topics they studied.
- Students of all entering abilities showed significant gains in science — and low-performing students improved the most.[2]

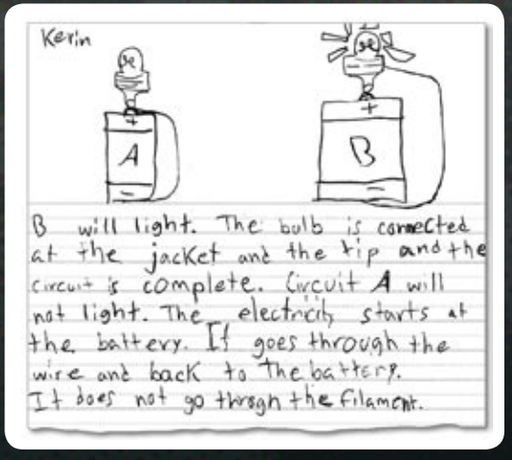
Building on these strong results, project developers plan to publish in the coming years a full set of 15 professional development

[2] J. I. Heller, *Final Evaluation Report for Science Cases for Teacher Learning: Impact on Teachers, Classrooms, and Students, Project Years 2000-2003* (submitted to WestEd and Stuart Foundation, 2006).

BACK PAGE

Another student makes the correct prediction, but using the wrong reasoning.





This student was one of a "handful" in the class who made the correct prediction with the correct reasoning.

TURNING TO THE Evidence

Research Shows the Value of Using Artifacts in Professional Development

>> *Educators have long touted the value of using manipulative materials — cubes, blocks, coins, tiles — to help students learn math concepts and skills. Now, a similar use of materials in professional development programs for math* **teachers** *is getting equally high marks.*

"Teachers who have an opportunity to work, over time, using mathematically focused classroom artifacts are learning some important things that appear to be helping their teaching," says Nanette Seago, Senior Program Associate at WestEd. "For one thing, they tend to become better able to see a student's potential, which we think is huge."

Seago and Lynn Goldsmith, Principal Research Scientist at the Education Development Center (EDC), Inc., were co-principal investigators of Turning to the Evidence: What Teachers Learn by Using Classroom Records and Artifacts in Mathematics Instruction, a four-year study funded by the National Science Foundation. The study evaluated how such artifacts — specifically, samples of student work and videos of classroom teaching — impact professional development and, in turn, teaching practice.

As part of the study, 49 middle and high school teachers participated in a series of 12 three-hour seminars based on one of two professional development programs that incorporate artifacts. (Another 25 teachers who did not attend the seminars served as a comparison group.) One program used components of EDC's Fostering Algebraic Thinking Toolkit (ATT), and the other, WestEd's Learning and Teaching Linear Functions: Video Cases for Mathematics Professional Development (LTLF). Both programs focus on how teachers can better understand students' thinking and reasoning processes related to algebra, a "gateway" subject in math that many students find particularly challenging.

Among the artifacts teachers worked with in the ATT seminars were examples of student work, and the LTLF seminars used video clips of teaching lessons. "Both these programs differ from more typical professional development in which teachers might read research articles and talk about how the abstract ideas might apply to their classrooms," says Seago. "In our seminars, teachers worked with concrete examples to explore issues of math learning and teaching."

In LTLF seminars, teachers solve math problems, then share their various solutions with one another. Next, they watch and analyze a video of students working on the same problems. Seago says that because the videos are designed to be teaching aids, some feature innovative teachers engaging students in math. "However, the videos are not meant to represent perfect lessons. They're unscripted and unstaged and show the complexity of teaching."

Seminar participants then take part in an activity, such as designing a lesson for their own students or coming up with an accompanying homework task, that links what they discussed from the video to their own practice. "In

PAGE 8

We want them to take what they've learned from their analysis and find a way to transfer it to their own classrooms.

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other words, we want them to take what they've learned from their analysis and find a way to transfer it to their own classrooms," explains Seago.

In ATT seminars, teachers work together to solve a specific math problem before comparing their solutions with those found in samples of their students' work. They also study written transcripts of the discussions their students had while the students were solving the problem in small groups. "Teachers try to understand what the students were thinking, the logic behind that thinking, and, if relevant, they try to spot and understand any common misunderstandings," says Seago. The goal of the exercise, she adds, is to make it more likely that teachers will begin to regularly undertake similar analyses in their own classrooms.

Analysis of assessments that teachers took before and after the two types of seminars yielded three major findings.

- **Increased focus on students' potential.** At the end of the study, most (61 percent) of the seminar participants focused on students' mathematical potential, compared with 37 percent of those in the comparison group. "Usually, when teachers look at student work or videos, they tend to do so from a negative or deficit view," says Seago. "But we found teachers who had taken the seminars were more likely to notice what students *did* know. Rather than say, 'This kid doesn't get it,' they'd be more likely to say, 'He's on the right track; it's just at this particular juncture, he went off in the wrong direction.' That shows me teachers have a much better understanding of how students are thinking, and therefore more likely to change the approach they take in the classroom."
- **Backing claims with evidence.** Seago says 42 percent of the seminar participants (versus 18 percent in the comparison group) backed up claims about the students' abilities with evidence. "They really had moved much further along in terms of not making unsupported assumptions," she says.
- **Increased specificity.** Seminar participants had become much more mathematically specific about analyzing the students' work than their peers in the comparison group. Explains Seago, "It's the difference between a teacher saying 'This student doesn't see the pattern' and 'This student doesn't seem to be defining the variable in the same way as others, he is defining the variable as the previous number in the pattern.'"

Seago takes heart from the study findings, especially the prospect of increasing teachers' focus on student potential. "What would that mean if teachers left a professional development experience more likely to look at students' potential? They'd have more of an idea of how to build on that potential to help students develop an even fuller understanding. It could be especially beneficial in algebra, an area of math that tends to be deficit-focused and that has for so long been impenetrable for many students."

For more information on Turning to the Evidence, contact Nanette Seago at 951.682.1070 or nseago@WestEd.org.

Teacher Externships

Connecting the Classroom to the Workplace

>> For many educators, professional development brings to mind workshops, night courses at a college of education, or perhaps meeting with colleagues for lesson study. But teacher externships offer a very different kind of professional development experience, one that is often transformative for educators and their students.

Externships — spending time in a workplace outside the classroom to learn about how a discipline is applied in a career setting — "provide a peer-to-peer learning environment," says WestEd Senior Research Associate Svetlana Darche. Externships range from a day of simple job shadowing to full externships that are usually project-based and last as long as two weeks or a full summer.

In a program and guidebook on teacher externships that Darche developed for the Alameda Unified School District, she writes that externships "offer teachers exposure to the most current workplace practices, tools, and information, and an 'on-the-ground' understanding of future economic and career trends that will affect their students.... They provide teachers real examples about the kinds of teamwork, planning, decision-making, problem solving, communication, and creativity employed in successful ventures and organizations."

PAGE 10

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California has invested in teacher externships through community grants that are part of the state's Career Technical Educational (CTE) Pathways Initiative. To understand how these externships have been working in the field, WestEd conducted interviews and focus groups as part of an ongoing evaluation for the California Community College Chancellor's Office in collaboration with the California Department of Education.

The CTE initiative funds teacher externships for high school and middle school teachers and counselors as well as for community college faculty. From her work evaluating the initiative, WestEd Senior Research Associate June Lee-Bayha cites Glendale Community College's experience as an exemplary model of teacher externships. In the summer of 2007, four Glendale faculty members received grants to pursue 10—12 weeks of original research projects with senior scientists at NASA's Jet Propulsion Laboratory (JPL) at the California Institute of Technology.

Adults learn through doing and problem solving; they need to understand why they are learning something; and they learn best when the subject is of immediate use to them.

Glendale Oceanography instructor Laura Faye Tenenbaum used her externship to develop a general education college course on climate change. Working with preeminent climatologists, she studied recent changes in sea level and sea ice distribution. As a result, "we're rewriting the lab manual we use and updating our information," Tenenbaum says. "What we used previously was from textbooks; this is from scientists themselves. The students were really inspired; some changed their majors, and others became more involved in things like internships and research."

The externship also led Tenenbaum to write an article on JPL's ocean surface topography missions for NASA's newsletter, *The Earth Observer*, and to host Glendale Community College students on tours of the lab, a kind of job shadow that inspired one of her students to apply and be hired for a position at JPL. Many of her students had previously taken a dim view of science, seeing it as "cold, hard, intimidating," says Tenenbaum. "I hope the relevancy of the global climate change topic and its broad level of interest in our society will change their views and attract students to this course who may not otherwise be interested in the sciences."

Not all the Glendale grantees were scientists. Photography instructor Joan Watanabe worked at JPL's Image Processing Lab to create a digital presentation of the journeys of the two Mars Rovers (Opportunity and Spirit). Building on her externship, Watanabe developed a curriculum on creating content to be used in digital planetariums. In addition, some of her students received JPL internships, and Glendale students from different disciplines collaborated in a team project to create planetarium content. Art students instructed science students on imaging techniques and the aesthetics appropriate for planetarium shows. Together, they worked in a state-of-the-art facility at JPL, gaining skills suitable for employment at other digital planetariums or for related software development.

Lee-Bayha has heard many grant recipients describe similar cases of an externship becoming a career-altering experience: "It energizes faculty. It gets them to think about how what they are teaching can be applied when students leave the classroom. It also changes the classroom dynamic when faculty become more like students and see what kind of world their students are entering. It raises the stakes of what's being taught and can make teachers more empathetic to their students."

According to WestEd's Darche, the core ideas behind externships are rooted in a constructivist approach to education and in tenets of adult learning theory: Adults learn through doing and problem solving; they need to understand why they are learning something; and they learn best when the subject is of immediate use to them.

A defining moment for Darche came while working at the Marin County School to Career Partnership, a school reform initiative she helped launch in 1997. Darche was invited to participate in a teacher job shadow at a local hospital. "I spent the day with the director of the cardiac catheterization unit," she recalls. "It turned out that not only did she run this amazingly sophisticated high-tech unit, but she had been a teen dropout who had risen up the ranks of this hospital, taken it on herself to get a Masters in human resources, and in 1997 was making over $100,000 a year."

Darche recalls that when she visited the hospital, "computer technology was just taking off. Today, we take it for granted that there's absolutely no way you can be a medical technician without being comfortable around technology, but back then it just hit me like a two-by-four on that job shadow. Not only did the experience help me understand how skills in technology are used, but it also was so powerful to see how this woman rose to her level of responsibility. It was one of the most inspiring days of my life."

For more information on teacher externships, contact June Lee-Bayha at 858.530.1076 or jlee@WestEd.org, or Svetlana Darche at 510.302.4304 or sdarche@WestEd.org.

>> *It's not unusual for teachers to dread the time they're required to spend in professional development workshops. And it's not uncommon for some to pass that time by surreptitiously grading papers or checking email, even when the content of the workshop is meaningful or relevant — such as when it's closely aligned to a school district's improvement plan.*

Professional development so often fails to engage teachers, according to WestEd researchers, because it does not take into account the unique way adults learn and the conditions most likely to transfer that learning to the classroom.

"We need more professional development that goes way beyond traditional workshops, no matter how valuable the content of those workshops," says Sue Harwood, Senior Research Associate at WestEd. "The material needs to be embedded in instruction that considers teachers' knowledge, experience, and unique ways of learning, and then reinforced with expert coaching and feedback to ensure changes in teaching practice."

Harwood has worked extensively on WestEd's Teach for Success (T4S) and Coach for Success (C4S), which use such an approach to improve classroom instruction

Systemwide Improvement

THROUGH PROFESSIONAL DEVELOPMENT

and, in turn, student achievement. Huck Fitterer, Director of Field Services at WestEd, spearheaded the development of these projects that grew out of a school improvement initiative intended to clarify and deepen teachers' understanding of effective instruction. The strategies that ultimately provided the framework for what would become T4S included using proven instructional practices to support all learners, actively engaging students in learning, and creating a positive classroom climate.

"We're after systemwide change, and to achieve that requires getting everyone on the district's leadership team on board, including the principals who are trained to coach the teachers," says Harwood. "We've learned that working with individual schools doesn't get you a big enough payoff." So, WestEd's focus is almost always districtwide. Over the past seven years, hundreds of districts, as well as schools, in California, Hawaii, Nevada, Arizona, and Massachusetts have participated in T4S.

The T4S process begins with classroom observations and data analysis by WestEd staff, who share their findings with district leaders in a series of strategic planning meetings. "It is in these meetings that a district's strengths and challenges emerge and where decisions are made on what needs to be done to improve instruction," says Harwood.

If, for example, classroom observations in a particular district reveal that teachers are not actively engaging students in their own learning, addressing the issue would become a key element of the district's strategic improvement plan. What's more, the strategy would become the topic of T4S workshops for both administrators and teachers. In both cases, WestEd staffers would explain the rationale behind the strategy and demonstrate concrete ways (such as scaffolding instruction or more clearly communicating goals and objectives to students) for teachers to incorporate the strategy into their practice.

Customizing professional development to fit a district's needs, however, cannot guarantee an increase in student achievement, says Harwood. "You can focus on the most appropriate and important instructional strategies, but unless you present them in a way that's meaningful, relevant, and understandable *for adults,* the strategies won't take effect."

Thus, T4S and C4S reflect research findings on andragogy, or adult learning theory. "Adults bring unique experiences to any learning situation and are more self-directed in their learning," says Harwood. "They are problem-centered

PAGE 14

continued from previous page

and problem solvers who want concrete learning experiences that are relevant to their day-to-day work."

T4S workshops incorporate this perspective. A lesson for teachers on how to actively engage students in learning, for example, delivers that information in ways that require the teachers themselves to be active and self-directed. Harwood might model how to conduct a large-group discussion so that everyone in the class is actively engaged in the activity.

You can send teachers to classes all year long, but it's not until they get help in their own classrooms with their own students that true change is created.

"I always pose a question and then, instead of calling on one person to answer it, I ask each teacher to turn to a colleague and talk about it, or ask each teacher to write out an answer," she says.

Following the demonstration, Harwood asks the teachers if such an approach would mesh with their teaching styles and, if not, how it could be modified. "It's a matter of giving them choices on how to implement the concept," she says.

The Coach for Success part of the process gives principals and other administrators the skills to help teachers embed what they've learned into their classrooms. "We take the instructional framework of T4S and help principals and academic coaches learn how to give specific feedback to teachers based on that framework," says Harwood.

C4S participants study adult learning theory, learn classroom observation techniques, and master coaching skills to be able to give teachers valuable feedback. For example, working with observation instruments that include clearly defined criteria, principals observe teachers in their classrooms, record observation data, then talk with the teachers about how closely the teachers are meeting those criteria.

"We know from research on andragogy that adult learners want feedback," says Harwood. "And for improving teaching practice, what could be more important than having principals offer that feedback through a collaborative conversation?"

Cindy Didway, Superintendent of the 6,000-student Crane Public Schools in rural Yuma, Arizona, credits the coaching piece of the process with significantly improving student achievement in her district. Between 2004 (when T4S and C4S were implemented) and 2007, there was a dramatic increase across the district in the number of teachers actively engaging students.

At one school, for example, only 47 percent of teachers in 2004 were actively engaging students, based on classroom observation, as compared with 79 percent in 2007. And at the same school, the percentage of 8th graders who met or exceeded Arizona's proficiency standards increased from 24 to 58 percent in reading over the same time period, and from 51 to 65 percent in mathematics.

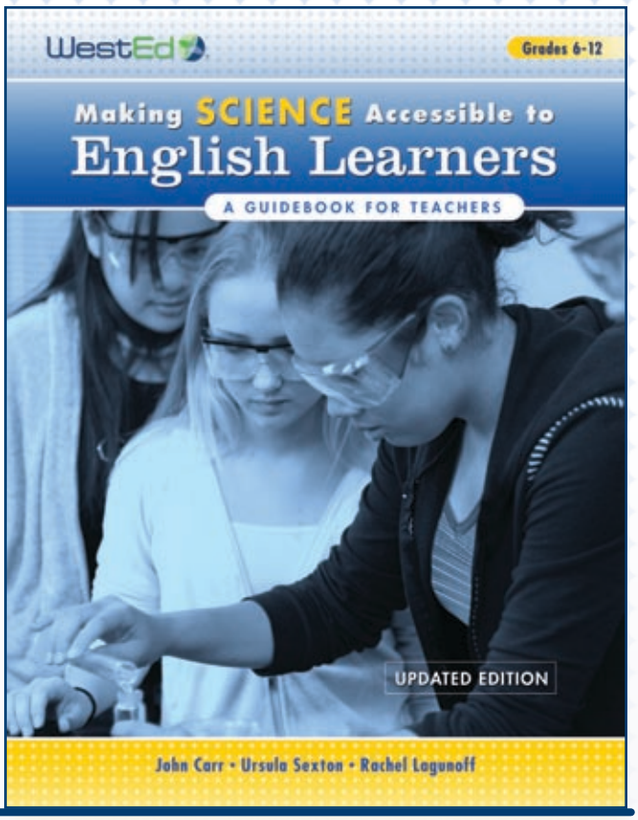
"You can send teachers to classes all year long," reflects Didway, "but it's not until they get help in their own classrooms with their own students that true change is created."

For more information about Teach for Success and Coach for Success, contact Sue Harwood at 602.322.7010 or sharwoo@WestEd.org, or Huck Fitterer at 602.322.7002 or hfitter@WestEd.org, or visit WestEd.org/teachforsuccess.

A RESOURCE TO HELP

Science Teachers Work with

English Learners



>> Most professional development geared to science teachers appropriately aims to strengthen their content knowledge and their science-focused teaching skills. But as language diversity in classrooms continues to increase, science educators often feel a key element is missing from their preparation: a focus on how to teach standards-based content to English learners.

Knowing that many educators were looking for guidance in this area, WestEd researchers developed *Making Science Accessible to English Learners*, a resource offering practical, step-by-step strategies for integrating English language development into daily science lesson plans, instruction, and assessment.

Intended for secondary science educators with little or no training in teaching English learners, the guidebook explains the basics of language development, describes strategies for scaffolding science learning, provides tools for differentiating instruction for students at five levels of English proficiency, and suggests simple accommodations for assessments.

"Science teachers tell us they have too few opportunities for professional development focused on science, so time on English learner issues needs to relate directly to teaching science effectively," says John Carr, coauthor of *Making Science Accessible to English Learners*. The guidebook and related professional development workshops take teachers' needs and preferences into account.

PAGE 16

continued from previous page

A response to "persistent prodding" from teachers

Several years of classroom observations, professional development workshops, and conversations with teachers persuaded Carr and coauthors Ursula Sexton and Rachel Lagunoff that many teachers could substantially improve science instruction for English learners simply by making more informed, strategic use of familiar teaching tools.

Making Science Accessible to English Learners was inspired, in part, by the popularity of *The Map of Standards for English Learners,* coauthored by Carr and Lagunoff. The *Map* helps language arts teachers design instruction and assessment, with one volume covering grades K—5, another covering grades 6—12. Each volume includes a chart of California's English Language Development standards presented side-by-side with the related English Language Arts standards for listening, speaking, reading, and writing.

All of the guidebook's ideas and strategies, Carr notes, are rooted in three research-based principles about how people learn.

After publication of the *Map,* middle school and high school science teachers began urging Carr and his colleagues to develop a similar tool geared to science. Although initially uncertain it could be done, "persistent prodding" and the pressing need to provide English learners equal access to standards-based science instruction persuaded the authors to try.

Although not a map in the same sense as the language arts resource is, *Making Science Accessible to English Learners* offers detailed guidance on planning and assessing science instruction for English learners. It includes a chart showing academic language skills from beginning up to fluent English learners. The chart helps science teachers tailor instruction and assessment to fit their particular students.

The guidebook is built on a "Five Es" model of recursive stages required for inquiry-based learning: Engage, Explore, Explain, Elaborate, and Evaluate.[1] And all of the guidebook's ideas and strategies, Carr notes, are rooted in research-based principles about how people learn.[2]

In particular, English learners need a way to connect what they already know to what they're going to learn; need to learn facts and ideas, and be able to organize those facts and ideas within a conceptual framework; and benefit from reflecting on their learning goals and progress (in terms of both their English language learning as well as their progress in learning discipline-specific content).

Using common teaching practices more strategically to reach English learners

"Often," says Carr, "teachers tell us the guidebook or one of our workshops showed them the importance of making more frequent use of a familiar teaching strategy — using visual aides, for example — building upon the strategy throughout a lesson, and integrating it with other strategies." This reinforces learning and provides visual scaffolds to support oral instruction.

[1] R. W. Bybee, *Achieving Scientific Literacy: From Purposes to Practices* (Portsmouth, NH: Heinemann, 1997).

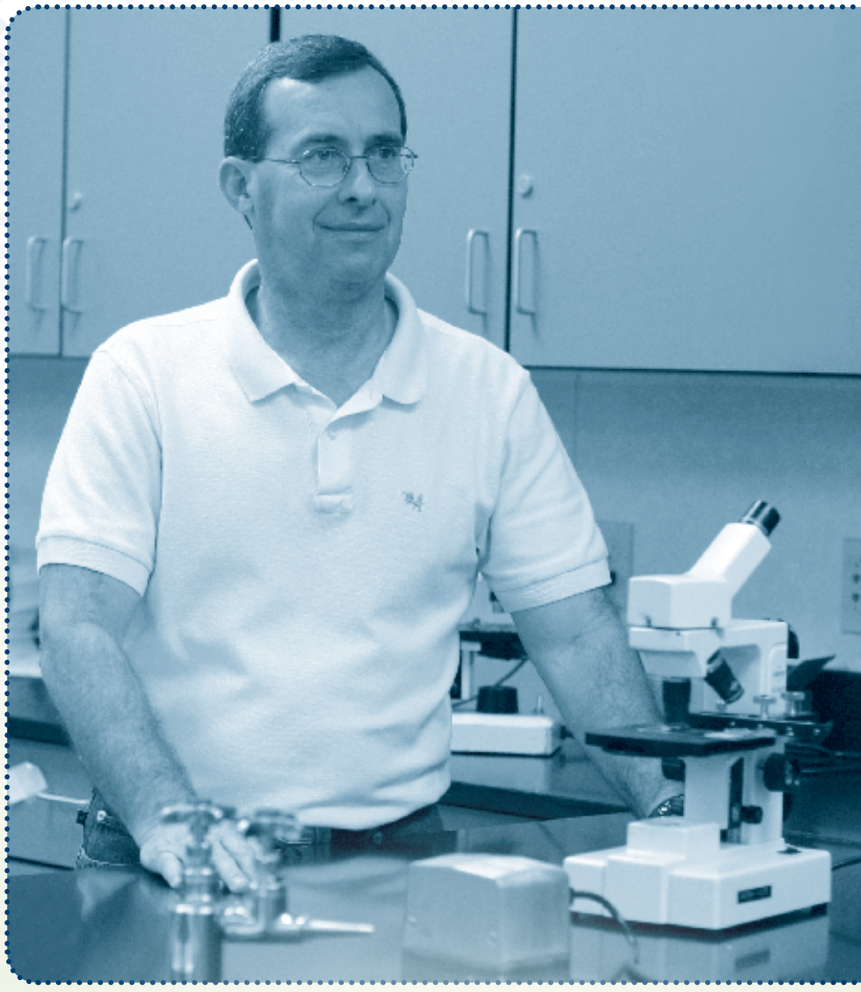
[2] National Research Council, *How People Learn: Bridging Research and Practice* (Washington, DC: National Academies Press, 1999).

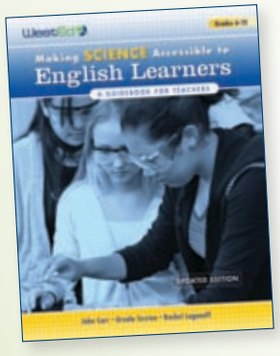
For example, Carr says, a teacher might previously have believed it was appropriate at the *end* of a lesson to use a graphic organizer illustrating the life cycle of a butterfly as a means to summarize and help students connect concepts. But the *Making Science Accessible* guidebook tells teachers how — and why — to use a graphic organizer *throughout* a lesson, and in combination with other strategies, to enhance its impact and provide students with more consistent, coherent, and "brain-friendly" instruction.

Coauthor Sexton, Senior Research Associate in WestEd's Center for the Study of Culture and Language in Education, is particularly interested in helping science teachers use strategies to effectively "connect with" their students. That connection, she says, "becomes an open door" to find out what students know, establish an environment of trust and respect, and monitor their progress.

"For example, with a minimal investment of time, teachers can activate students' prior knowledge, assess their current use of academic language, and relate the topic to students' lives," Sexton says. "Many teachers tell us they don't have time or 'aren't very creative' at engaging students in ways that tap their prior experiences. We try to help them provide engaging, meaningful experiences that make content more accessible and open the door for students to draw on their own language and prior knowledge. Research and best practices demonstrate the importance of doing so."

Although the guidebook can be a stand-alone resource, the authors say that both the guidebook and related workshops are ideally used as "one part of a whole plan of ongoing professional development in a school or district." To take full advantage of the resources in the guidebook and accompanying workshops, Carr says, districts should have an infrastructure in place for teachers to work together in professional learning communities.





To order *Making Science Accessible to English Learners*, call the WestEd Publications Center at 888.293.7833 or order online at www.WestEd.org/makingscienceaccessible.

WestEd, 2007 / 132 pages / $24.95 /
Product #: CC-07-0102 / ISBN: 978-0-914409-40-3

For more information about the Making Science Accessible to English Learners *guidebook and workshops, contact John Carr at 925.673.0801 or jcarr@WestEd.org, or Ursula Sexton at 650.381.6442 or usexton@WestEd.org.*

Playing for

How a Simulation Game CAN IMPROVE Professional Development

Real

>> Professional development can come in many forms — even playing a game can be an occasion for serious professional learning.

Educators in law, medicine, and other professions use simulations and case discussions to introduce real-life challenges and prepare people for addressing those challenges. Games that give professionals an opportunity to simulate real-life scenarios offer safe opportunities to make decisions and learn about the consequences of those decisions through feedback and reflection.

Over the past few years, WestEd staff have developed and field-tested a simulation game to help leaders in science education learn how to design, implement, and sustain effective professional development in schools. The *Building Systems for Science Literacy Simulation Game* replicates educational change in action. Working in teams, players encounter problems and situations, such as how to use limited funds to meet the needs of all teachers, similar to what they might face in their own districts and schools, and they learn how to make wiser decisions.

The game's main messages are based on ideas and principles taken from *Designing Professional Development for Teachers of Science and Mathematics*.* Through a simulation process, players discover what activities and resources have the greatest impact on teacher and student learning, why some teachers struggle to improve their instructional practices, and how much it "costs" in time, materials, and commitment to provide effective professional development.

"People who are doing this difficult work need a risk-free, supportive environment where they can try out their ideas about what would work," explains Susan Mundry, principal investigator of the simulation game project. "When planning and conducting professional development, you're spending limited resources. So you hope your decisions will have the most leverage, but you may not always know what would work best." The simulation game helps teams explore what to do and what pitfalls they might face before making real-life decisions.

What steps should staff members take *before* implementing professional development? Does the school have a vision for reform? How can schools provide

PAGE 20

* S. Loucks-Horsley, N. Love, K. E. Stiles, S. Mundry, & P. W. Hewson, *Designing Professional Development for Teachers of Science and Mathematics*, 2nd ed. (Thousand Oaks, CA: Corwin Press, 2003).

continued from previous page

professional development to meet *all* teachers' learning needs? What is the principal's role? Which data sources should the staff review? The game encourages teams to ask such questions as they work together to solve problems and consider changing course before they try interventions in real school settings.

Through the simulation, teams learn to make improvements in four key areas: leadership, teacher learning, quality teaching, and student learning.

"The simulation helps designers of professional development focus not just on a traditional workshop model," says Jody Bintz, a science educator at the Biological Sciences Curriculum Study in Colorado Springs, Colorado, who has observed and facilitated the game with teams of educators. "It pushes players to ask, 'What do we need to prepare people for change?'"

By playing the game, participants learn how to work together and communicate better, Bintz says. They also see themselves and their colleagues represented in the game's characters, which further helps them apply what they learn to real-life settings. Players must consider the strengths, interests, and needs of staff members such as "Ike," a 15-year veteran who hasn't kept up with the latest developments in his field of physics and isn't convinced that science inquiry projects will enrich his instruction; "Gina," an overwhelmed new teacher who wonders if she made the wrong career choice; and "Faith," a master teacher and concerned colleague who is searching for greater leadership opportunities.

Through the simulation, teams learn to make improvements in four key areas: leadership, teacher learning, quality teaching, and student learning. Mundry says the most challenging points to earn in the game are those dealing with student learning, which is true in real life as well. In the game, players must make progress in teacher leadership, teacher learning, and quality teaching before they can move student learning forward. This aspect of the game highlights the need to establish a foundation of teacher knowledge and effective practice before changes in student learning can happen and be sustained. And the game shows how questions like "What specific steps did you take to change the outcome?" and "How do you know that the interventions worked?" can be answered and supported with evidence.

WestEd staff developed and field-tested the simulation game and are using the feedback to revise and expand activities that will lead users to apply what they learn directly to their own settings. The National Science Foundation provided a grant to develop the simulation and accompanying learning modules for education leaders to explore the game's ideas in more depth. While the game is focused on science, its big ideas and lessons are applicable to school-based professional development initiatives focused on other subjects as well.

Mundry says one of the key lessons of this project has been the importance of developing collaboration and active participation in the reform process. "When people are taking on the hard work of introducing or sustaining new ways of thinking throughout the school, it can't be a solo venture," she says. "It's something school leaders have to thoughtfully coordinate with others."

For more information about the simulation game and learning modules, contact Susan Mundry at 781.481.1106 or smundry@WestEd.org, or Kathy Stiles at 317.923.9378 or kstiles@WestEd.org.

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What's New & Useful

Editor: Karen Kearney

Publisher: WestEd, 2003

Pages: 57 / Price: $15.95

Product #: DOP-03-0102 / ISBN: 978-0-914409-17-5

Moving Leadership Standards Into Everyday Work: Descriptions of Practice

For each of six research-based leadership standards, the descriptions of practice (DOPs) in this publication identify the underlying goals and describe specific administrator actions, attitudes, and understanding needed to attain each goal. The DOPs also depict key aspects of each standard in action across a continuum of developing practice, as an administrator moves from being a tactical manager to a strategic instructional leader whose efforts result in improved student learning.

Authors: Kathy Dunne & Susan Villani

Publisher: WestEd, 2006

BOOK:

Pages: 96 / Price: $21.95

Product #: LI-06-0402 / ISBN: 0-914409-30-1

FACILITATION GUIDE:

Pages: 294 (plus CD) / Price: $120

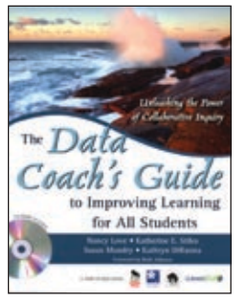
Product #: LI-06-0502 / ISBN: 0-914409-30-12

Mentoring New Teachers Through Collaborative Coaching: Linking Student and Teacher Learning *and* Facilitation and Training Guide

Based on research and their extensive work across the country, the authors offer guidance on how mentors can understand the needs of new teachers, build strong relationships with them, and coach them through an ongoing process of improvement. This book and facilitation guide are geared to education leaders who oversee mentor programs and those who provide professional development for mentors.

The Data Coach's Guide to Improving Learning for All Students

This guide helps schools move away from unproductive data practices and toward examining data as a catalyst for systematic and continuous improvement in instruction and student learning. To help both current and aspiring data coaches facilitate school-based data teams and lead teachers in collaborative inquiry, the authors demonstrate a data model that has been field-tested and proven effective. It includes a CD-ROM keyed to the book, with templates, handouts, PowerPoint slides, resources, and sample goals and agendas.



Authors: Nancy Love, Katherine E. Stiles, Susan Mundry, & Kathryn DiRanna

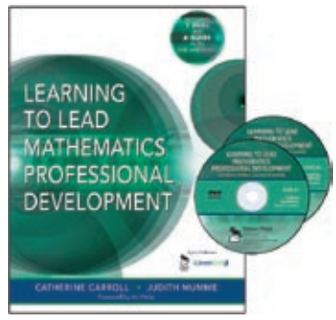
Publisher: Corwin Press, 2007

Pages: 408 / Price: $50.95

Product #: LI-08-0102 / ISBN: 978-1-4129-5001-5

Learning to Lead Mathematics Professional Development

Designed for mathematics professional development leaders, this set of case-based leadership materials helps build facilitation skills, content knowledge, and pedagogy to design and implement effective staff development programs. Ideal for those charged with supporting teacher leaders and others who lead mathematics professional development, the kit includes a user's guide and two DVDs with 44 seminars containing notes, video clips, participant work, PowerPoint slides, and much more.



Authors: Catherine Carroll & Judy Mumme

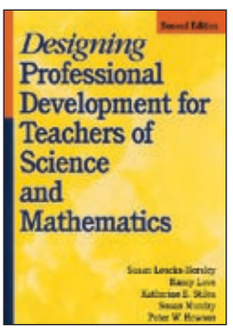
Publisher: Corwin Press, 2007

Format: Multimedia / Price: $199.95

Product #: MATH-07-0102 / ISBN: 978-1-4129-1504-5

Designing Professional Development for Teachers of Science and Mathematics (2nd Ed.)

Drawing on the research, literature, and wisdom of experienced professional developers, *Designing Professional Development* presents best practices to guide the design of learning experiences for mathematics and science teachers that are directly linked to improving student learning. A bridge between theory and practice, this book is a comprehensive tool for professional developers, administrators, and teacher leaders.



Authors: Susan Loucks-Horsley, Nancy Love, Katherine E. Stiles, Susan Mundry, & Peter W. Hewson

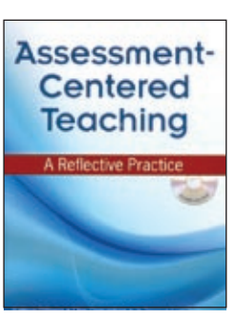
Publisher: Corwin Press, 2003

Pages: 408 / Price: $40.95

Product #: LI-03-0302 /
ISBN: 978-0-7619-4686-1

Assessment-Centered Teaching: A Reflective Practice

Assessment-Centered Teaching (ACT) is a unique practice that allows teachers to gather information during instruction to uncover learning gaps and guide students toward deeper understandings of complex ideas. Suitable for all grade levels, this resource describes how reflective practitioners can use the ACT portfolio to reflect on, modify, and improve their curriculum and instruction.



Authors: Kathryn DiRanna, Ellen Osmundson, Jo Topps, Lynn Barakos, Maryl Gearhart, Karen Cerwin, Diane Carnahan, & Craig Strang

Publisher: Corwin Press, 2008

Pages: 224 / Price: $36.95

Product #: MS-08-0102 /
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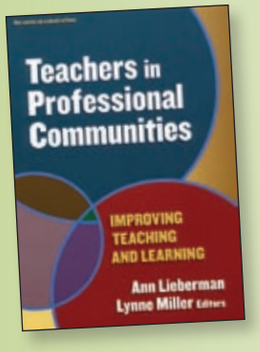
continued from page 5

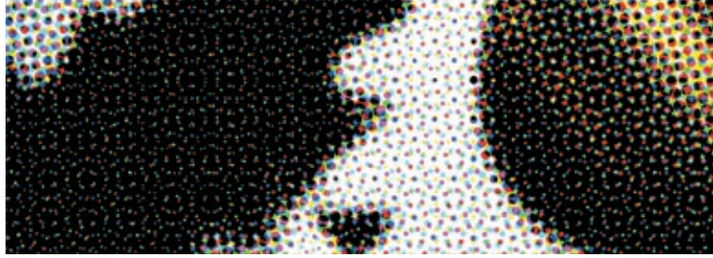
courses on the major concepts of K—8 earth, life, and physical sciences. Shinohara reports that she and her colleagues have chosen topics sufficiently focused so that educators can get "traction" in the content and approach in 24 hours, but big enough to be relevant and meaningful to their teaching.

For more information about WestEd's Understanding Science project, contact Michelle Simone at 510.302.4206 or msimone@WestEd.org.

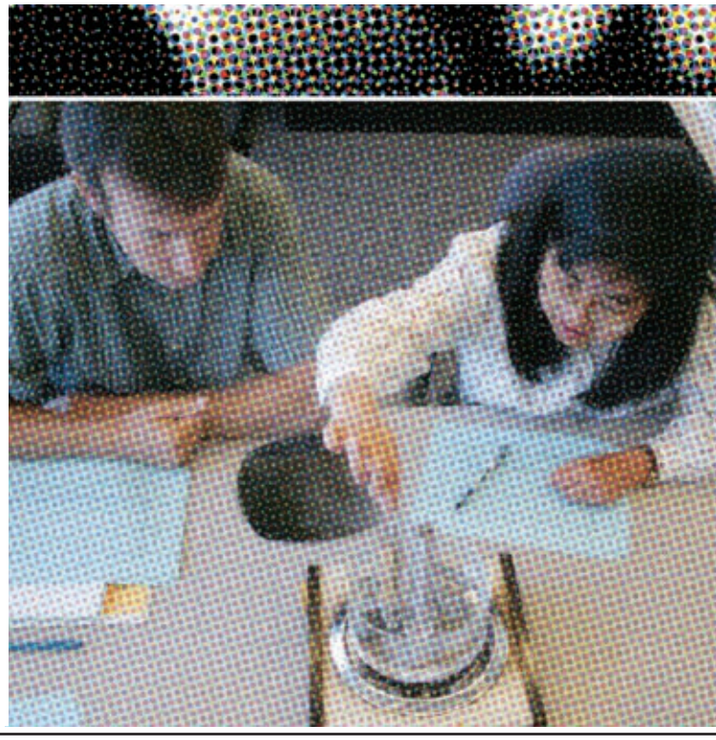


Teachers in Professional Communities

WestEd's Mayumi Shinohara and Kirsten Daehler provide more detail on key aspects of their Understanding Science work in a chapter of *Teachers in Professional Communities*, edited by Ann Lieberman and Lynne Miller. To order online, visit WestEd.org/products.



The focus on how students think about science concepts and on the teaching needed to improve their science literacy has proven effective.



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