2061 today

Science Literacy for a Changing Future

Fall 2007 • Volume 17, Number 2

Atlas of Science Literacy

Two Volumes Map K–12 Science Learning

Science literacy depends on knowledge that is richly interconnected, forming a coherent understanding of the world and how it works. *Atlas of Science Literacy, Volume 2*, Project 2061's newest tool for educators, is helping teachers across the country see how students might develop this coherent understanding as they move from kindergarten through 12th grade. Co-published by Project 2061 and the National Science Teachers Association, *Atlas 2* joins the original *Atlas 1* in giving teachers a new perspective on K–12 learning in science, mathematics, and technology.

With the publication of *Atlas 2*, the *Atlas* volumes now include nearly 100 conceptual strand maps that chart all of the learning goals specified in Project 2061's *Benchmarks for Science Literacy. Benchmarks* was derived from the recommendations for adult science literacy proposed in Project 2061's landmark report *Science for All Americans*. By providing a visual display of the *Benchmarks* learning goals, the *Atlas* maps make it easier for teachers to see the relationships among ideas within and across core topics.

The *Atlas* maps—and commentary on the maps—offer educators the "big picture" of what students can be expected to learn in different grades and foster the design of more coherent curriculum, instruction, and assessment. When these three elements promote coherence, science literacy can be approached not as a compilation of isolated bits of information and abilities, but as a rich fabric of mutually supporting ideas and skills that must develop over time.

What's New in *Atlas 2*

In addition to contributing new maps to *Atlas* chapters that were not fully covered in Volume 1, Volume 2 introduces maps for two chapters that were not covered at all in the earlier volume. Chapter 10: Historical Perspectives introduces nine new maps on important episodes of scientific discovery, including maps on The Copernican Revolution, Relativity, Splitting the Atom, and Explaining Evolution. Chapter 12: Habits of Mind presents six maps that deal with attitudes, skills, and values that are essential to science literacy (see Values in Science map on page 4).

Also new to *Atlas 2* are improvements to the maps themselves. Based on feedback from participants in Project 2061's *Atlas* workshops, on the needs of curriculum materials developers, and on Project 2061's own work clarifying what particular benchmarks expect students to know, the new volume incorporates the following enhancements:

- **Increased Coherence:** *Atlas 2* identifies a wider array of important connections among key ideas and shows these connections explicitly in the maps. Off-map Connections show links to the codes of related bench-

Continued on page 5

"Project 2061 has done it again—a simply elegant, well-thought-out, visionary tool for goal-oriented teaching and learning!" **—Page Keeley, Maine Mathematics and Science Alliance**

WHAT'S INSIDE

Project 2061
AAAS

Jo Ellen Roseman

"By emphasizing connections among ideas, Atlas *maps can help ensure that state science standards focus on a coherent set of useful ideas."*

FROM THE
Director

Bringing Coherence to State Standards

In the months since we launched Volume 2 of *Atlas of Science Literacy* at the national NSTA conference in St. Louis, we have been delighted by the enthusiastic response. Already in its second printing, *Atlas 2* joins the first *Atlas* volume in helping educators take on critical challenges—defining state and local content standards for all K–12 students; aligning assessment to content standards; and specifying a scope and sequence for curriculum and instruction to help students make progress in their understanding of key topics.

Consider, for example, the contribution that *Atlas* maps can make to the development of state science standards, which are often criticized for their lack of coherence, specificity, and evidence to back up their expectations of students. Indeed, in a brief review of how states treat ideas on an important topic—the particle model of matter—we found that only 19 states have clearly identified what students should learn. Many states either have no goal at all for these ideas or only vague descriptions of what students should be able to do (but nothing about the knowledge needed to accomplish the tasks). Other states have placed quite sophisticated ideas about the topic at inappropriate grade levels, such as one state's expectation that fifth graders should be able to describe the structure of atoms and the electrical charges of protons, neutrons, and electrons. Rather than promoting a deep understanding of significant science ideas, standards like these often lead to rote memorization of disconnected bits of information.

By emphasizing important connections among ideas and taking account of the logic of the disciplines, *Atlas* maps can help ensure that state standards—and the curriculum materials and assessments that are based on them—focus on a coherent set of useful ideas. By drawing on findings from student learning research, maps provide guidance on the placement of ideas in the grade bands where a wide range of students are most likely to make sense of them. And by depicting how students' understanding of a topic is likely to grow over time, *Atlas* maps reinforce the need for careful articulation of content from kindergarten through high school.

The learning progressions now depicted in the *Atlas* maps are paving the way for long-term, serious study—by ourselves and by others—that will eventually lead to maps built on empirically tested assumptions. We hope you will be a part of this effort. As you continue to make use of the maps, we invite you to share your experiences and results with us.

Jo Ellen Roseman

To contact Project 2061 staff, visit www.project2061.org/about/contact.htm.

Order Your Copy of the *NEW*

Atlas of Science Literacy, Volume 2

for only $59.95

Please send me:

____ copy(ies) of ***Atlas of Science Literacy, Volume 1***, ISBN# 0-87168-668-6, at $59.95 each ($47.95 each for AAAS Members; $47.95 each for 10 or more copies).

____ copy(ies) of ***Atlas of Science Literacy, Volume 2***, ISBN-13# 978-0-87168-712-8, at $59.95 each ($47.95 each for AAAS Members; $47.95 each for 10 or more copies).

____ copy(ies) of ***Atlas of Science Literacy, Volumes 1 and 2***, ISBN# 0-87168-668-6 and ISBN-13# 978-0-87168-712-8, at $99.95 per set ($89.95 per set for AAAS members; $95.95 per set for 10 or more sets).

BILL TO:

Name _____

Address _____

_____

City _____ State _____ Zip _____

Phone _____

E-mail _____

For Credit Card purchases please provide the following additional information

❑ Visa ❑ American Express ❑ MasterCard ❑ Discover

Card Number _____ Expiration Date _____

Name on Card _____

Signature _____

SEND TO: ❑ same as above

Name _____

Address _____

_____

City _____ State _____ Zip _____

Phone _____

E-mail _____

SUBTOTAL $ _____

Residents of California, the District of Columbia, West Virginia, and Canada please add sales tax. $ _____

Shipping $ _____

TOTAL $ _____

Shipping Information

Order amount	Continental U.S.	AK, HI, U.S. Territories & All Other Countries
For orders under $25.00	$7.00	Contact us for shipping information
$25.00 – $74.99	$11.00	
$75.00 – $124.99	$13.00	
$125.00 – $349.99	$15.00	
$350.00 and over	7% of subtotal	

Normal delivery time is 2–3 weeks. For faster delivery (usually in 2–3 business days), please call the Book Order Department at 202-326-6666 by 2 p.m.

How to Order

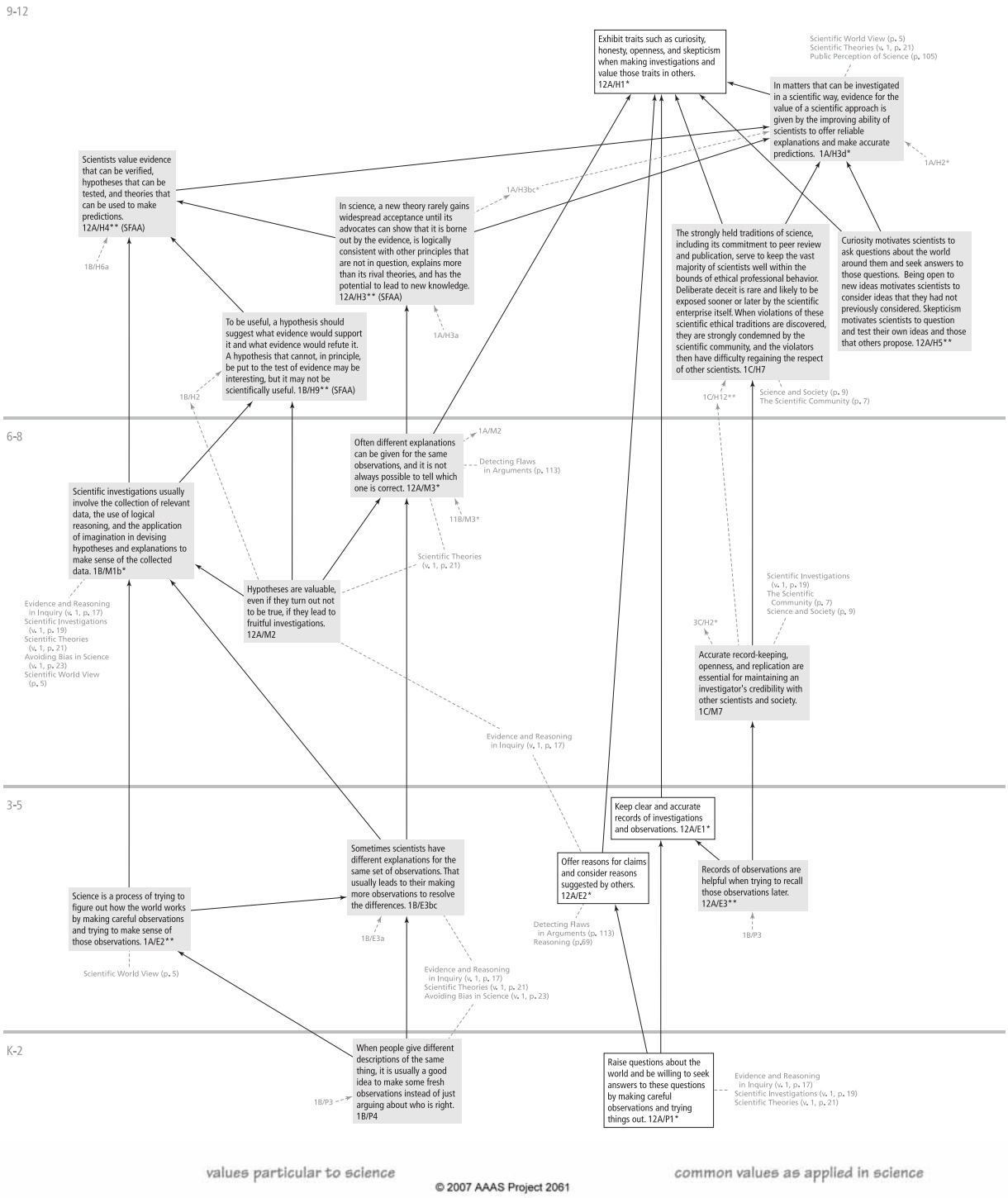
Return this form with payment to

AAAS Project 2061
Book Order Department
1200 New York Avenue, NW
Washington, DC 20005

To order by fax using a credit card, send this form to 202-842-5196.

To order by phone using a credit card, call 1-888-737-2061.

A Strand Map on *Values in Science*



- Text in boxes are learning goals derived mostly from *Benchmarks for Science Literacy* but also from *Science for All Americans* and *National Science Education Standards*. Colored boxes indicate knowledge goals; bordered boxes indicate skill goals.
- Connecting arrows indicate that achieving one benchmark contributes to achieving the other. Connections can be based on the logic of the subject matter or on cognitive research about how students learn.
- Cross-references to other maps indicate that the benchmark also appears on the maps that are listed.
- Codes indicate related benchmarks.

Atlas of Science Literacy

Continued from page 1

marks when the full text of that benchmark does not appear. Cross-references to Other Maps indicate that a benchmark also appears on the Volume 1 and 2 maps listed.

- **Updated Science:** For the topics in Volume 2, the maps reflect new science knowledge when needed. For example, the Materials Science map in Chapter 8: The Designed World includes two new benchmarks that focus on the properties of substances at the nanoscale and on the use of nanotechnology to design materials for special purposes.
- **New Cognitive Research:** *Atlas 2* has been influenced by new cognitive research on how students learn particular concepts and skills. For example, the Weather and Climate map in Chapter 4: The Physical Setting draws on learning research that emphasizes the difficulty students and adults have in understanding the reason for seasons.
- **Reconciled National Learning Goals:** To capture more fully the coherence and completeness of learning goals that are currently part of the national consensus on science literacy, *Atlas 2* maps incorporate ideas from the National Research Council's *National Science Education Standards*.

"The *Atlas* has been a beneficial tool as we develop and review materials that support science literacy for all students."
—Juanita Clay Chambers, Ed.D., Detroit Public Schools

Using the Set of Maps

Because *Atlas 2* completes the set of maps begun in Volume 1, the new volume has several features to help users move back and forth between the two volumes. To help readers find particular benchmarks, *Atlas 2* has a useful index that can be used to locate benchmarks on maps in either volume. In addition, the inside front cover of *Atlas 2* presents a combined table of contents with all of the maps and their page numbers organized by *Benchmarks* chapter and section. The inside back cover presents a list of the maps in both volumes in alphabetical order.

While *Atlas 1* and *Atlas 2* map all of the learning goals recommended in *Benchmarks* as essential for every student to learn, they do not prescribe a particular curriculum or instructional strategy. Instead, they present a framework meant to inspire a variety of different ways to design and organize learning experiences suited to local circumstances. Educators working in a wide range of settings are making extensive use of *Atlas* maps to:

"At last, coherence for the science curriculum may be within the grasp of all educational systems throughout our nation."
—Dennis Cheek, Ph.D., Ewing Marion Kauffman Foundation

Understand benchmarks and standards. By studying maps carefully, teachers and other educators can get a better sense of the content and nature of the benchmarks as specific learning goals.

Design curriculum. The information in the maps helps educators distribute responsibilities for students' science learning across different grades and subjects, thus fostering K–12 coherence.

Plan instruction. Maps enable educators to develop instruction that is focused on the specific ideas in a benchmark and to take account of the precursors these specific ideas build on.

Develop or evaluate curriculum materials. Maps offer materials developers a helpful perspective on which benchmarks to target and at what level of sophistication.

Construct and analyze assessment. Maps help answer questions about when it is appropriate to assess particular ideas and skills, and why students might have had trouble with a particular task.

Prepare teachers. Whether in a pre-service or in-service context, using maps can sharpen teachers' sense of what benchmarks mean and how to help students attain them.

Organize resources. Maps are proving to be useful frameworks for organizing education resources and linking them to particular ideas that are found in national and state science standards.

As educators use the set of *Atlas* maps in these and other ways, the maps will always be open to improvement in light of new discussions, classroom experiences, and research on learning. But the enduring message of *Atlas* is that thinking carefully about the growth of understanding from kindergarten through high school graduation is an essential part of planning what students can be expected to learn and how best they can be helped to do so.

For more details about *Atlas of Science Literacy,* including sample maps from both volumes, visit www.project2061.org/atlas.

Put *Atlas* to Work in Your Science Program

Sign up for a session of Project 2061's popular professional development workshop, "Using *Atlas of Science Literacy*":

March 11–13, 2008	October 15–17, 2008
Washington, DC	Washington, DC

More workshops will be scheduled throughout the year. For registration and scholarship information, visit **www.project2061.org/workshops**.

About AAAS and Project 2061

Publisher of the peer-reviewed journal *Science*, the American Association for the Advancement of Science (AAAS) is the largest general scientific organization in the world. Its education initiative, Project 2061, has been at the forefront of the K–12 reform movement

- Defining science literacy and promoting it as a goal for all Americans;
- Developing K–12 benchmarks for student learning in science, mathematics, and technology;
- Producing a wide range of innovative tools for educators—books, CD-ROMs, and online resources—to guide their reform efforts; and
- Conducting research on the design and use of curriculum materials, assessment, professional development, and other areas of science teaching and learning.

AAAS gratefully acknowledges the following Project 2061 supporters over the past 20 years: Carnegie Corporation of New York, Hewlett-Packard Company, John D. and Catherine T. MacArthur Foundation, Andrew W. Mellon Foundation, Noyce Foundation, David and Lucile Packard Foundation, Pew Charitable Trusts, Siemens Foundation, and the National Science Foundation.

For more information:
AAAS Project 2061
1200 New York Avenue, NW
Washington, DC 20005
Phone: 202-326-6666
Fax: 202-842-5196
E-mail: project2061@aaas.org
Web site: www.project2061.org

To order Project 2061 products:
Call 1-888-737-2061 or visit www.project2061.org/publications/order.htm

Meeting the Needs of Science Teachers

An Interview With Linda Froschauer

Linda Froschauer, a national leader in science education, has been teaching science for over 30 years. An 8th grade science teacher and department chair at the Weston Public Schools in Connecticut, she was the 2006–2007 President of the National Science Teachers Association (NSTA). She has been involved in Project 2061 since 1990, having served on the project's National Council on Science and Technology Education. She recently assisted in the publication of *Atlas of Science Literacy, Volume 2*, co-published by Project 2061 and NSTA. Cathy Tramontana of Project 2061 interviewed Froschauer by e-mail about the needs of today's science teachers and the role of Project 2061.

CT: Based on your recent tenure as NSTA president, what do you see as the most pressing issues facing today's K–12 science teachers?

LF: I have heard many issues from people I've met traveling throughout the United States; the two most common issues are lack of support, especially for new teachers, and the provision of little or no professional development.

> "How can we expect teachers to understand—and teach students about—advances in DNA sequencing, cloning, or a myriad of other scientific advancements if they don't have a solid foundation in the sciences or any type of ongoing training?"

Many people talk about the shortage of teachers as a major issue, but the real issue is teacher retention. Many school districts around the country need science teachers, but the demand is caused by teacher turnover in the science teaching profession, not the lack of people who are getting teaching degrees. According to the NSTA science teacher survey, teachers' top reason for potentially leaving their profession is job dissatisfaction. This is true for new teachers as well as master teachers with many years experience. When asked about the causes of their dissatisfaction, the top two reasons given by those with nine or fewer years of experience are poor administrative support and low salary.

Good teachers must be supported and encouraged to remain in the teaching profession. Many new teachers tell me that they are overwhelmed and surprised by the amount of paperwork and duties that seem to have little to do with student learning. New teachers need encouragement, they need mentors, and they need a support system. Support should also include a fair and competitive wage, especially in a work environment where teachers generally make significantly less than other workers with similar educational backgrounds.

With respect to professional development, I am one of the people who benefited greatly from Eisenhower funding. Thanks to those funds I participated in summer institutes, traveled to science conferences, and took workshops locally. When Congress reauthorized No Child

Left Behind (NCLB), they eliminated the Eisenhower professional development grants, which for years had provided dedicated funding for science and math teacher training. This lack of funding—compounded by dramatic cuts in state and school budgets—has resulted in reports from scores of science administrators and teachers that their districts are reducing or eliminating their professional development programs.

CT: Why is the lack of professional development a problem?

LF: Primarily because research indicates that the most important component in student success is the quality of teaching. Unfortunately, research also shows that a large number of science educators come to the classroom lacking the necessary content knowledge needed to teach effectively. In the last few years alone, the advances in science and technology have been staggering. How can we possibly expect our teachers to understand—and then teach students about—advances in DNA sequencing, cloning, or a myriad of other scientific advancements if they don't have a solid foundation in the sciences or any type of ongoing training?

Much of the professional development school systems provide is generic. It is one-size-fits-all for the entire faculty rather than meeting the needs of individual teachers. It's interesting to hear new teachers discuss the obstacles to receiving quality professional development. Many are not allowed to attend conferences or workshops because it is perceived that they have not yet earned the "reward" of being allowed to attend.

CT: What advice do you have for teachers as science testing under NCLB begins this school year?

LF: The most important message is to not assume that student success is just the responsibility of a single teacher at the grade level where the test is being administered. Increasing student achievement—and test scores—is a school and community effort. Quality learning takes place through articulation and communication, preK–12.

Assessment is important and can be valuable if we keep in mind how useful the data may be. Assessment is a part of good teaching—that includes both formative and summative assessments used throughout the learning experience. NCLB is about student learning; the accountability piece of NCLB should not become a barrier to quality science teaching and learning. Providing well-crafted learning progressions along with formative assessment should lead to excellence in learning and to valuable data provided through summative assessments.

CT: How do you think science educators can best use *Atlas of Science Literacy* and its growth-of-understanding maps? How do you use the maps?

LF: For many years teachers have used *Benchmarks for Science Literacy* as a guide in creating curriculum. It provides a comprehensive identification of learning goals for discrete grade bands. *Atlas of Science Literacy* takes that a step further and shows the connections between those goals while providing a clear, visual roadmap to how students' understanding might grow from K to 12. In planning any curriculum, understanding of this progression is critical.

Teachers should use the versatile *Atlas* in ways that best fit their needs. If an educator is involved in designing curriculum, the learning progressions identified in both *Atlas* volumes can be invaluable resources in determining articulation from grade to grade. Even if teachers have a curriculum that restrains them from incorporating additional topics, understanding precursors, connections, and these progressions is vital to developing student understanding.

I initially used the strand maps as guides in determining correct placement of concepts within grades during our curriculum work. I then used them to check on the learning progressions of my students. Now I find myself using them as I consider professional development for teachers, selecting concepts that allow them to build personal conceptual understanding of topics they address with their students.

CT: What are the most important things that Project 2061 can do to help teachers support their students in achieving science literacy?

LF: Since its inception, Project 2061's vision has included the notion that science literacy is a common core of understanding and that all children can learn science. As a long-term project focused on providing the tools needed by teachers, Project 2061 has based their initiatives on helping teachers to ensure students' conceptual understanding. It is clear that their products make a difference. The only advice I can provide is to continue to do what they do so well—serve as a proactive force in meeting the needs of teachers as they invest themselves in student learning.

Teaching Climate Change

Project 2061's *Communicating and Learning About Global Climate Change* focuses on the ideas and skills that are central to understanding the science of climate change, the process of scientific inquiry, and the trade-offs and constraints implicit in making choices about technology. The 32-page guide features K–12 strand maps from *Atlas of Science Literacy* and recommended trade books. To read the guide online and to order print copies, visit **www.project2061.org/publications/order.htm.** You may also call 1-888-737-2061 to order. $3.95 each; orders of 10 or more copies, $3.00 each.

American Association for
the Advancement of Science
1200 New York Avenue, NW
Washington, DC 20005

www.project2061.org

Change Service Requested

Non-Profit Org.
U.S. Postage
PAID
Woodbridge, VA
Permit No. 150

Online Update

The Maine Mathematics and Science Alliance (MMSA) and Project 2061 have launched a collection of Web-based resources aligned to science content standards. PRISMS (Phenomena and Representations for the Instruction of Science in Middle Schools) provides free access to a wealth of videos, lessons, simulations, and other resources, along with resource reviews and instructional tips. Visit **http://prisms.mmsa.org.**

Moving?

Help *2061 Today* keep up with you! Send your change of address to project2061@aaas.org or call us at 202-326-6666. You may also visit **www.project2061.org/confirm** to update your address, switch from print to electronic delivery, and sign up for other FREE Project 2061 newsletters.

FYI...

Georgia Teacher Wins AAAS Prize

Chris Kennedy, a chemistry teacher at Hiram High School in Hiram, GA, is the first winner of the AAAS Leadership in Science Education Prize for High School Teachers. For more information, including how to nominate a teacher for the 2008 prize, visit **www.aaas.org/aboutaaas/awards.**

New Project 2061 Staff

AAAS Project 2061 is pleased to welcome four new staff members. Research associate **Natalie Dubois** comes from Ohio University, where she was a postdoctoral research associate in the Department of Biological Sciences. She holds a Ph.D. in zoology and ecology, evolutionary biology, and behavior from Michigan State University, and a B.A. in biology and French from Albion College. Research associate **Karina Nabors** comes from California State University, Sacramento, where she taught environmental science for the Department of Environmental Studies. Nabors holds a Ph.D. in ecology from the University of California—Davis, and a B.A. in biology from The Colorado College in Colorado Springs.

Programmer analyst **Brian Walker** was previously a website developer and budget analyst for the Biomedical Engineering Department at Johns Hopkins University. He holds a B.A. in visual communications and information design from Miami University of Ohio. Research associate **Jill Wertheim** recently completed her Ph.D. in geological sciences from the University of California, Santa Barbara, and holds a B.A. in geology and music performance from Middlebury College. Previously, she was assistant curator at the Museum of Science, Boston.

AAAS, NSBA Launch Partnership

A three-year collaboration between AAAS and the National School Boards Association (NSBA), funded by the Ewing Marion Kauffman Foundation, is helping school boards develop policies and public support for a state-of-the-art science curriculum. Details about the project and materials from a June seminar, including AAAS's new education video, are available at **www.project2061.org/nsba.**