How Can Museums Help Teachers with the NGSS?

By Jim Short

Released in 2013, the Next Generation Science Standards (NGSS, *www.nextgenscience.org*) have the potential to revolutionize science education in the United States, requiring a very different way of thinking about learning and teaching science. Now is an opportune moment to prepare teachers for these new approaches to science instruction and classroom assessment and introduce them to the types of curriculum resources needed to implement the NGSS successfully. What are these teaching resources and professional development (PD) needs? What is the role of museums in supporting schools and teachers as they address the demands of the NGSS?

A family enjoys hands-on activities in the American Museum of Natural History's Cullman Hall of the Universe at the Rose Center for Earth and Space. Photo courtesy AMNH/R. Mickens

TOOLS AND PROCESSES FOR PROFESSIONAL DEVELOPMENT

The American Museum of Natural History (AMNH) in New York City is addressing these needs along with collaborators at WestEd, an education research and development agency *(www.wested.org)*, and the Biological Sciences Curriculum Study (BSCS, *www.bscs.org*). With support from the Carnegie Corporation of New York, and working with PD providers from several NGSS-adoption states, the AMNH and its collaborators have developed a set of tools and processes for PD providers to work with middle and high school science teachers to translate the NGSS into instructional sequences and units with classroom assessment tasks.

In September, teams from California, Illinois, Kentucky, New Jersey, Rhode Island, and Washington, D.C., which have all adopted the NGSS, began field-testing these tools and processes with middle and high school science teachers to help refine them and build capacity for broader NGSS implementation within each state or district. In addition to district and regional network leaders, some of these teams include partners from informal science education institutions and higher education. All materials generated by this project will be available online at the conclusion of the project in September 2015.

TEACHERS' CHALLENGES AND NEEDS

One of the challenges educators face in translating the NGSS into classroom instruction is that the standards present an integrated, three-dimensional view of learning and teaching science—a new approach for science teachers. The NGSS performance expectations weave together science and engineering practices, crosscutting concepts, and disciplinary core ideas. (See the article beginning on page 20.) For classroom assessment to incorporate these dimensions, science instruction needs to be designed so that all three are explicitly part of teaching an instructional sequence with students. To support this approach, we are using the BSCS 5E Instructional Model *(www.bscs.org/bscs-5e-instructional-model)* to help teachers develop instructional sequences that lead to assessment tasks aligned with the NGSS performance expectations.

In addition to tools, science teachers need access to rich curriculum resources to meet the demands of the NGSS. The NGSS emphasize students learning to use science practices such as analyzing and interpreting data, developing and using models, and constructing explanations from evidence. Doing so often requires access to scientific data sets, simulations, or data visualizations to investigate science phenomena such as climate change, depletion of natural resources, human impact on ecosystems, and natural hazards. Teachers also need support in learning to use these data-rich resources in instruction.

Gottesman Hall of Planet Earth. Photo courtesy AMNH/D. Finnin and C. Chesek

AMNH'S TEACHING CASES

Over the past five years, with support from the (U.S.) National Science Foundation, the AMNH has developed several examples of teaching case materials and has worked with groups of science teachers on

using them with their students. The three teaching cases developed thus far focus on river ecology, earthquake risk, and evolution of antibiotic resistance in bacteria. Each case has three components:

1. **Reading passages**—typically four text passages with graphics and diagrams—provide background information about what scientists are doing to study a specific problem. The text includes details about how the data are gathered. Both teacher and student versions of these passages are developed for use in PD sessions and in the classroom with students.

2. **Four video segments** accompany the text passages and weave together interviews with scientists and images of them at work in the field and laboratory, as well as animations to illustrate science concepts. They provide learners with opportunities to hear directly from the scientists about their work.

3. **Interactive, web-based data visualization tools** provide access to secondary data sets. For example, the river ecology teaching case materials *(www.amnh.org/education/hudsonriver)* explore a unique data set collected from the Hudson River, New York, over a 25-year period by aquatic scientists at the Cary Institute of Ecosystem Studies. Students can work with this data set to learn about the short- and long-term impacts of invasive zebra mussels on the river ecosystem and the way scientists gather data and explain the meaning of their observations.

Teaching cases support the development of the

MUSEUMS AND THE COMMON CORE STATE STANDARDS

As schools and teachers focus on addressing the demands of the Common Core State Standards for English Language Arts *(www.corestandards.org/ELA-Literacy)*, teaching and learning science has sometimes taken a "back seat" to teaching literacy. Museums and science centers are well positioned to respond to this challenge because their exhibits and many other resources provide opportunities for nonfiction disciplinary-based reading, which is required in meeting the Common Core State Standards for English Language Arts. Using these types of resources, museums can develop educational materials to help teachers focus on teaching science while also supporting nonfiction reading and writing—in other words, literacy in the service of teaching science.

Over the past few years, the Gottesman Center for Science Teaching and Learning at the American Museum of Natural History (AMNH), New York City, has been grappling with how best to help teachers integrate literacy with science learning. With support from the Louis Calder Foundation and working with New York City science teachers and literacy consultants, we have developed a successful model for creating resources and delivering related professional development (PD). This model helps teachers incorporate better reading and writing opportunities in the science curriculum and link what they are doing in the classroom with museum visits and learning experiences.

The model includes three parts:

1. **An Educator's Guide** includes an overview of the essential questions addressed by the content in an exhibition. It includes a Teaching in the Exhibition section designed to direct teachers to the exhibits that most closely connect to the topics relevant to the state science standards and core curriculum.

2. Online versions of these **Guided Explorations** are provided on the AMNH's website and optimized for mobile devices to further enhance opportunities for teachers to bring the museum into their classrooms.

3. **Science and Literacy Activities** include previsit science readings about the science content in the exhibition, student worksheets to gather information during a museum visit, post-visit writing tasks, and Common Core–aligned scoring rubrics. An informational writing task that draws on the previsit reading and on observations and information collected during the AMNH visit provides students with opportunities to learn science as well as develop the nonfiction reading and writing skills required by the Common Core.

We've used these types of resources with more than 500 science teachers in PD workshops over two years. Throughout the process, we've learned lessons and refined both the PD workshops and the materials. Teachers in our workshops have reported a greater understanding of how to integrate literacy skills into science instruction and how to use museum learning experiences to support the teaching of both science and literacy. In addition, the AMNH science and literacy materials have been reviewed by Common Core experts, including the EQuIP (Educators Evaluating the Quality of Instructional Products) Peer Review Panel at Achieve, an education reform organization *(www.achieve.org)*. One of these lessons for Grade 10, Earth Systems Evolution, was rated an EQuIP Exemplar and is available on Achieve's website along with EQuIP peer review feedback *(www.achieve.org/EQuIP)*.

All resources are available on the AMNH's website:

Gottesman Hall of Planet Earth
www.amnh.org/davidsandruthlgottesmanhallofplanetearth/educatorresources

Cullman Hall of the Universe
www.amnh.org/dorothyandlewisbcullmanhalloftheuniverse/educatorresources

Ross Hall of Meteorites
www.amnh.org/arthurrosshallofmeteorites/educatorresources

Guggenheim Hall of Minerals
www.amnh.org/harryfrankguggenheimhallofminerals/educatorresources. —*J.S.*

specific NGSS science practices mentioned earlier. These resources also support specific Common Core State Standards *(www.corestandards.org)* in reading and writing, including determining the central ideas of text and citing specific textual evidence to support the analysis of science texts; writing informative texts to construct science explanations; and writing argumentative passages in science using the framework of claims, evidence, and reasoning. (See the sidebar on page 30 for more about the Common Core).

During the past two years, with support from the Carroll and Milton Petrie Foundation, AMNH educators have worked closely with a group of middle school science teachers and a literacy consultant to learn how to integrate literacy strategies into the teaching of science content. Using the river ecology teaching case resources, some of these teachers have designed and taught units in their curriculum that support both the Common Core and the NGSS. These science units incorporate literacy strategies that teachers learned to use during PD sessions facilitated by both AMNH and literacy educators.

Building on our experiences using these types of innovative resources with teachers, the AMNH now plans to work with curriculum developers at the Lawrence Hall of Science, University of California, Berkeley, to develop the river ecology teaching case materials into an eight-week middle school ecology unit aligned with the NGSS and the Common Core. The unit will include instructional materials for students and teacher's support materials—in other words, an example of an NGSS-aligned science curriculum.

THE ROLE OF MUSEUMS

Museums are well suited to support teachers and schools as they address the demands of the NGSS. Through teacher PD and partnership programs, museums have a lot of experience working with schools, supporting teachers, and developing innovative resources. While many school systems seem to be constantly changing, particularly in urban environments, museums can provide places for teachers to find ongoing support and for schools to develop deep relationships focused on improving teachers' practice and students' learning.

At a Leadership Institute at the AMNH, three professional development providers work on deepening their understanding of the NGSS by organizing disciplinary core ideas, science and engineering practices, and performance expectations to promote curricular coherence in a unit of instruction. Photo courtesy AMNH/MS

Teachers and schools need partners—the demands of NGSS-aligned instruction and classroom assessment will need everyone's help. This is an excellent opportunity for informal and formal institutions, as well as other nonprofit partners, to work together as collaborators. Museums can develop innovative resources, visualize data, bring the real work of scientists into instructional materials, and help make learning science more accessible and engaging for students. Teachers can help inform the development of these resources by sharing the realities of the classroom and challenges of addressing the needs of all students. Nonprofit partners can provide expertise and tools to help science teachers achieve their goals. For example, we have formed a strong partnership with the Literacy Design Collaborative *(ldc.org)* to help science teachers build students' literacy skills and understanding of science. Working together, we can all make a difference in helping teachers meet the challenges of implementing the NGSS and ensuring all students learn science. ■

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