Learning Science in Cultural Context
Resources From a School Yard Hike

By Sandra Yarema, David Grueber, and Maria Ferreira

Teachers in districts with high rates of poverty and low-achieving schools often lament the lack of resources for instruction. However, when a teacher in a third-grade inner-city classroom began a lesson about natural resources by saying, “We will find out what we know before we start,” she used a precious resource—students’ ideas. Mrs. Majors’s lesson opening represents an important constructivist teaching disposition: Begin with what the students know. Students’ ideas and experiences, no matter the classroom, are an important resource for teachers committed to academic achievement for underserved students.

Teachers’ perspectives toward students’ ideas and experiences is a key factor in hindering or promoting student learning. Seeing the students, school, and community resources as deficits may hinder students’ learning; utilizing them as resources may promote it (Nieto 1999). The teacher’s goal should be to harmonize or build a bridge between the students’ experiences and science. Cities provide rich material resources to explore both the natural and built environment. Mrs. Majors is able to use this urban school yard as a resource for the children to explore and build toward a shared experience. Accordingly, learning theory that encompasses students’ experiences as a resource is helpful to use when students’ experiences are different from their teacher’s.

We share here the guiding principles to harmonize teaching during a yearlong professional development project funded by the state department of education, and the result of those principles enacted in a classroom.

Strategy to Adapt Curriculum Materials

It is useful to apply the situative learning theory in order to adapt curriculum materials for diverse learners. This theory describes student learning as becoming proficient in the practical activity of a culture. Teaching students science requires teachers to help students make connections between their everyday activities and scientific activities. We find the situative learning theory most useful when enacting effective urban teaching because it focuses the teacher’s attention on building bridges between students and science; using student experiences as a resource rather than as an obstacle.

To put the situative learning theory into teaching practice for the vision of 21st-century science teaching, we used the ideas described in Ready, Set, SCIENCE! (NRC 2008). There are four learning “strands” that encompass the knowledge and skills that students acquire to be proficient in science. A framework of “sequenced instruction” used to adapt curriculum materials is described that consists of four phases for teaching science as practice: (1) Engage students in a staging activity that determines what they know; (2) Gather information to establish a background for the investigation; (3) Investigate, collect observations, and classify; and (4) Present and discuss findings. This framework aligns with the Next Generation Science Standards (NGSS Lead States 2013, p. 382), specifically in developing essential science and engineering practices of Analyzing and Interpreting Data, Constructing Explanations, Engaging in Argument From Evidence, and Obtaining, Evaluating, and Communicating Information.

The following activities illustrate how Mrs. Majors adapted an AIMS lesson, “The Earth Has What We Need” (AIMS 2006), focused on identifying rock and mineral materials in and around students’ classroom that come from the Earth.

Staging Activity

Mrs. Majors began the lesson with a two-column notes writing-to-learn strategy. It is particularly useful for helping students make personal connections with new information and as a formative assessment for
teachers. Terms were introduced in the left column related to the resources topic: renewable, reusable, and nonrenewable. For example, she introduced the term reusable and asked students to write their ideas in the right column. Students shared their responses, including, “Will never run out.” Mrs. Majors replied, “That’s right, and two examples?” To which students responded, “Uh, pop cans” and “water and air.” These responses reflect resources that can be recycled or that have a natural renewal cycle so that they can be reused. Then Mrs. Majors summarized student responses with a definition: “Resources that will never run out.” The process was repeated for the remaining two terms. By opening the lesson this way, Mrs. Majors affirmed the students’ prior experiences as resources for learning.

Establishing Background for Investigation

Mrs. Majors then used the children’s notes as a bridge between their knowledge and the academic language and content in the textbook. Students continued the lesson with a directed reading from their text, in which they identified examples to include next to each term in the notes. The text defined resources as “Things we need in order to live” and confirmed their identification of air and water as reusable resources.

After reading and discussing the text, students constructed a graphic organizer booklet of natural resources as further practice. The activity did two important things. First, students’ words, language, and experience were used as a resource for teaching when the first strand for learning, Understanding Scientific Explanations (NRC 2008, p. 19), was applied. Mrs. Majors used students’ words, language, and experiences to introduce them to the science content in the text. Then, students had an opportunity to reinforce their ideas by constructing graphic organizer booklets, which were essentially an adaption of a vocabulary chart separated into four squares with each quadrant containing one of the following for each vocabulary term: a definition in students’ own words, an example, a nonexample, and a picture (see NSTA Connection).

Second, as the students drew, colored, and cut out pictures of natural resources, classified them, and pasted them onto separate pages for each term, an opportunity occurred for Mrs. Majors to assess whether students were correctly matching pictures with concepts. For additional background information, students integrated answers from the textbook review question, “List two products that come from trees,” into the natural resources booklet. For the renewable natural resources page of the booklet, one student wrote, “The two products that come from trees are paper and pencil.”

Investigate

While the textbook provided background information, research suggests that students learn best when their learning is situated in the context of investigating personal experiences. Mrs. Majors continued the
lesson by going on a school yard hike with her students. By doing so, she aimed to ground the lesson in actual objects and events experienced by the children and help them build connections to actual science content. The students explored the school yard and collected various objects found along the way. Caution students to stay on school grounds. Remind them to conduct themselves in a responsible manner in the field and not to touch dangerous objects such as broken glass and poison ivy.

The students returned to the classroom and engaged in Next Generation Science Standards–aligned science and engineering practices Analyzing and Interpreting Data (p. 382) as they classified their objects to determine whether the items they collected represented renewable or non-renewable natural resources. The school yard hike is special because it presented an opportunity for the teacher to apply strand 2 for learning, Generating Scientific Evidence (NRC 2008, p. 19). Furthermore, the objects from the students’ school yard hike are used to integrate the applied scientific process skills with the science content in their booklets.

Connections to literature and disciplinary core ideas can be made by introducing trade books to the classroom that relate to the scientific content, such as Citizen Scientists: Be a Part of Scientific Discovery From Your Own Backyard (Griffin Burns 2012), which illustrates how anyone can get involved in gathering data for ongoing, actual scientific studies just by going out into their own backyard.

**Present and Discuss Findings**

The discussion that followed provided additional opportunities for peer interaction among students, critical thinking, evaluation, communicating ideas, and making claims based on observed evidence. Mrs. Majors held up each collected item and asked the students to decide in which category it should be classified. She then listed each item in its category on the board as a data record of their initial results (see Figure 1). The collected items and the students’ category decisions were treated as valuable data. The children participated in doing real science and learned how objects in their world related to the concepts presented in the greater lesson.

The real magic in this discussion occurred when both the students and Mrs. Majors were unsure about deciding into which column some of the items should be placed. One student asked, “Is a leaf a renewable resource?” There was a chorus of yes and no responses from the students. The conflict occurred because some students could not agree that a leaf was a resource. To solve this problem Mrs. Majors used a “talk move” (NRC 2008, p. 91) to help students clarify their own reasoning, which incorporates strand 3 for learning, Reflecting on Scientific Knowledge (NRC 2008, p. 20), and provided an opportunity for both the teacher and the students to assess their understanding. “Talk Moves” are teacher-initiated discussion strategies that help students to clarify and expand their reasoning and understandings, such as revoicing a student statement, using wait time, asking students to explain reasoning, or asking students to restate someone else’s reasoning (p. 91). Mrs. Majors asked the students to find the definition of resources in the booklet. “Things we need to live,” responded a student. After the definition was read, the students questioned, “What kind of leaf is it? Can we eat it?” Other students commented, “Leaves come from trees, which we need for shelter.” The class finally decided that this leaf was a renewable resource because it came from a tree, which provides one of our basic needs.

Critical thinking, the application of NGSS-aligned science and engineering practices, Engaging in Argument From Evidence, and Obtaining, Evaluating, and Communicating Information (p. 382) and strand 4 for learning—Participating Productively in Science (NRC 2008, p. 20)—are all present in this activity. Students applied their understandings to decide whether an object is

<table>
<thead>
<tr>
<th>Type of Resource</th>
<th>Object From School Yard Hike</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable</td>
<td>Leaf</td>
</tr>
<tr>
<td></td>
<td>Broken stem of dandelion</td>
</tr>
<tr>
<td>Reusable</td>
<td>Newspaper</td>
</tr>
<tr>
<td></td>
<td>Rubber band</td>
</tr>
<tr>
<td>Non-renewable</td>
<td>Rock</td>
</tr>
<tr>
<td>Recycled</td>
<td>Paper bag</td>
</tr>
<tr>
<td></td>
<td>Plastic bottle</td>
</tr>
</tbody>
</table>
renewable and made an argument for their position. They applied the science information from the text and in-class activities to their own experience and made connections between school science and real life.

Conclusion

The activity in Mrs. Majors’s classroom illustrates that when using a situative learning theory to adapt curriculum materials, teachers can better use the resources of their students’ lifeworld as the context for learning, rather than focusing on any perceived deficit in resources of inner-city students. During this lesson Mrs. Majors masterfully wove together three complex aspects of culture (Nieto 1999): the content or product, the process of creating, and who was responsible for creating it.

The content is the scientific understanding of the concept of resources. The students began constructing their understanding with a collective graphic organizer, which assisted in guiding their reading and understanding of the terms. Mrs. Majors facilitated the process of creating a shared understanding with the students, in combination with the textbook terms, based on classifying objects from the school yard hike according to the terms in the graphic organizers. When students presented and discussed their findings, Mrs. Majors shifted the responsibility for making decisions about content onto the students. Students were able to make claims supported by their observations while collaborating as peers. Because students used the science terms in the context of authentic personal experiences they participated at individually differentiated levels.

Finally, when teachers use a situative theory to ground their instruction in the experiences of children, classroom activities then provide opportunities to mentally engage all students in the process of classification, demonstrating critical thinking, making evidence-based claims, and using science talk in context of authentic science practice to achieve the vision of 21st-century science teaching. This teaching practice demonstrates the value of using students’ knowledge and experience as a framework for learning, which is particularly important for children in underserved settings.

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References


Connecting to the Standards

Standard: 4-ESS3 Earth and Human Activity

Performance Expectation: 4-ESS3-1 Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

Science and Engineering Practices:

- Analyzing and Interpreting Data, Constructing Explanations, Engaging in Argument From Evidence, Obtaining, Evaluating, and Communicating Information

Disciplinary Core Idea:

ESS3.A Natural Resources

Crosscutting Concept:

Cause and Effect

NGSS Table: 4-ESS3 Earth and Human Activity

www.nextgenscience.org/4ess3-earth-human-activity

NSTA Connection

Visit www.nsta.org/SC0401 for the natural resources graphic organizer booklet.