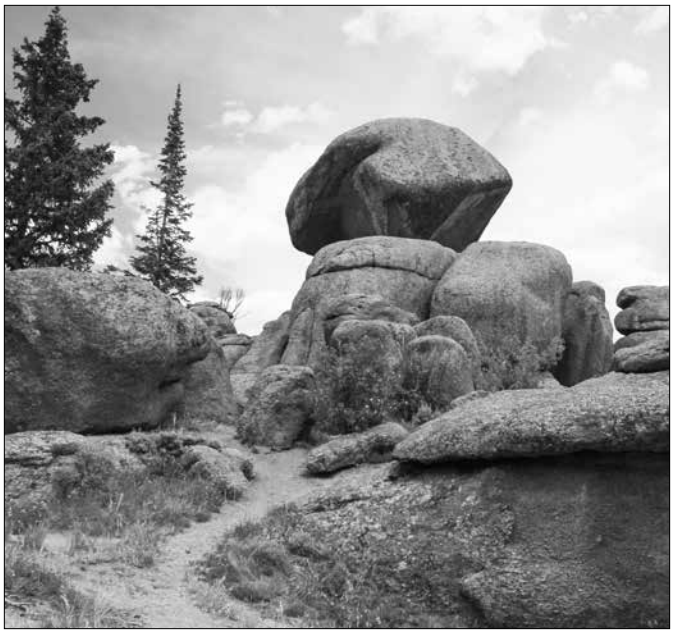
Finding a Place for Science

Letting place guide standards-based curriculum development for grades three and four



Photographs: Left, Ana Houseal; Right, Jack Dykinga

By **Sarah Hackworth** & **Ana Houseal**

THE CONNECTIONS WE MAKE as adults are very different than those made by the children we teach, in part due to more and varied experiences. While completing my Master's Degree at the University of Wyoming I helped organize curriculum development workshops with my advisor (second author) Dr. Ana Houseal in partnership with a Wyoming school district. Every three months for the last several years a team from the university has driven many hours to a rural Wyoming town to spend a few days helping guide elementary school teachers through the daunting task of developing new Science curriculum. Last summer, during one of our curriculum development workshops, a third grade teacher excitedly told us that she was combining her English-Language Arts (ELA) and Science curriculum with a unit on whale migration. We gently prodded her with, "Isn't there a migration story closer to home? One that your eight-year-old students might be more familiar with?" The largest pronghorn antelope migration occurs fairly close to her community. "How could I have missed this connection?" she asked us. Although it seems obvious in retrospect, she was so focused on connecting the two academic subjects; she failed to consider how the context of the readings related to her students.

A small shift in thinking and research revealed many resources for this teacher's new place-based integrated unit that not only combined ELA and Science curriculum, but also used examples closer to home. Starting with locally relevant examples can shift your frame of mind when designing new lessons or curriculum. This small shift can also help ensure that your students become more personally invested, connect to local issues, and develop an appreciation for their communities. By considering the organisms your students might encounter as they explore their local place, they can connect to their environment while gaining an understanding of the science content.

As curriculum design facilitators, we often wonder how we can help teachers develop new curriculum that meets the new national education standards, the Next Generation Science Standards (NGSS),[1] while also making the lessons locally relevant, meaningful, and engaging for students. Because they were written as broad national standards the NGSS do not specify the types of examples that you should use in activities and lessons. The standards are meant to be a framework for developing local curricula, thus, local examples and connections can be easily integrated. For example, a unit on ecosystems could be focused on a specific ecosystem found in your region, rather than one that is far away.

In this article we provide examples of how third and fourth grade teachers who volunteered to participate in this project were able to incorporate place into their NGSS-aligned lessons. By sharing these planning narratives we hope to inspire creativity in the planning process that could be used to help integrate place-based education into your curriculum.

Whether you are working in a formal or non-formal educational setting, you might be asking yourself: Why should I care about the NGSS? There are several reasons. The NGSS are relevant because they are based on current student learning research and are focused on developing more than just

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Revamping a science curriculum to include local examples.

science content knowledge. Both *A Framework for K-12 Science Education*[2] and the NGSS emphasize the importance of developing clear learning progressions from K-12 and the value of deep conceptual understandings over the memorization of discrete facts. This renewed emphasis on learning the skills of being a scientist is useful whether you educate students in the United States, Canada, or anywhere else in the world.

As more NGSS-aligned curriculum resources become available, educators must be able to examine these critically and adapt them to their unique places, whether in formal or non-formal settings. We have found that while incorporating place is important to developing engaging lesson plans, it is easy to leave out when using standards. Below, we provide tips that can help you use local place and place-based principles,[3,4] to intentionally guide the process of writing new curriculum or modify previously written lesson plans.

Connecting National Standards to Local Places

Initially, in this project we focused on helping teachers understand the integration of the three dimensions of the NGSS. These are the Disciplinary Core Ideas (science content), Crosscutting Concepts (the big ideas that cross the disciplines), and Science and Engineering Practices (scientific processes). The model which Dr. Ana Houseal developed to help teachers ensure their lessons makes connections among all three dimensions of the NGSS, provides a template for you to visually connect the components of your lessons and make sure they connect all three NGSS dimensions.[5] It can be found at greenteacher.com/finding-a-place-for-science/.

When you notice a disconnect between the content and context in your lessons, you can help ensure lessons will connect students to their local communities by focusing on Disciplinary Core Ideas (content) while answering the following place-based questions.

How does this lesson/unit:

- Foster an appreciation of one's place?
- Focus on local issues?
- Support learning with partnerships?
- Take advantage of place in schoolyard/local community/environment?
- Connect to students on a personal level?
- Engage students in investigation, inquiry, and problem-solving?
- Encourage interdisciplinary learning?

Local Life Cycles—Third Grade Life Science

In Spring 2015, the third-grade team of teachers in this project asked for feedback on their newly completed life cycles unit. The unit they created is made up of nine lessons that emphasize the patterns found in all life cycles and cause and effect relationships related to the inheritance of traits. In reviewing the lesson progression, we were surprised by the absence of local examples. When we mentioned this to the teachers, they were as shocked as we were. In designing this unit, they worked diligently using *Backwards Design*,[6] a way of designing curriculum that focuses on starting with the end goals and student objectives. This process can help you determine, at the beginning, which outcomes you will accept as evidence that your students have learned what you intended. In compiling ideas from a variety of online sources, this team of teachers did not intentionally tie their lesson and activity examples to their local place. As a result, they ended up with a unit that was well aligned to the standards, but devoid of any local connections.

In rethinking any unit, begin with the NGSS Performance Expectations, which describe what students should be able to do to meet a given standard. The Performance Expectation for this first lesson states that students should be able to "develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death" (3-LS1-1). Next, use locally relevant examples that connect to the three NGSS dimensions. Some local examples of plant and animal life cycles that work well for our Wyoming students include: grasshopper, ladybug, western toad, robin, sage grouse, grey squirrel, western wheat grass, sagebrush, pronghorn, and white tailed deer. The revised lesson and the local connections are presented in Table 2A (on page 26), within the discussion about tools to help teachers.

In planning units, online materials are still a good resource; however, we recommend that when you choose these sources you spend additional time identifying examples that can be exchanged for the existing, non-local examples. By adjusting the examples associated with your lessons' activities, you can greatly increase the relevance of the content for your students.

From Fossils to Fossil Fuels—Fourth Grade Earth Science

The fourth-grade team of teachers from this same project felt confident about their newly NGSS-aligned lesson about fossils, but they were struggling to come up with ways to make learning about fossils place-based for their students. After brainstorming they realized that drawing connections between the rich fossil fuel reserves found in their community and the story these tell about past landscapes could foster deep content connections among their students.

In the lessons these teachers developed, students are engaged initially by viewing images of different fossils.

They use the images to discuss what each fossil tells us about Earth's past. Next, students create a relative dating model by placing cut out fossils in different Earth layers represented by different colored pieces of paper. As a culminating discussion, students are asked to consider the following question: "What does the presence of coal in Wyoming tell us about the landscape of our past?" After discussing the *cause and effect* relationship of coal formation, students revise their relative dating models by adding a layer of coal. The culminating question and choice of fossils for the relative dating activity can easily be adapted to any location, and local geologists could be used as resources in planning and teaching. In addition, considering the historical context of your town or region can help engage students more deeply as they draw connections to science through place.

Traditionally fossils bring to mind objects (e.g. fish, plants, shells, dinosaurs) versus the byproducts of decomposition of plant matter that leads to the formation of oil and coal. This was the leap our teachers needed to make. By working collaboratively and thinking creatively to find local connections you can align your curriculum to the NGSS Earth Science standards and principles of place-based education. This will translate to more meaningful learning amongst your students.

This example also demonstrates how Crosscutting Concepts can be used to make complex content topics more locally relevant and approachable to both you and your students. In evaluating the alignment of your lessons with the NGSS you can look for explicit examples for how your students will be using *cause and effect relationships* (or other Crosscutting Concepts) to learn about specific science content, such as what the Earth's layers tell us about past landscapes. Similarly, you can look for explicit examples of how the principles of place-based education, such as *focusing on local issues*, are integrated throughout your lesson. Thinking about each of the three dimensions of the NGSS at once can seem overwhelming so we suggest thinking of how an activity can be framed in order to target the Crosscutting Concepts (i.e. cause and effect) after you have thought of the content component (i.e. fossils).

Tools to help teachers

In this process, we developed several tools that you can use to identify the alignment of your lessons to Place-based principles and how local examples connect to the three dimensions of the NGSS. Table 1A contains an example from our project – Table 1B (found at greenteacher.com/finding-a-place-for-science/) is empty for your use.

Lesson A: Devil's Tower Lesson Overview: In this lesson students learn about some of the creation myths of Devil's Tower and how various indigenous cultures can have different values and/or connections to the landscape. As a culminating activity, students write a persuasive essay describing how they believe Devil's Tower was formed, supporting their claims using evidence from the lesson.

Focus on the alignment of local examples to the three dimensions of the NGSS. Starting with locally relevant examples shifts the frame of mind of those involved in the design process. These changes help ensure that your students become personally invested, connected to local issues, and that they develop an appreciation for the communities that surround them. This tool is particularly useful if you want to demonstrate the need for local resources (people, places, field experiences) and how they connect to science

Table 1A. Incorporating Principles of Place-Based Education within an Integrated Science Sequence – Two examples:

Instructional Lessons & Place Based Principles	**Lesson A: Devil's Tower**
Appreciation of One's Place	Learning about Devil's Tower creation myths allows students to develop an appreciation for various indigenous cultures, their values, and connections to the landscape.
Local Issues	National Park Service (NPS) Rangers and/or tribal members could visit and discuss issues regarding recreational access to this sacred site (e.g. rock climbers).
Community Partnerships	Students participate in a field trip to Devil's Tower and learn from an NPS Ranger, park volunteers, local native tribe member, and/or other community representatives.
Schoolyard, Community, Environment	A field trip to Devil's Tower immerses students in their local environment.
Personally Relevant	Many students have visited Devil's Tower with their families; it is a locally important and well-known landscape feature.
Investigation, Inquiry, & Problem-Solving	Students investigate different explanations for how this landscape feature was formed.
Inter-disciplinary	Language Arts: As a culminating activity, students write a persuasive essay describing how Devil's Tower was formed, supporting their claims using evidence from the lesson.

Table 2A. Using local examples to support NGSS lesson development or adaptation. Third Grade Example

NGSS Performance Expectation[1]	3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death
Unit Focus	Life Cycles
Local Examples	Introduce local examples of plant and animal life cycles and have students focus on their similarities and differences (e.g. grasshopper, ladybug, western toad, robin, sage grouse, pronghorn, and white tailed deer).
Learning Experiences/ Assessment	Students make observations and identify patterns within each of the life cycles (compare/contrast number of stages, length of time from beginning to end, characteristics of each stage etc.). Students use observations about the diverse plant and animal life cycles to develop a generalized life cycle model (develop models to describe phenomena).
Disciplinary Core Ideas	LS1.B: Growth and Development of Organisms-Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles (3-LS1-1)
Crosscutting Concepts	Patterns of change can be used to make predictions (3-LS1-1)
Science and Engineering Practices	Developing and using models to describe phenomena (3-LS1-1)

standards. Table 2A gives an example from the third grade curriculum. Table 2B (found at greenteacher.com/finding-a-place-for-science/) can be adapted for individual use.

Life Cycles Lesson Overview: To begin this lesson, students are given a diagnostic assessment probe[7] to engage their prior knowledge. In this probe, students identify whether a series of living and non-living items have life cycles, such as rocks, trees, and worms. Next, they make observations about the life cycles of different local plants and animals. Students look for patterns within and between cycles. They use these observations to draw a model for all life cycles, which they share. Finally, students revisit the probe and use it to reflect on what they learned.

At a recent professional development workshop, the same elementary teachers who were originally overwhelmed and worried about designing and writing this new science curriculum, were buzzing with excitement. Educators in districts across Wyoming and in other states were requesting access to their NGSS-aligned, locally-relevant curriculum. One teacher jokingly suggested they post their curriculum on *Teachers-Pay-Teachers* to make a little extra money! But joking aside, they agreed that the units they had painstakingly created were designed with their local community and ecosystems in mind. Thus, the new NGSS-aligned curriculum could not simply be used by another school district, state, or country without adaptations and modifications. However, the processes, ideas, and tools we used can be shared widely to help others do what we did. By considering your local setting and place-based principles while creating NGSS-aligned curriculum, you too can deepen student experiences in science.

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Notes

1. NGSS Lead States. 2013. *Next Generation Science Standards: For states, by states*. Washington, DC: National Academies Press.

2. National Research Council (NRC). 2012. *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas.* Washington, DC: National Academies Press.

3. Sobel, D. (2013). Place-based education: connecting classrooms and communities. Great Barrington, MA: The Orion Society.

4. Junwanna, P. 2011. The development of non-formal education program to enhance vocational English skills based on place-based education and experiential learning approaches for taxi drivers in Bangkok metropolis. *Scholar*, 3(2).

5. Houseal, A. 2015. A visual representation of three-dimensional learning: A tool for evaluating curriculum. *Science Scope 39*(1): 58-62.

6. Wiggins, G. P., & McTighe, J. 2005. *Understanding by design*. Alexandria, VA: Association for Supervision and Curriculum Development.

7. Keeley, P. 2011. *Uncovering student ideas in life science*. Arlington, VA: NSTA Press.