Earth Science Extras (ESE2):
Telling Stories of Humans and the Earth
Earth Science and Sustainability

Native American Perspectives in the Science Classroom—Discussion Prompts

by Russ Colson

How can you include ideas of indigenous people in a science classroom? What would be your main objective and why? What would be your secondary objective and why? How would you implement those objectives?

Minnesota law requires that elements of thinking and heritage from Minnesota American Indian Tribes be included in Minnesota science curricula. This requirement has been included in the Minnesota standards for earth science, as shown below.

> Standard: 4.2.2 Students will be able to gather information about and communicate the methods that are used by various cultures, especially those of Minnesota American Indian Tribes and communities, to develop explanations of phenomena and design solutions to problems.

This is a particularly challenging standard since teachers prepared in earth science may not have a firm understanding of traditional cultures, and teachers with an understanding of traditional cultures may tend to be social studies teachers with less preparation in the natural sciences. Thinking about how to address this important challenge in your own classrooms is an important prerequisite to doing a good job with your students.

To aid your thinking, here are three short essays illustrating how both native and non-native thinkers might address this challenge.

Empowering Learning in Science

An essay by Dr. Hillary Barron, Department of Biology, Teaching and Learning, University of Minnesota, Oct 23, 2020

Abstract: Multi-dimensional, holistic, and inclusive science can empower learning for everyone. By including Indigenous science and ways of knowing in our classes we can

open doors of opportunity for all students, including Indigenous students, that might have otherwise been shut.

Boozhoo! (Hello!)

My name is Hillary Barron and I'm a descendent of the White Earth Band of Ojibwe in Northern Minnesota. I've spent most of my career working in Tribal Communities and working toward creating empowering and culturally responsive science learning spaces for Indigenous students and students of color.

Prior to my doctoral work and research in science education, I taught undergraduate biology and environmental science courses at Leech Lake Tribal College for several years. As a primarily Native-serving institution, most of my students were Tribally-enrolled or descendants such as myself. My science courses were requirements for them to graduate, and I'm not exaggerating when I say that nearly all of my students came into my classes with the thought that they couldn't 'do science', or they weren't smart enough for science. Why? That was the narrative that they had been exposed to during their K-12 educational experiences.

Unfortunately, it's common that teachers who work in Tribal communities are not part of the community, but, rather, outsiders. And whether they meant to or not, those teachers reinforced a stereotype that their Native students were somehow less capable of succeeding in science. I left the Tribal College for the express reason of learning more about education research, and how to disrupt those narratives. While completing my Ph.D. in science education, I forged a research trajectory with two major objectives: to disrupt systemic inequities for Native students in science by a) changing the narrative in K-12 science about who can do science and whose knowledge and voices count as valid, and 2) creating empowering science learning opportunities for Native students in undergraduate science by training educators in culturally responsive science teaching.

For example, culturally responsive science teaching can include connecting science content and/or practices to students' lived experiences or current issues. Educators can increase student agency in their own learning by positioning students as leaders in thinking about solving real-world problems.

In this work, I've had the privilege of serving as one of the co-chairs of the Minnesota Science Standards Review Committee. We dared to undertake a revision that aimed to make science learning in Minnesota more dimensional, more holistic, and more inclusive of the diverse communities that make up our state. As a Native woman and educator in the sciences, it was exciting and humbling to have an opportunity to help create this vision of science education. Our charge was also to incorporate contributions of Minnesota American Indian Tribes and communities. It was particularly important to me that we take that opportunity to think critically about the ways in which Indigenous

science and ways of knowing was framed in relation to the dominant, Western approach to science. In creating benchmarks that blend examples of Indigenous ways of knowing with Western science and engineering practices, we have created a framework for Minnesota science education that engenders inclusivity and equity.

One benchmark, for example, says that students will “communicate and evaluate claims by various stakeholders, including Minnesota American Indian Tribes and communities and other cultures, about the environmental impacts of various chemical processes on natural resources.” In a recent training for teachers, we examined the interactions of sulfates and water, and anchored the conversation around the importance of manoomin (wild rice) in Anishinaabe culture. Teachers were asked to identify recent news articles related to sulfates in Minnesota, which spurred a conversation about mining. Then teachers were asked to add “Native American” to their online searches and describe the additional sources, if the information was different, and how. The basic conversation about the interactions of sulfates and water didn’t change, but the second search included an entirely new (to many teachers) perspective. Minnesota American Indian communities have been practicing conservation and management of manoomin for centuries, and their voices in the sulfate and mining conversation are invaluable. When teachers use this approach in class, all students will benefit from the additional perspectives and Indigenous knowledge, and Native students, in particular, will be able to see themselves in science.

I’m thrilled that through these new standards, Native students may be able to see themselves in science and believe that their voices and knowledge are valid and important.

Questions for contemplation:

According to Dr. Barron, what is one major purpose of including indigenous science and ways of knowing into your classroom?

Given Dr. Barron’s examples, how might you include indigenous science and ways of knowing into your classroom?

Native Earth Science, Listening to the Sky

An essay by Dr. Steven Dahlberg, Circle of Life Academy, White Earth, MN, September 1, 2020

Abstract: Native science isn't really about explaining phenomena, but rather is about observing and noticing patterns, then using those patterns to make predictions (two key

elements in the practice of science). Native narratives are not intended as explanations for patterns so much as mythic vehicles to help people remember the pattern.

All people who live in close contact with and depend directly on the natural world for their immediate needs are, by necessity, consummate scientists. They must observe the world intently, sift through all the available phenomena, focus on the most relevant data, understand what these mean, and make accurate predictions that effect their success and survival. That is science! Moreover, it is a science with significant and direct consequences for failure. We all know that farmers and sailors are serious meteorologists. Many kept detailed data logs before wireless communication became ubiquitous. Farmers also regularly go to conferences to discuss their observations and predictions with other scientists. There is a strict peer review process at these events which are usually held at the co-op or the coffee shop.

I use this as a, hopefully, familiar introduction into something that is probably much less so. Indigenous peoples the world over have also been keen observers of their world. They are not recreational observers. They must live in their place, find the resources they need, avoid dangers, and prepare for both known and unknown future events. If they do this successfully, they survive and, perhaps, flourish. If not, they suffer at best. The only way to collect the data they need for this is through: observing the natural world, noticing patterns of correlation between certain phenomena and others that are of particular importance, and using these correlations to make useful and reliable predictions that have efficacy in their lives. Again, this is science! All the steps of the scientific process are there and there will be a test at the end. Failing the test is a little more serious than letters on a report card!

Let me illustrate with a story I was first introduced to by an Anishinaabe artist, storyteller, and emeritus faculty member at the College of St. Scholastica, Carl Gawboy. He coauthored a book, along with a geologist, Ron Morton, entitled Talking Rocks containing this and other stories. A very brief synopsis goes like this:

> The animals had been suffering through a bitter winter that would not end. They were cold, starving and at their wits end. Ojig (Fisher) calls all the animals together and announces he is going into the sky world to find the birds and bring them back. For the birds are the bringers of spring.
>
> Ojig climbs a giant White Pine tree and jumps through the hole in the sky that does not move and lands in the sky world. He wanders about until he comes to a giant lodge and inside finds a basket upside down on the ground. Under the basket he hears a cacophony of bird sound. He lifts up the basket to release all the birds who immediately fly off to the hole in the sky and back to earth.

> Just then a giant appears and begins to chase after Ojig firing arrow after arrow at him. Ojig leaps through the hole in the sky and almost made it to the tree before an arrow caught him in the tail and pinned him to the sky were he circles around the hole in the sky to this very day. Below him spring was returning for all his animal friends.

Carl Gawboy's interpretation of this story is that Ojig is the Ojibwe name for the constellation we know as the Big Dipper or Ursa Major. The hole in the sky is, of course, the North Star or Polaris. If you observe the pattern of movement of all the northern constellation you notice that they circle Polaris over a 24 hour period. They also have a pattern over the course of a year. Ojig spends the fall months below Polaris near the horizon in the evening. As winter begins he begins to climb (up the giant pine) up into the sky on the east side of Polaris. By April he is above Polaris at his highest point in the evening at the time of year when spring returns. Carl's claim is that this story is a tool for teaching and remembering how to keep time on a calendar scale and know how far away spring is during those difficult days of winter in the north woods.

A key point to remember is that a reasonable interpretation of this story is that it may be no more literal than a story of Santa Claus. Story is how people learn and remember, especially in cultures without a written history. It is a teaching device not a literal explanation of physical phenomena. If we in the mainstream culture were a little more humble and more realistic about how human beings actually are instead of literally believing our "meat robot" fairy tale, we might learn a few things from Native storytellers!

<u>Questions for contemplation:</u>

According to Dr. Dahlberg, in what way is indigenous science like western science, and in what way is it different?

Dr. Dahlberg suggests that the story of Ojig is a mnemonic for an applied scientific understanding based on observation. Write down what parts of the story correspond to particular real-world features or events (such as the movement of Ojig upward on the west side of Polaris as winter begins).

In what way can Native American thinking and heritage be included appropriately in the science classroom (as opposed to a social studies or religion classroom)?

An essay by Dr. Russ Colson, Professor of Geology, Minnesota State University Moorhead, July 2020)

Abstract: In the past, Native American observations and experimentation with natural resources informed all manner of developments in ceramics, agriculture, tool manufacture, art, and so on. Well-chosen examples of Native American processes of investigation, including experimentation and testing of ideas through application to practical problems, can suit the NGSS practices of science quite well.

People of all cultures and times have engaged in discovering the world around us, making observations of the natural environment and experimenting with resources so as to adapt those resources to a variety of uses. For example, Native American people used specialized types of rock to grind grain for flour or to make arrowheads and knives. They selected mineral pigments for artwork based on properties of color and durability. They chose raw materials for ceramics based on plasticity, temperature at which important phase transitions occur, shrinkage during firing, strength, density, permeability and other useful properties.

When people interact with the natural world, and find ways to use materials in practical ways, it necessarily involves scientific investigation. Discovering how different materials with different physical and chemical properties can be used for different purposes involves the practices of observation, experimentation, and reasoning. What's more, if a particular practice leads to uses of materials that actually work, then the fact that they work attests to their scientific validity. Thus, those aspects of traditional Native American heritage that use observation and reason to figure out how to adapt and live in the natural world are certainly appropriate in a science classroom.

Examples of real science applied to technological solutions might include how understanding of natural processes and materials impact food production, manufacturing processes, trade, and transport, or on how that understanding informed the design and use of homes, tools, weapons, clothing, or artwork. Including some of this type of investigation in the science classroom can validate Native American contributions to observation-based innovation as well as provide a broadened understanding of the scope and nature of science.

Some people think that *cultural attitudes* toward resources should be treated as science, which is a bit more of a grey area for me. For example, sub-cultures in the United States, including Native American cultures, offer different perspectives and attitudes toward sustainable use of resources. To me, attitude toward sustainability is more of a social studies issue (economics, geography, religion, ethics, politics). However, I suspect that other earth scientists, thinking of Earth as a system of interacting sub-systems, might disagree and consider that concepts of sustainability are part of the contribution earth science makes to our collective understanding of our place on Earth and in the universe. Given this interpretation, Native American perspectives

on sustainability, and the place of humans in the natural world, are valid scientific considerations.

Although the practice of science produces explanatory narratives about the natural world (that is, narratives that explain origins and causes), it does not follow that explanatory narratives are the only product of science, or that any explanatory narrative must be science. Not all aspects of Native thinking might be called ‘science’.

For example, there is a strong belief within the social sciences that socialized attitudes toward the natural world are indistinguishable from natural science. However, to a scientist, science proceeds according to a particular set of unique practices by which a narrative is discovered and constructed. Although scientists cannot be purely objective, they do try to base ideas on practices that can help identify failures of objectivity. Ideas in science 1) are based on observation and arguable reasoning, 2) make connections between cause and effect and 3) are testable in that they make predictions or optimizations which can be checked against future observations. Examples of explorations of this sort exist in all cultures, including Native cultures, and should be a reasonable part of the science classroom. However, when presenting cultural narratives in the science classroom, care should be taken to address which aspects of the narrative are like science, and which represent other ways of knowing and living in our complex world.

Questions for contemplation:

Dr. Colson makes a distinction between practices of science and socialized attitudes toward science ideas. What do you think about this distinction?

Dr. Colson proposes specific types of investigation that are universal to all cultures and perfectly consistent with scientific investigation. What are some of those?