Building Background Knowledge: What is Indigenous Science and Why Does it Matter in the Science Classroom

In this section, Marissa Spang (Northern Cheyenne/Crow), an high school science teacher in Lame Deer discusses her perspective on teaching science and integrating Indigenous science in the classroom.

Pevehe e'šeevehe, Esevona'e na hehe šehe vehe naa Ná'tsėhéstahe naa Apsáalooke naa Mo'ohtave'e heo meneno na hehe stahe. Good day, my name is Buffalo Woman, I am a Northern Cheyenne and Crow person and I am from Black Lodge. I was raised, alongside my six siblings, by a hard-working nahko'eehe (mother) and neho'eehe (father) on the Northern Cheyenne and Crow territories. I descend from Pretty Shield through my Crow grandmother, Evelyn, and from Chief Morning Star through my Northern Cheyenne grandmother, Barbara. I open the introduction with my lineage because it demonstrates the long, inter-generational lineages and knowledges we as Northern Cheyenne and Crow have to the land. This long storied and lived relationship with the land also demonstrates the immemorial sovereignty and self-determination we as Indigenous peoples have with our territories, regardless of the settler state's attempt to enclose us to fractions of our original territories. This will be true for all Indigenous peoples, including those in Montana and across the United States and Canada, and it is critical that this be made productively explicit when teaching and apprenticing our children/students in science learning.

This document is just one Indigenous person's perspective on why Indigenous Sciences/Knowledges (I will be using these interchangeably) matter. This is not an easy nor simple prompt to respond to, thus, I have done my best to offer what I have learned thus far about why Indigenous Knowledges matter and why the synthesis of Indigenous Sciences and western science matters. I will be making sense and meaning of 'why Indigenous Sciences' matter through my Indigenous ontology and axiology. I want to be clear: this is a starting place – I encourage you to have more conversations with Indigenous experts/scientists (of all ages) directly in the communities in which you and they belong to. And to put yourself in a place of practicing Indigenous Sciences yourself – not just as pieces of information but to also engage in the protocols and practices of Indigenous Knowledges and what it means 'to know' from an Indigenous standpoint.

Think of this introduction as having a direct conversation with an Indigenous woman/educator/mother/ scientist about what Indigenous Sciences are and why they deeply matter to our (human and more-than-human) collective wellbeing. Thus, I will not be making meaning of 'why Indigenous Sciences matter' through Western ways of knowing. Rather I will be making meaning of Indigenous Knowledges/ epistemologies through an Indigenous ontology and axiology, i.e., maintaining the distinct cultural values and ethics of Indigenous Knowledge. This move achieves the following, which are critical to the ethical practice, maintenance and growth of Indigenous knowledges:

Situates and maintains Indigenous Knowledges (i.e., epistemologies) sovereign relations with their corresponding axiology, ontologies, and methodologies (i.e., Indigenous knowledges are not 'pieces of information' dissected from their corresponding values and protocols that are then filtered through a Western gaze).

Before I discuss IKS's more deeply I think it is helpful to discuss the elements that comprise bodies and knowledge and ways of knowing: ontology, epistemology, axiology, and methodology. Possessing a working understanding of these elements is critical to realizing how different ways of knowing and being come to be constructed, e.g., Indigenous and western knowledges, and how they inform human inquiry about the world our roles in it.

To begin, an ontology "is the theory of the nature of existence, or the nature of reality...people develop an ontological set of beliefs and take it on faith from there...research then follows these beliefs in an attempt to discover more about this agreed upon reality" (Wilson, 2008: 30). An ontology informs a culture's (e.g., Indigenous and Western cultures) articulation of "why" or the reason(s) for being and defining what is real/reality.

An epistemology "is the study of the nature of thinking or knowing…theory of how we come to have knowledge, or how we know that we know something...Choices made about what is "real" will depend upon how your thinking works and how you know the world around you" (Ibid). An epistemology is a culture's way of constructing what it means to know and what then counts as knowing.

An axiology "is the ethics or morals that guide the search for knowledge and judge which information is worthy of searching for…what knowledge is worth seeking to better understand reality...the ethics of how that knowledge is gained" (Ibid). An axiology is a culture's explanation of what ethical knowing is, i.e., the ethics that dictate how one comes to know and how that knowledge is generated/comes to be.

A methodology "refers to the theory of how knowledge is gained, or in others words the science of finding things out. Your view of what reality is, and how you know this reality, will impact on the ways that more knowledge can be gained about this reality" (Wilson, 2008: 31). A methodology is essentially a culture's way of gathering and generating knowledge or "the how" knowledge is produced.

Figure 1 helps to illustrate the above points when thinking about Indigenous Sciences and Western Sciences (which are culturally constructed ways of coming to know the world and articulating "what is real," "what counts as knowing," as well as the culturally defined ethics that inform knowing, knowledge production and how the knowledge itself is generated). Figure 1 also demonstrates how Indigenous Sciences and Western Sciences are distinct and sovereign from one another, while also sharing commonalities, i.e., they are culturally constructed bodies of knowledge that are founded upon their own distinct ontologies, epistemologies, axiology, and methodologies.

Different cultural orientations generate different human inquiries, methodologies and 'results' that are rigorous and contribute to human knowing/knowledge of the world. This is particularly important in an age on anthropogenic climate change. Bang, Marin and Medin (2018). Indigenous scholars are articulating and implementing what it means to practice Indigenous knowledges particularly when it comes to the climate crisis. IKS hold the knowledges, methods, and ethics that are needed to adapt to and mitigate climate change, not only for human and non-humans, but for the entire natural world. It is paramount for educators to responsibly mentor the next generation of scientists. We must apprentice them in multiple ways of knowing that includes western and Indigenous sciences.

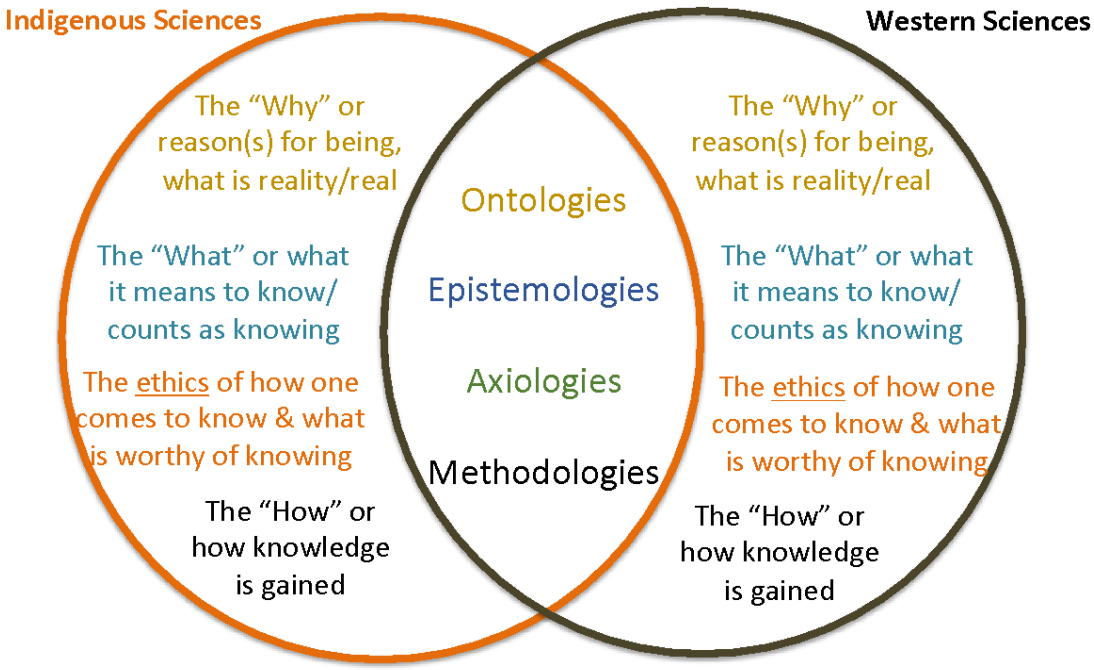

Figure 1. Venn Diagram 1 of Indigenous Sciences and Western Sciences

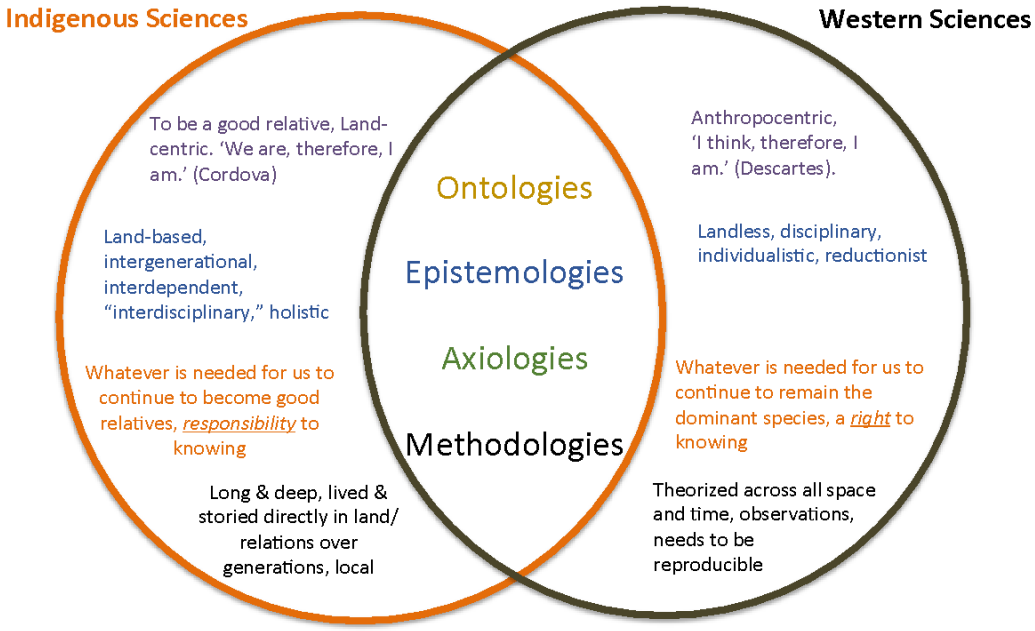

Figure 2. Venn Diagram 2 of Indigenous Sciences and Western Sciences

Figure 2 illustration of the differences across Indigenous and Western ontologies, epistemologies, axiologies, and methodologies.

How can I take and use this information in my classroom?

The following are direct practices/examples of what it can look like to practice and integrate Indigenous sciences:

- Incorporate Indigenous languages/meanings.
- Build knowledge locally and directly on the land, directly in relationships of all beings.
- Incorporate and honor Indigenous theories about how the universe and world came to be. Informed tribes and interactions with environment.
- Read/Discuss peer-reviewed journal articles (scientists review their peer's work and connect it to the larger work/body of knowledge).
- Utilize "Storywork" journals. Storywork (Archibald, 2010) in general is also a key practice – creating collective stories/theories in the classroom to engage students in constructing scientific arguments.
- Engaging in forest walks/walking the land (Bang, Marin, Medin, 2018).
- Designing and fulfillment of a research inquiry using Indigenous and western research methodologies.
- Collective design and production of a digital youth story.
- Co-construct scientist practices according to Indigenous ontologies and axiology with youth/students – as IKS are intergenerational, i.e., we come to know and practice that knowing/knowledge in the world across generations.
- Investigate ways Native students practice their Indigenous knowledges in their community. Learn about methods of hunting and the gathering of plant food relatives: what do they gather, when and why? What are the stories/theories/knowledges shared during these activities, stories, and songs?
- Search out the Indigenous experts/scientists in your community to guest speak in your classroom, regularly. Don't know who they are? Ask your fellow teachers and district staff. You can also go to the tribe's website, as well as OPI's website.

I encourage you to continue to build upon these examples with Indigenous experts who are in your community, as well as with your students. By doing so, teachers engage in Indigenous scientific practice and build upon the expertise of students and community members.

Here are things you can do to ethically achieve Indigenous Sciences integration in your classroom/learning setting:
Search out the Indigenous experts/scientists in your community to guest speak in your classroom, regularly. Don't know who they are? Ask your fellow teachers and district staff. You can also go to the tribe's website, as well as OPI's IEFA website.

A key purpose of Indigenous Sciences and their practices is to keep one in good relation to their responsibilities to all their relations, human and more-than-human. To be an Indigenous Scientist then is measured by 'how well' one attends to these relations (i.e., what it means to be an ethical human scientist).