



# AI/AN Representation in STEM Instruction

## Competency

Educators will demonstrate knowledge of how AI/AN ways of being, knowing, and doing are traditionally and foundationally grounded in STEM and learn to utilize some methods for incorporating these ideas and processes into their classrooms.

## Key Method

Educators will incorporate AI/AN ways of being, knowing, and doing into at least five individual STEM lessons of study. These lessons are currently used in the educator's classroom and follow the methods and protocols learned in this micro-credential with their students.

## Method Components

What are AI/AN ways of being, knowing, and doing?

Indigenous peoples from around the world have systems in place which are often embedded within the language and culture. This kind of knowledge is called Indigenous knowledge, oral knowledge, traditional knowledge, or ways of knowing, depending on the context. When incorporating and representing AI/AN knowledge in STEM instruction, Indigenous ways of being, knowing, and doing are important to utilize as a framework for learning.



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- **Ways of being:** Indigenous worldviews see the whole person (physical, emotional, spiritual, and intellectual) as interconnected to land and in relationship to others (family, communities, nations). A framework first developed by Kirkness and Barnhardt (1991) called the 4 Rs and then added to by Restoule (2008) to become the 5 Rs, can be used to teach these important holistic values and ways of being. They include:
  1. **Respect** for cultural values and traditions
  2. **Relevant** perspectives, practices, historical contexts
  3. **Reciprocal** exchange with others for mutual benefit creating a cyclical obligation
  4. **Responsibility** to the community and to care for all relatives
  5. **Relationships** that honor the connection between people and everyone's contribution
- **Ways of knowing and doing** is the information and practices that people in a community have and continue to develop, based on experience and adaptation to local culture and environment (Barnhardt and Kawagley, 2005) Indigenous ways of knowing and doing:
  - Include respect and trust for inherited wisdom;
  - Are often communicated through oral tradition;
  - Have proven their utility in everyday practices;
  - Are often collective and evolve through community exchange and decision-making with respect for the knowledge and the authority of elders;
  - Include cultural protocols and practice; and
  - Are connected to the land you are on and the knowledge that is contained within the relationship to that land and groups of peoples of the land.

## How are Indigenous Ways of Knowing Relevant to STEM?

Greg Cajete, Ph.D., a Tewa Indian, and scholar from Santa Clara Pueblo, New Mexico, pioneered reconciling Indigenous perspectives in sciences with a Western academic setting. In this lecture, [Native Science: The Indigenous Mind Rising](#) (UNE Center for Global Humanities, 2020), Dr. Cajete says that Indigenous worldviews are relational and ecological. These ways of understanding include thinking about the natural world through connections, interdependence, and relationships including those with animals, the land, and forces of nature.

This way of knowing is born of a lived and storied participation with the natural landscape. In his lecture, Prof. Cajete posits that Indigenous ways of knowing can help with developing a better relationship to the earth, to each other, and to the entity that "guides it all," meaning the unique innate quality that we have within us called spirituality. Some tenets of Native science include:

- It is a different journey than western (sometimes called mainstream) science, but is no less valid or rigorous
- A goal to be open to the natural world with all of one's senses - body, mind, and spirit.
- It is a metaphor for Native knowledge. It is the stories of the world for living and participating in processes for seeking life, relationships, and meaning



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- It is expressed through story, art, song, dance, ritual, music, community, hunting, fishing, farming, healing, architecture, and astronomy, and is embedded into any and all of these practices
- The process has a period of preparation, adherence to natural patterns, has theory behind it, knowledge with purpose introduced at the right time, intrinsic belief behind this knowledge, and celebrations
- Technologies, skills, and insights that are based on places on the earth

## Methods for incorporating Indigenous ways of knowing into STEM lessons

Below are some methods and options to help you to think about how to incorporate Indigenous knowledge into STEM lessons and learning environments. Respectfully invite Indigenous elders, business people, artists, etc. into your classroom to speak or do demonstrations and authentically partner with them to teach Indigenous STEM and ways of knowing on an ongoing basis (not just once)

- Regularly invite guest speakers to share Indigenous STEM and ways of knowing through storytelling
- Learn ways of knowing directly from experience with Indigenous students, their families, and their communities by inviting them into the classroom and attending appropriate community events
- Acknowledge the territory where the learning is taking place (where the school is located), and engage the class in learning the naming of places, plants, and processes that align with indigenous knowledge systems of that place
- Move learning outside, and center it on local flora, fauna, and phenomena with the goal of reinforcing relationships to land. Read about [this example](#) and [this study](#)
- Inform yourself by reading about how to orient cultural ways of knowing to promote inclusive instruction
- Identify and partner with an out-of-school community-based organization to connect STEM learning in school and out of school
- Plan field trips to Indigenous events, exhibits, or landmarks while providing context for students and engaging Native knowledge experts connected to these spaces

## Supporting Rationale and Research

Barnhardt, R., & Kawagley, A. O. (2005). Indigenous Knowledge Systems & Alaska Native Ways of Knowing. *Anthropology and Education Quarterly*, 36(1), pp. 8-23. [http://www.ankn.uaf.edu/curriculum/Articles/BarnhardtKawagley/Indigenous\\_Knowledge.html](http://www.ankn.uaf.edu/curriculum/Articles/BarnhardtKawagley/Indigenous_Knowledge.html)



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Cajete, G. (1999). *Native Science: Natural Laws of Interdependence*. (1st edition). Clear Light Books.

<https://www.amazon.com/Native-Science-Natural-Laws-Interdependence/dp/1574160419>

Kirkness, V. J., & R. Barnhardt (2001). First Nations and Higher Education: The Four R's - Respect, Relevance, Reciprocity, Responsibility. In *Knowledge Across Cultures: A Contribution to Dialogue Among Civilizations*. R. Hayoe and J. Pan. Hong Kong, eds., Comparative Education Research Centre, Univ. of Hong Kong.

<https://www.uaf.edu/ankn/publications/collective-works-of-ray-b/Four-Rs-2nd-Ed.pdf>

Restoule, J.P. (2008, Nov. 26). *The five r's of Indigenous research: Relationship, respect, relevance, responsibility, and reciprocity* [Workshop]. Wise Practices II: Canadian Aboriginal AIDS Network Research and Capacity Building Conference, Toronto, Ontario, Canada.

UNE Center for Global Humanities (2020, February, 26). *Gregory Cajete—Native Science: The Indigenous Mind Rising* [Video]. YouTube.

<https://www.youtube.com/watch?v=3BqoZhp2Zn4>

## Resources

### Articles About Teaching with Indigenous Knowledge

- [Appropriate Use of Indigenous Content – Pulling Together: A Guide for Curriculum Developers](#)
- [11 Equity and Diversity in Science and Engineering Education | A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas](#)
- [Improving Science Education for Native Students: Teaching Place Through Community](#)
- [Improving Science Education: Teaching Place Through Community](#)
- [Incorporating Indigenous Cultures and Realities in STEM](#)
- [Indigenous STEM Education Project - CSIRO](#)
- [Putting Raven Back Together Again](#)



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- [Teaching STEM In Ways that Respect and Build Upon Indigenous Peoples' Rights : StemTeachingTools \(en-US\)](#)
- [Reimagining the Science Classroom: Building Indigenous and Non-Indigenous Partnerships Shane Buck](#)

#### Instructional Videos

- [Culturally Responsive Indigenous Science](#)
-  Indian Education for All Ethnobotany Webinar #1 Rosalyn LaPier
-  Indigenous STEM: From Canoes to NASA
-  The Honorable Harvest - Robin Kimmerer
-  Gregory Cajete - Native Science: The Indigenous Mind Rising
-  Robin Wall Kimmerer, Reciprocity

#### Learning Resources

- [Digital Resources for Parents and Teachers — National Indian Education Association](#)
- [Indian Education for All Lessons](#)
- [Integrating Indigenous Epistemologies and Pedagogies into Curriculum Design and Development](#)
- [Star Stories - YouTube](#)
- [Videos Archive - Tribal Legacy Project](#)
- [Voices To Hear CDA Tribe](#)
- [Wabanaki Place Names | Environmental Studies | Bates College](#)

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## Submission Guidelines & Evaluation Criteria



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To earn the micro-credential, you must receive a passing score in Parts 1 and 3 and be proficient in all components in Part 2.

## Part 1. Overview Questions (Provides Context)

(200-300 words)

Please use the suggested word count as a guide to answering the following contextual questions. This will help our assessor understand your current context for working on this micro-credential.

Please do not include any information that will make you identifiable to your reviewers.

1. What is your motivation for learning more about why and how to teach STEM in your classroom that is aligned with an Indigenous knowledge framework?
2. How do you hope incorporating Indigenous knowledge into your STEM lessons will impact your student learning? How might the impact be different for your Native and non-Native students?
3. Which of the suggested methods for incorporating Indigenous knowledge into your STEM lessons seems the most relevant to what you teach and the context you live in, and why?

**Passing:** Response provides reasonable and accurate information that justifies the reason for choosing this micro-credential to address specific needs of both the teacher and the student. A learning goal should clearly state what they hope to gain from earning this micro-credential.

## Part 2. Work Examples/Artifacts/Evidence

To earn this micro-credential, please submit the following three artifacts as evidence of your learning.

Please do not include any information that will make you or your students identifiable to your reviewers.

### **Artifact 1: Research Teaching Opportunities and Methods (200-300 words)**

Explore the AI/AN communities (past and/or present) in your region with the suggested teaching methods from this microcredential in mind. This exploration includes an investigation of the places in your community that are important to Indigenous peoples, the history of the Native peoples in your place, and Indigenous community events that are open to you and the students in your classroom.



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Summarize what you find along with possible teaching strategies and methods that you would like to try in your classroom. Include the following:

- Describe the opportunities you found in your explorations
- How will the incorporation of Indigenous knowledge through these opportunities bring respect, relevance, reciprocity, responsibility, and relationship into the STEM learning for your students?
- How will these methods and this knowledge align or not align with how you have been teaching these STEM lessons prior to learning about this?
- How will incorporating this knowledge into your STEM lessons work to support STEM learning in your classrooms?

### **Artifact 2: Five Lesson Plans**

With the knowledge opportunities that you researched in Artifact 1, outline at least five individual STEM lessons that you will revise for teaching in your classroom. In each lesson plan, include the following information

- STEM Discipline(s) focus
- Learning objective(s)
- Teaching methods that will be used to incorporate Indigenous knowledge into the learning
- How one (or more) of the 5 R's will be incorporated into the learning.
- What real-world issue or idea will be included in this learning
- Background information on the STEM/Indigenous Knowledge topics

Teach each of the lessons using these methods and the Indigenous knowledge that is available and relevant to each lesson.

### **Artifact 3: Sharing with Colleagues**

Develop a slide presentation to share with your colleagues that focuses on what you learned about the importance of incorporating Indigenous knowledge and practices into your STEM lessons. Your presentation should also include how learning about this knowledge impacts students and the methods used to integrate Indigenous knowledge in your science classrooms. The EIGHT slides you create should also include:

- An introduction of the value of Indigenous knowledge and STEM instruction
- A slide that highlights your own learning through this micro-credential process
- Information on each of the five lessons that you developed in Artifact 2, and pinpoints potential impacts and ways in which you recognized your students' learning in positive ways because of your lesson revisions
- Discussion questions that facilitate a discussion at the end with your colleagues about how they might think about incorporating Indigenous ways of knowing into their teaching disciplines



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## Part 2. Rubric

	<b>Proficient</b>	<b>Basic</b>	<b>Developing</b>
<b>Artifact 1: Research Teaching Opportunities and Methods</b>	The summary includes a thorough description of the teaching strategies and methods, as well as each of the bullet points included in the instructions for this artifact	The summary includes the teaching strategies and methods they would like to try in their classroom and some of the information that was requested, but not all of the items on the list	A summary of the teaching strategies describes the strategies and methods they will use, but nothing else
<b>Artifact 2: Five Lesson Plans</b>	Five developed STEM lesson plans that include each of the components requested for this artifact	Developed plans for five STEM lessons but did not include each of the requested components in individual lessons	Developed plans for less than five STEM lessons
<b>Artifact 3: Sharing with Colleagues</b>	Slide presentation submitted with eight slides and all four components present (introduction, learning highlights, five lesson showcase, and discussion questions)	Presentation is missing one of the following: introduction, learning highlights, five lesson showcase, or discussion questions	The presentation is missing two or more of the following: introduction, learning highlights, five lesson showcase, or discussion questions

## Part 3 Reflection

(200-400 words)

Use the word count as a guide to writing a personal reflection about your work on this micro-credential. For tips on writing a good reflection, review the following resource:



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## [How Do I Write a Good Personal Reflection?](#)

*Please do not include any information that will make you identifiable to your reviewers.*

1. How easy or difficult was it for you to utilize the 5Rs as a framework for incorporating Indigenous knowledge into STEM lessons? Did this framework help you to think about lesson revisions?
2. What was student engagement like when you revised the STEM lessons that incorporated Indigenous knowledge?
3. What plans do you have for incorporating Indigenous knowledge into future STEM lessons?

**Passing:** Reflection provides evidence that this activity has had a positive impact on both educator practice and student success. Specific examples are cited directly from personal or work-related experiences to support claims. Also included are specific actionable steps that demonstrate how new learning will be integrated into future practices.

NEA acknowledges the [National Indian Education Association](#) for its review and endorsement of this micro-credential.



National Indian  
Education Association



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