



SPACE MESSENGERS

BioSTEAM Activity Guide:
Particle Physics Meets Lakota Cosmology



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SPACE MESSENGERS' WORKSHOP
Week 5: Feb 22-26
Particle Physics Meets Lakota Cosmology

OVERVIEW

In this lesson you will prepare your students for Particle Physics Meets Lakota Cosmology. Students will meet and hear from Dr. Steven Goldfarb a particle physicist, and Steve Tamayo a Lakota artist and cultural specialist as they discuss the parallels between native and western science.

Indigenous science incorporates traditional ecological knowledge (TEK) and Indigenous perspectives, while non-Indigenous scientific approaches are commonly recognized as Western science. In this lesson students will hear both perspectives from experts in the field and discover how they each contribute to modern science and combined provide a greater understanding of the universe.

Subjects

Art, technology, imaging science, particle physics, indigenous cultural knowledge

Estimated Time

Several class periods throughout the week.

Grade Level

7-12



INTRO

One of the defining talents of the human brain is the ability to recognize and organize patterns. It is no surprise then that this would lead to diverse symbolic languages representing unique perspectives and meanings. These messages of understanding move with us through time as living cultural expressions of self and our connection to the universe. Symbols are the words, sounds, gestures or images that create the descriptive language of human experience. Western and Indigenous Sciences bring unique perspectives to the questions: Where do we come from? How are we connected to the universe? What is our responsibility to our world and future?

SCIENCE + PICTURE WRITING ACTIVITIES

Objectives

Students will be able to:

- Understand the concept of time through the lens of Western science and Indigenous science (Big Bang/Origin stories).
- Draw connections between the diverse ways that we connect with nature; Through direct relationship and through measurement and instrumentation.
- Realize the importance of 'responsibility' in protecting the environment for future generations, and in the pursuit of truth in the scientific method.
- Recognize the cultural role of symbology in science and art to understand our place in the universe in both western and native science (imaging science + native symbology)

UNDERSTANDING THE UNIVERSE THROUGH PARTICLE PHYSICS

Watch Dr. Steven Goldfarb speaker video (25 mins)

1. Watch Dr. Steven's video, Large Hadron Collider: Understanding What We Can See as a class and discuss Steven's key take-aways:

- ◆ Why were 1 billion people interested in viewing the discovery of the Higgs boson?
- ◆ How do we measure what we can't see?
- ◆ What is your favorite big question particle physicists are trying to answer?
- ◆ How big is the universe compared to you and how old is it compared to you?

2. Further thought for students:

- Where did the elementary particles that make up your body come from?
- Why is it important that we do fundamental scientific research, even if we do not know what exactly we will get from it (other than knowledge)?
- What is the advantage of having people from different parts of the world, who speak different languages and have different backgrounds, work together on an experiment?
- *Extra credit:* Name 3 elementary particles

3. Below are some extensions to deepen the understanding.

- CERN in 3 minutes
- Power of Ten
- CERN: Standard Model of the Universe

UNDERSTANDING THE UNIVERSE THROUGH INDIGENOUS SCIENCE

Ethnoscience is a more technical form for Indigenous knowledge, *Native science*, *African science*, *Maori science*, etc. "Ethnoscience refers to the system of knowledge and cognition typical of a given culture...to put it another way a culture itself amounts to the sum of a given society's folk classifications, all of that society's ethnoscience, its particular ways of classifying its material and social universe" (Sturtevant 1964: 99–100). The aim of ethnoscience is to gain a more complete description of cultural knowledge. Cultural knowledge is a deeply local expression of human experience. Tied to seasonal change and cycles, traditions are intimately connected to the systems that support life, and are preserved through tools of cultural memory like story, symbology, movement and song to help answer "Why, why why, why why?".

Watch Steve Tamayo speaker video (15 mins)

1. Watch Steve Tamayo video, *Living in Balance*, as a class and discuss Steve's key take-aways:

- ◆ How can we bring cultural ethnoscience to the classroom?
- ◆ It's our responsibility to stand up and come together to save our lands, water, and air. How can we carry out this mission?
- ◆ Research your own creation stories, find creative ways to share this information with the new up and coming scientists in your communities.

2. Below are some extensions to deepen the understanding.

- Watch and discuss Dr. Greg Cajete's video on Biodiversity Loss and Native Science.
- Dr. Leroy Little Bear: Indigenous Knowledge and Western Science
- Rick Hill: What is Indigenous Knowledge
- More links here in the STEAM wiki.



★ **Create Symbols for Storytelling**
(Steve Tamayo activity) ★



1. Find or create your own symbols for the following:

- ★
- Pleiades and the rotation of the four seasons
 - Turtle
 - Elk
 - Snake
 - Bear
 - Stars four-five point
 - Rain
 - Sun
 - Moon
 - Rainbow
 - Lightning
 - Salamander
 - Thunderbird
 - Race Track around the Milky Way
 - Tipi
 - Devils Tower
 - Deer, Buffalo, and all four legged tracks
 - Winged relative tracks
 - Two legged tracks
 - River
 - Earth
 - Forest
 - Meteor
 - Dwellings
 - Movement
 - Food/plants
- ★



IMAGING SCIENCE AND SYMBOLOLOGY

Explore the art of expression in symbols

1. Explore the links below to see some of the ways symbols have been used across time to understand and describe the universe:

- ◆ FEYNMAN DIAGRAMS: A pictorial representation of the mathematical behavior and interaction of subatomic particles. Link: [Feynman examples](#), [What are Feynman Particles?](#)
- ◆ NATIVE SYMBOLS: “Picture writing”. The pictorial language Native Americans used to convey words or ideas. Link: [Native American 'Winter Counts' Serve As Unique Archives For Climate Research](#)
- ◆ IMAGING SCIENCE: The generation, collection, duplication, analysis, modification, and visualization of images, including imaging things that the human eye cannot detect. Links: [What is Imaging Science?](#) , [Picturing Particles](#)
 - *(Wikipedia) Examples of imaging science for inspiration: image processing, computer vision, 3D computer graphics, animations, atmospheric optics, astronomical imaging, biological imaging, digital image restoration, digital imaging, color science, digital photography, holography, magnetic resonance imaging, medical imaging, microdensitometry, optics, photography, remote sensing, radar imaging, radiometry, silver halide, ultrasound imaging, photoacoustic imaging, thermal imaging, visual perception*

2. Try out one or more of these activities.

- Upload your favorite images from the imaging science and symbology activity to the Space Board Gallery and include source and description in the caption. Imagine how they will be collaged into the silhouettes.
- Research one image/symbol that is meaningful to you for this project. Write a space message that communicates its meaning.
- Draw or create light/shadow silhouettes that integrate your local culture in pictorial or symbolic language. How might you represent the Space Messengers theme: Wonder, Change, or Celebration?
- Create light/shadow silhouettes inspired by symbols of science. Can you use your body to create shapes that communicate ideas the ways symbols do, for example the way particles interact in a Feynman diagram?

Preparation for Group Share

Work with students to prepare questions for Steven and Steve.

- We will allocate 5 minutes for each planet team during group share.
- Allow a question for each speaker. If time allows more questions will be possible.
- The chat can be used to post additional questions.
- Save all questions in a word doc and we will share them with the speakers to answer at a later time via email or website.

