

## Lesson Plan

### Fred Begay: Physicist by 3 names

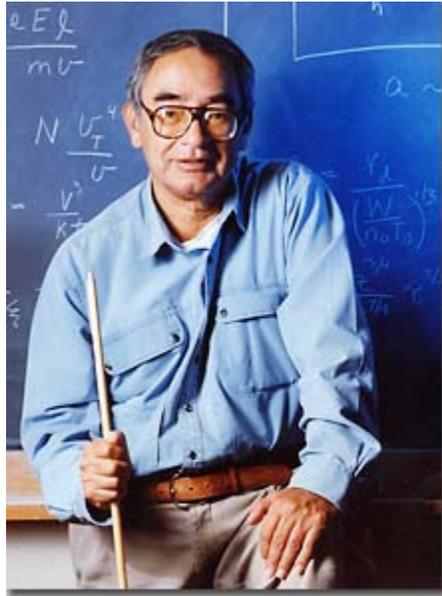


Photo credit to Physics Central

**Grade Level(s):** 9-12

**Subject(s):** History, Native American, Physics

**In-Class Time:** 50 min

**Prep Time:** 30 min

#### Materials

- A screen top project both the power point and the video
- Printed copies of the article
- Printed copies of the discussion questions

#### Objective

In this lesson students will be learning about the life and work of Fred Begay, also known as Fred Young and Clever Hunter, the first Native American to earn a PhD in physics.

#### Introduction

Clever Fox was a Navajo child born in the Shiprock settlement around 1932. No one knows the exact year he was born though. Clever Fox was raised in a very traditional Navajo way, learning to hunt and farm. He was named Clever Fox for his innovative hunting ideas. Clever Fox was heavily interested in his Navajo religion, and would often ask probing questions about how the world around him worked. He

particularly wanted to understand how rainbows were made. All the answers he received from the medicine men of his tribe were didn't satisfy him enough.

As Clever Fox got older, he and his family would go into the nearby cities to trade. He was "impressed with the standard of living of white people." He was surprised to see how the people in the city always had food, and even would throw away good food, while he and his family were starving. At times, Clever fox would sneak into the city and rummage through the trash, searching for food people has thrown out.

Eventually, Clever Fox's parent decided to send him to a boarding school in town run by missionaries. His parents sent him because the school offered free food to the children. The leaders of the school assigned him a new name, Fred Young, and estimated him to be around 10 years old. His parents had no say in his education, and the school decided he should learn things they thought would help him in the Navajo tribe, so Young learned primarily how to farm for over 10 years. The school was "run like an army camp". The children were not allowed to speak Navajo or practice any Navajo religious ceremonies, and were harshly punished if they were caught. The school would have him and the other Navajo children dress up as Indians for school plays and parades, but they "weren't allowed to be real Indians, just play as them." Over the years, Young lost contact with his family.

Because of his farm based education, when Young graduated he barely knew how to read or write. The tribal council of the Navajo tribe had just come into money to send some of their people to university, and still chose Young. The tribal council decided Young would go to the University of New Mexico to learn engineering. While he was studying there, Young found an optics book that finally explained to him how rainbows worked. Soon after, Young changed his major to physics.

During his studies, his teachers described him as constantly anxious and on edge. Yong would leave school for days at a time to go back to the reservation. Young received weekly cleansing rituals said to protect him from the influence of the white man. Young was fiercely protective of his tribe's way of life, and was known to get into fights with any one who criticized it.

In 1971, Young became the first Native American in history to earn a PhD in physics. Young specialized in nuclear physics, and began working in the nearby Los Alamos Laboratory. Sometime during this point in his life, Young changed his name to Fred Begay. Begay's research at Los Alamos focused on advancing nuclear fusion as an energy source, and searching for sources of high energy gamma rays and solar neutrinos. Nuclear fusion is predicted to be a nearly unlimited energy source with little to no environmental consequences. Gamma rays and neutrinos are high energy particles that science knows very little about but are trying to research as they predict they could be the key to faster communication systems in the future. Begay would go back to the Navajo schools and college to talk about his work and encourage students to pursue degrees in science. While Begay was constantly uncomfortable living with white people, he was also anxious in his own tribe. Begay felt a disconnect from not being able to explain his work in Navajo himself, and requiring a translator. Begay felt on edge constantly, worrying

about if he was acting correctly, being a proper Navajo. He kept trying to spike interest in physics, but many people of the tribe, including the medicine men, found Begay's work impractical and useless to them. Begay knew this was because understanding rainbows didn't help the Navajo people in their day to day struggle to survive and find food. Still he continued working with the tribe and Los Alamos labs to try and increase Navajo participation, though was largely unsuccessful.

Fred Begay, for all the work he has done, lived largely in obscurity for most of his life. Navajo culture puts a strong emphasis on the accomplishments of the whole, and disparages one being too self-absorbed. Though Begay tried to speak, and participated in interviews and documentaries, he was always uncomfortable. Film crews recalled how Begay would leave for days during filming, either to the reserve or someplace else the film crew didn't know. He would always come back insisting they continue.

Fred Begay died in 2013.

[1] "The Long walk of Fred Young", *The British broadcasting Cooperation and NOVA*, 1978

[3] "Fred Begay", *Physics Central*, <http://www.physicscentral.com/explore/people/begay.cfm>

### Instructions

#### Engage: 15 Minutes

In this section the teacher will give a short presentation on Fred Begay and his life

#### What is the teacher doing?

The teacher is presenting the power point linked in the additional resources. The presentation is about Fred Begay's life

#### What are the students doing?

Listening and taking notes on the discussion sheet about Fred Begay.

#### Explore: 10 Minutes

Video about Nuclear Fusion

#### What is the teacher doing?

Playing the video provided that gives a brief overview about what Nuclear fusion power is, and some of the problems that arise while working on it.

#### What are the students doing?

Watching the video provided and filling out the questions in their discussion sheet

#### Explain: 20 Minutes

Article on the developments of Nuclear Fusion

#### What is the teacher doing?

Handing out the article provided in the extra resources sections. Making sure the students stay

#### What are the students doing?

Reading the article provided about the most recent discoveries in the field of Nuclear physics

on topic while reading and discussing the article as well as answering questions as they come up.	and fusion power. Writing answers down to the discussion questions and discussing the implications of the article.
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**Elaborate: As time provides**

Group discussion	
<p><b>What is the teacher doing?</b> Leading a group discussion about what the implications of the article could mean. What would this mean for Fred Begay if he was alive? Would it affect native American land and culture, which had been drastically affected by the need for coal? Lead the students to realize the affect of coal mining in the US on Native Lands, and how energy is a large concern for most Native peoples. Many Native Americans have been forced out of sacred land for the sake of ebergy and coal. With a new fusion process, the land wouldn't be needed for coal mining anymore. Discuss more of the hardships Begay had acclimating to "White Culture" and his feeling of being lost between two vastly different ideologies.</p>	<p><b>What are the students doing?</b> Participating in the group discussion. Asking questions about the Native American culture and how it affected the choices Begay made. Asking questions and possibly sharing stories about cultural assimilation stuggles.</p>

**Evaluate:**

The teacher will be able to evaluate the students based on their participation and answers to the discussion sheet.
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**Required/Recommended Reading and Resources**

- *Fusion Power explained- Future or Failure*, Kurzgesagt <https://www.youtube.com/watch?v=mZsaaturR6E>
- Stephanie Williams, Presentation on Fred Begay's life and work., AIP Center for History of Physics, 2018
- Phoebe Sharp, *A Twinkle in Mother Earth's Eye: Promising fusion Power*, APS Physics Central, 2018

**Discussion Questions**

Discussion Questions can be found as a Handout with a corresponding Answer Key in the Supplemental Materials to this lesson plan.

1. Why did Fred Begay go by 3 different names in his life time?

2. What inspired Begay to go into physics?
3. What were Begay's research interests?
4. What does it mean to be a thermonuclear process?
5. What are the two methods scientists have used to make plasmas hot enough to fuse?
6. What is the main reason fusion reactors may not be viable?
7. Why do scientists predict that there is deuterium on the moon?
8. Why are fusion reactors safe? Are they a danger to the environment?
9. What is the NIF breakthrough discussed in the article?
10. Does this mean that fusion is commercially viable now?

### Further Reading and Additional Resources

- *Nation within a Nation*, Hearst Metrotone News, 1972
- *In Our Native Land*, Sandia Laboratory, 1973
- *The Long Walk of Fred Young-Begay*, British Broadcasting Corporation and NOVA, 1978;
- *Dancing with Photons* (KNME-TV, 1997)
- *Fred Begay*, Physics Central, <http://www.physicscentral.com/explore/people/begay.cfm>

### Extensions

### Common Core Standards

For more information on Common Core Standards, visit <http://www.corestandards.org/>.

Reading: Literature	
CCSS.ELA-LITERACY.RL.9-10.6	Analyze a particular point of view or cultural experience reflected in a work of literature from outside the United States, drawing on a wide reading of world literature.
CCSS.ELA-LITERACY.RL.9-10.2	Determine a theme or central idea of a text and analyze in detail its development over the course of the text, including how it emerges and is shaped and refined by specific details; provide an objective summary of the text.
CCSS.ELA-LITERACY.RL.9-10.3	Analyze how complex characters (e.g., those with multiple or conflicting motivations) develop over the course of a text, interact with other characters, and advance the plot or develop the theme.
Reading: Informational Text	
CCSS.ELA-LITERACY.RI.9-10.2	Determine a central idea of a text and analyze its development over the course of the text, including how it emerges and is shaped and refined by specific details; provide an objective summary of the text.
CCSS.ELA-LITERACY.RI.9-10.7	Analyze various accounts of a subject told in different mediums (e.g., a person's life story in both print and multimedia), determining which details are emphasized in each account.
Speaking & Listening	
CCSS.ELA-LITERACY.SL.9-10.1	Initiate and participate effectively in a range of collaborative

	<p>discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.</p> <p>a. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.</p> <p>b. Work with peers to set rules for collegial discussions and decision-making(e.g., informal consensus, taking votes on key issues, presentation of alternate views), clear goals and deadlines, and individual roles as needed.</p> <p>c. Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.</p> <p>d. Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.</p>
CCSS.ELA-LITERACY.SL.9-10.2	<p>Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.</p>
Language	
CCSS.ELA-LITERACY.L.	
History/Social Studies	
CCSS.ELA-LITERACY.RH.9-10.2	<p>Determine the central ideas or information of a primary or secondary source; provide an accurate summary of how key events or ideas develop over the course of the text.</p>
Science & Technical Subjects	
CCSS.ELA-LITERACY.RST.9-10.4	<p>Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.</p>
Subject Writing	
CCSS.ELA-LITERACY.WHST.	

### Next Generation Science Standards

For more information on the Next Generation Science Standards, visit <http://www.nextgenscience.org/>.

<a href="#">Dimension One: Practices</a>	
<a href="#">Dimension Two: Crosscutting</a>	

<a href="#">Concepts</a>	
<a href="#">Dimension Three: Disciplinary Core Ideas</a>	Core Idea