

New to TEK: Teacher's Guide

This guide is written for instructors who are new to TEK, but can be beneficial for all educators

Introduction

Thank you so much for your interest in these lessons! We are so excited to share this with you and your students. We have provided a series of lessons to help students (and teachers!) learn about a variety of aspects around Indigenous Knowledge/science. This is a combined social studies and science series of lessons that align with the three dimensions of the Next Generation Science Standards (NGSS). In these lessons students learn about the following:

1. A branch of Indigenous Science and Knowledge known as Traditional Ecological Knowledge (TEK).
2. Aspects of Yurok TEK, especially as related to knowledge about and relationship with animals and the environment.
3. Similarities and differences between TEK and what we call “Western science,” or Western Ecological Knowledge (WEK) particularly as it relates to “wildlife ecology” and the environment.
4. Ways in which TEK and WEK can be used to help protect the environment.
5. Dr. Seafha Ramos and her work. Dr Ramos is a practicing scientist and wildlife ecologist who has studied TEK through the Yurok cultural lens and applied that knowledge to design wildlife research.
6. How to identify a subset of mammals by their tracks and scat; an activity that combines TEK and WEK

NGSS alignment

5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.

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If you are new to TEK it may take a bit of time and reading to understand the concepts described here. We encourage you to continue reading, as this guide provides examples and different ways of thinking about TEK and all it encompasses!

Traditional Ecological Knowledge (TEK)

Note: We use the term “Indigenous” or “Native American” here, preferring it over “Indian,” which can be considered offensive.

Important Terminology

Before describing what TEK is, please note that the term, TEK or “Traditional Ecological Knowledge” is not an Indigenous term. This was created by non-Indigenous scientists who became interested in the deep body of Indigenous knowledge about animals, plants, ecosystems, climate, sustainability, and more. The term “Western science” refers to the dominant science that takes place in the United States (and elsewhere) today. Western science is originally associated with science as practiced in Western Europe or a colonized America but is practiced by people all over the world and from all backgrounds today.

What is TEK?

Traditional Ecological Knowledge refers to knowledge, beliefs, value systems, and practices in Indigenous communities that relate to the natural world.

TEK involves knowledge about the physical environment (for example about animal habitats or local plants) and beliefs and values about the importance of life, ecosystems, and humans’ role in taking care of the Earth. TEK is a practice*, it is a way of relating to the environment. TEK is a science and is sometimes called “Native Science” or “Indigenous Science.”

The knowledge in TEK has been passed down over millennia and modern Indigenous communities continue to practice and add to TEK. Many Indigenous people who practice TEK see it simply as a “way of life.” Importantly, each of the over 550 federally recognized Native American tribes in the United States has its own unique culture and knowledge of the natural world.



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Traditional Ecological Knowledge (TEK) (cont)

What is TEK? (cont)

As described in part above, TEK involves many elements related to caring for the environment and learning about the natural world. TEK includes science, spiritual elements, cultural practices, values, relationships with the environment, language, and more. A fundamental aspect of TEK is that all these elements are interconnected to such an extent that one element cannot be considered without the others.

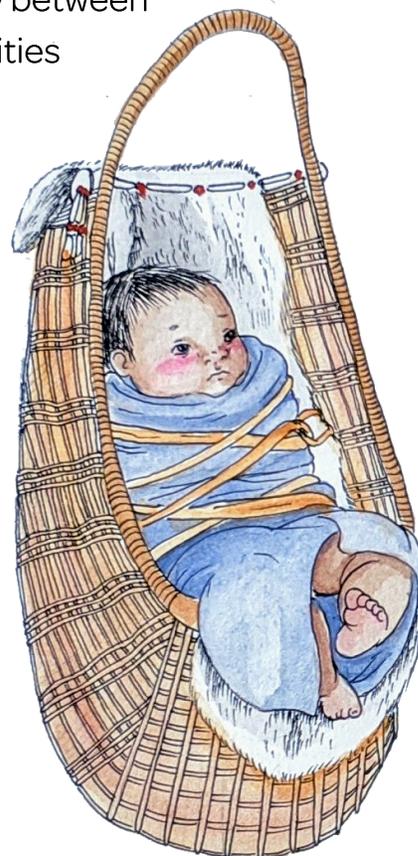
TEK includes many things and is not easily described in a few short paragraphs! We expand upon TEK below, in the section about Yurok culture, and in teacher's keys to specific lessons in this unit. We also provide "further reading" suggestions below.

**We use the term "practice" here in the way people use the term when referring to a "meditation practice," "yoga practice," or "religious practice."*

Definitions

Understandings of definitions of science, and even TEK, vary between Indigenous and Western perspectives. Indigenous communities and scientists consider TEK as a science. However, TEK includes elements not included in the Western definition of science; TEK is broader and explicitly encompasses cultural aspects and values.

If you are thinking of science from a Western perspective, it might help you to think of TEK as including science and other elements in an interconnected way (this interconnectedness is key). However, if we broaden our own perspectives as to what science is - or that there are different types of sciences - TEK might be better understood as Indigenous science.



A basket lined with rabbit fur

Illustrations by : Melitta Jackson

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Traditional Ecological Knowledge (TEK) (cont)

Definitions (cont)

There are many areas of TEK and WEK that align. Still, the inclusion of TEK as a science has been questioned and met with resistance in some areas of Western science. We disagree with this assessment and ask that in teaching this lesson you, as the teacher, show full respect to Indigenous science as a body of knowledge as equal to Western science.

Western Science

In many places in the United States, the term “science” is typically connected with what we will call “Western science.” Western science often focuses on formal experiments, cataloging information, and publishing results in journals. Dr. Seafha Ramos, co-creator of this lesson, sometimes uses the term "WEK" or "Western Ecological Knowledge" in addition to "Western Science" when discussing it in relation to TEK. However, for the purposes of reading comprehension, we mostly use "Western science" in this document.

Western science has traditionally excluded Indigenous science or used their knowledge without acknowledgement. For example, many Western medicines, including many in active use, were created based on Indigenous knowledge of healing plants.

Western science has allowed people to communicate their findings around the world and brought advances in medicine and other areas. However, Western science has often considered all new knowledge to be “advances” without examining the impacts of what has often



Redwood trees at Muir Woods National Monument, CA (Graton Rancheria, Me-Wuk (Coast Miwok), and Ohlone ancestral lands)

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Western Science (cont)

uncritically been considered progress. For instance, the invention of plastic allowed many modern conveniences, but has also created difficult environmental challenges. The use of coal and natural gases has warmed the planet, damaging the ecosystems humans rely on to live.

In contrast, Indigenous Science, or TEK, allows people to reflect on their relationship with the environment and strive to interact with it in a sustainable way. Indigenous communities have played a major role in shaping local ecosystems and creating and maintaining biodiversity. In this reciprocal relationship, Indigenous peoples harvest food, medicine, and materials from plant communities and animal populations while also taking care not to deplete the environment.

For example, Indigenous peoples in many areas of what is now California used fire to manage and care for the land; they burned the prairies which kept them open and served to maintain animal's habitats. This also allowed them to grow traditional plants that both humans and animals relied on for food. The practice of traditional burning has been brought back by community-led efforts in Indigenous communities in northwestern California.

The extent of climate change and environmental damage has led some Western-trained scientists to look toward TEK for solutions. Indigenous communities are also interested in the continuance of their TEK and cultural survival. Recently, there have been several successful collaborations between Western-trained scientists, Indigenous scientists with TEK and WEK training, and Indigenous communities that have worked to restore and protect our environment.



Left: Gulf of Mexico
(Akokisa, Karankawa, Atakapa
ancestral lands)

Right: Shoshone National Forest,
WY (Apsaalooké
(Crow), Cheyenne, and Očeti
Šakówiŋ ancestral land)

By Yinan Chen, Public Domain, <https://commons.wikimedia.org/w/index.php?curid=33638355>

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A collaboration between:



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With additional support
from many individuals.
(Please see webpage)

Find all TEK lessons at STEMTradingCards.org/TEKlessons
Also check out Science-Delivered.org

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Understanding "Passing Down Knowledge" from a Western Perspective

NOTE: TEK is a way of life and full of nuance and complexity. The analogy below is meant to make one aspect of TEK more accessible to a Western audience. However, please understand that TEK is much greater than the following analogy.



Cooking skills like barbecuing are passed down from generation to generation

An important aspect of TEK is the passing down of knowledge learned over generations. If you are someone who has grown-up and been educated in a Western system it may be challenging to shift your thinking and understand different “ways of knowing.” But Western culture also includes scientific knowledge passed down between generations; it is just not typically labeled “science.”

One example of this is cooking. Cooking, in fact, involves a substantial amount of science. How different foods or substances interact with heat, or pressure (e.g. kneading) or how they interact with each other is indeed a type of scientific knowledge, even if we usually don't think of it as such. For example, the water pasta is boiled in contains starch; many people use this pasta water in sauces to get a better consistency. This example includes a knowledge of chemistry and biology. Another example is people comparing different types of pans - what materials is a certain pan made from, does it heat evenly, or heat up quickly? Does it have a coating to prevent sticking? This is knowledge of materials science. And of course, anyone who gardens is using biology and agricultural science.

While there are cooking institutions where you can get certifications and degrees, cooking today is still passed down through generational knowledge. It would be absurd to claim only people who have attended cooking school are capable of being skilled chefs or of possessing deep knowledge on the science of food. In fact, schools and institutions are simply a “formalized” way to provide mentorship and pass down knowledge to younger members of a community.

While this is an imperfect analogy, thinking about how cooking knowledge is passed down

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Understanding "Passing Down Knowledge" from a Western Perspective

through generations might help people new to the concept of TEK understand one aspect of the culture: the intergenerational transfer of knowledge and the value of that knowledge.

Brief introduction to the Yurok Tribe

If you are interested in teaching about TEK and using this lesson, and are not in Yurok ancestral lands, please consider also learning the ancestral territory where your school is located and discussing this with students. You can use <https://native-land.ca/> to find this information.

The Yurok Tribe is a federally recognized tribe whose reservation is located in Humboldt and Del Norte counties in northwestern California. Prior to European colonization, Yurok people practiced a reciprocal relationship with the land, based on physical and spiritual management. Today, many Yurok people maintain their TEK and cultural traditions, such as in gathering and preparing traditional foods, ceremonial regalia making, participation in ceremonies, and language revitalization.

Does the information presented here apply to every Yurok individual?

Within the Yurok Tribe, as in all communities, perspectives are diverse. There are people who follow and practice their TEK devotedly, there are people who might practice it to a degree, and also there are people who might not practice it at all. Due to historical policies in the United States, not every Yurok person is culturally active. There have been many community-led efforts to revitalize TEK, allowing opportunities for individuals to reconnect with the culture. Further, as "TEK" is a term that came from outside the Yurok community, many Yurok people may not use or identify with the TEK label and rather see TEK as simply a "way of life."



Fish on sticks in Yurok country. Photo by Seafha Ramos

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Brief introduction to the Yurok Tribe (cont)

Yurok-Wildlife Relationship

Note: Yurok relationships with wildlife are deep and complex and this section provides only a simplified version of a rich culture and history.

In the Yurok worldview of TEK, Yurok people have a strong and sacred relationship with the environment, including animals. This relationship stems from creation stories where humans and animals were all in spiritual form. The purpose of Yurok people as part of this system is to maintain balance of the world. This involves management by both physical and spiritual means and is accomplished through their TEK, which can be described in the Yurok language as “hlkelonah ue megetohl” (“to take care of the earth”).

What is spiritual and physical management of the environment? Examples of “physical management” include the use of fire to keep the environment healthy (“fire ecology”) or harvesting plants. Examples of “spiritual management” can include participation in ceremonies, or singing or talking in the Yurok language.

It is important to understand that in Yurok TEK if the spiritual aspect is not considered then physical management is somewhat irrelevant, since spirituality is the foundation of everything. This is quite different from Western culture where science and religion or spirituality are typically kept in separate realms.

In addition to the spiritual aspect, Yurok people are also interested in practicing TEK and managing the land for “practical” reasons like survival and health. Yurok people who are practicing TEK aim to restore the biodiversity in their land and make the environment healthier.



Klamath River in Yurok country. Photo by Seafha Ramos

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Brief introduction to the Yurok Tribe (cont)

Yurok-Wildlife Relationship (cont)

It is important to them to understand and teach what can be taken from the earth (like foods or basket materials), how to maintain respect for animals, how and when to gather, hunt, and fish, and how to prepare traditional foods.

Another motivation of TEK outside of survival and spiritual reasons is to gain more knowledge and to learn about the Earth! This is how science is often described in Western culture.

An important component in Yurok TEK is that humans and animals, in a spiritual sense, are considered equal. All humans and animals have a purpose and animals are believed to have a spirit. Animals therefore hold a sacred place in Yurok culture, and many species are revered as important components of ceremonies. For example, traditional dance dresses and quivers are made from animal hides.

In the Yurok worldview, every item used for ceremony, such as those that come from animals, has a spirit. In that way, the items and animals participate in ceremony, where the spiritual and physical unite.

In the series of lessons included here, students learn about animals that are important to Yurok TEK.

TEK and Language

It is also relevant to note that there is no single equivalent word for “wildlife” in the Yurok language, but rather there are many different words or ways to describe it. This can make it a challenge to fully describe aspects of Yurok TEK in English!

As language is one of the ways people perceive the world, share knowledge, and express



Halos, worn in Yurok ceremonies, are made with porcupine quills.
Illustration by Melitta Jackson

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Brief introduction to the Yurok Tribe (cont)

TEK and Language (cont)

worldview, language is considered an important element of TEK. For example, in Dr. Seafha Ramos' research with the Yurok community, a cultural leader (and, therefore, TEK practitioner) shared, "It [TEK] is in the language." He then went on to discuss how the Yurok name for the river otter (nepe'weeshneg) translates to "fish eater." Understanding the ecosystem of the local area in the Native language, and then speaking and teaching that knowledge is one aspect of TEK. That is why language revitalization is critical to the survival of TEK. You will have an opportunity to share in this effort: we provide Yurok language in the lessons, and one of the focal animals is nepe'weeshneg! You can hear Yurok words, phrases and pronunciations at [The Yurok language dictionary](#).

(Very) Brief History of Western Science Wildlife Management

We have discussed the strong respect that is to be given to wildlife, nature, and the environment in the Yurok lens of TEK. Here we will discuss a little about Western wildlife management.

Western culture has had a more challenging relationship with nature. While many in the culture love and respect nature, there is also a culture of extracting resources which has created an environmental crisis. Environmental protections are currently, and have been in the past, hot-button issues.

Despite the depletion of resources that occurred during Western colonization, some Western scientists and environmentalists have made serious attempts to preserve and conserve the environment.

In 1905, the government of the United States established the National Forest Reserves which were designed to protect wildlife by keeping people out of the protected areas. In the 1930s, the study of wildlife management was set-up in the United States. Aldo Leopold is considered the father of this field and coined the term "wilderness." Leopold wanted the environment to be managed in a sustainable way, with balance and without human dominance of nature.

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(Very) Brief History of Western Science Wildlife Management (cont)

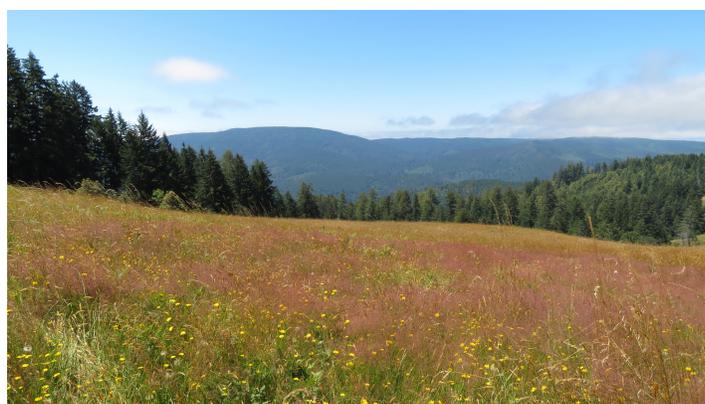
Unfortunately, when wildlife management was developed as a field, United States laws and policies were being enacted that were detrimental to Native peoples, leaving most opportunities open only to Western-trained science professionals, and did not incorporate or include the extensive Indigenous knowledge of how to sustainably manage wildlife.

Integrating TEK and Western Wildlife Management Practices Today

In recent decades Western scientists have become interested in incorporating TEK into Western wildlife management. This interest stems from the environmental challenges that have reached crisis level and the realization of the value of Indigenous knowledge in how to sustainably maintain ecosystems. However, collaboration has had its challenges due to differing philosophies between Western scientists and Indigenous communities including instances where Indigenous communities were consulted but not brought on as full partners in some projects.

For example, Indigenous communities and Western scientists might disagree on when it is appropriate to use certain common Western wildlife techniques such as tagging and collaring animals due to the stress these techniques cause to animals.

Despite these challenges, many successful projects have moved forward combining TEK and Western techniques. Some Indigenous scientists like Dr. Seafha Ramos, co-creator of this lesson, have used noninvasive techniques like collecting scat (feces) in order to do genetic analysis of animals. Similarly, researchers and tribes have worked together as full partners in several areas to do less invasive or noninvasive tracking of animals like bears, caribou, and moose. Indigenous scientists work to promote Western and TEK collaborations that consider and respect Indigenous values and culture.



Dr. Ramos studies animals in areas like the Bald Hills prairies ("Chulue" in Yurok), shown here. Her work is influenced by both TEK and WEK. Photo by Seafha Ramos.

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NGSS Scientific and Engineering Practices, Crosscutting Concepts and TEK

Traditionally in many schools across the United States, the scientific method was taught as a gold standard and foundation of science. However, many scientists felt the scientific method over-simplified and misrepresented the process of science. The Next Generation Science Standards (NGSS), adopted in many states, have replaced teaching of the “scientific method” with teaching “Scientific and Engineering Practices” (SEP). SEPs are a better representation of how many aspects of Western science and TEK are conducted. The “crosscutting concepts” of the NGSS especially have large overlap with TEK.

Much of NGSS is focused on observation, making science relevant to students, and solving real-world problems, aspects that are integral to TEK. SEPs like “Asking Questions and Defining Problems” and “Constructing Explanations and Designing Solutions” especially fit with TEK as do parts of many other SEPs. (We note TEK is less focused on systematic experiments, which is a prevalent part of the SEPs). All eight crosscutting concepts - “Patterns,” “Cause and Effect,” “Scale, Proportion and Quantity,” “Energy and Matter,” “Structure and Function,” “Stability and Change,” - are extremely relevant to and found within TEK.

NGSS Scientific and Engineering Practices, Crosscutting Concepts and TEK (cont)

Language used to describe TEK even mirrors language used to teach science through NGSS. For example, co-creator of this lesson Dr. Seafha Ramos wrote in her 2018 publication: “Explanations of many phenomena (emphasis ours) have been validated via a “massive set of scientific experiments continuing over generations” ¹by people whose survival depended on correct interpretations of observations, such as migratory patterns of wildlife and seasonal changes.” ² Indeed one of the foundational elements of NGSS is students making sense of observed phenomena.



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Please enjoy the lessons!

We hope you and your students enjoy this series of lessons and learn a lot from them. If you have questions about TEK or implementing the lessons contact Dr. Olivia Mullins from Science Delivered at omullins@science-delivered.org and she will do her best to consult where needed and find answers to your questions.

References

1. Kawagley et al. (1998) The indigenous worldview of Yupiaq culture: its scientific nature and relevance to the practice of teaching of science. *Journal of Research in Science Teaching*. Vol 35,pg 133-144
2. Ramos (2018) Considerations for Culturally Sensitive Traditional Ecological Knowledge Research in Wildlife Conservation. *Wildlife Society Bulletin*. Vol 42, pg 358-364