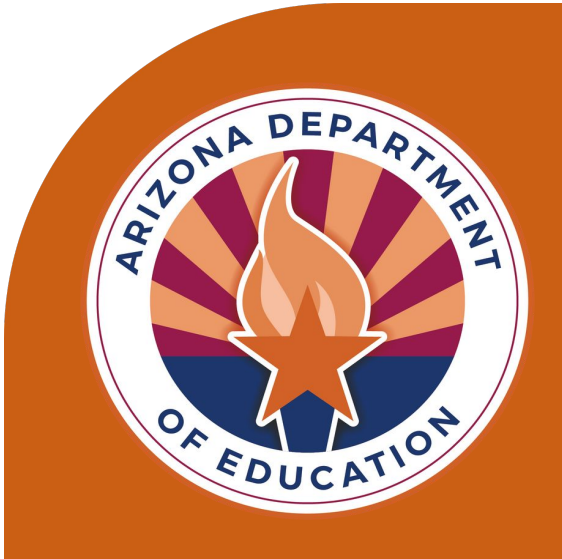
# Rooted in Place

## Elevating Local Phenomenon and Indigenous Knowledge into Science Education

OIE Connect Webinar
November 9, 2026



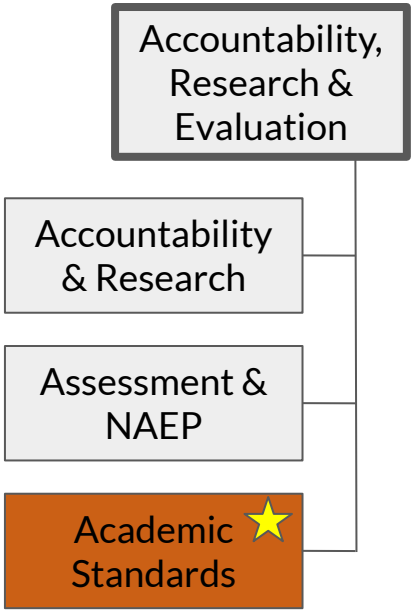
# Presenter



## Johanna Kaiser

K-12 Science
Education Specialist

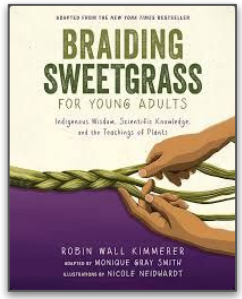
Arizona Department of
Education,
Academic Standards



# TODAY

## GOALS

- Understand the role of phenomena in Arizona Science Standards and science sensemaking.
- Strengthen educators' confidence in grounding instructional units in phenomena informed by Indigenous ways of knowing.
- Discover resources to expand your knowledge and classroom practice.



# What are Science Phenomena?

# What are phenomena?

**Natural phenomena are observable events that occur in the universe and that we can use our science knowledge to explain or predict.**

(STEM Teaching Tool 42, 2016)

# What are phenomena?



Shellfish are dying.



A soccer ball curves around a wall of players.



You can read through some covers, but not others.



Corn sprouting after it has been harvested.



The sky changes colors at sunrise and sunset.

# Physics Phenomenon



Why do the city lights farther from Camelback Mountain appear to twinkle while the closer city lights do not appear to twinkle?

# Good Phenomena:

- ✓ Spark curiosity and wonder
- ✓ Address the standards(s)
- ✓ Can be investigated
- ✓ Aren't always phenomenal






# AzSS Snapshot: What Students Are "Doing," "Thinking," "Knowing," and "Using" in Science

## Dimension 1: Science and Engineering Practices
*The actions students perform in science.*

**DO**

1. Asking questions and defining problems (p. 54)*
2. Developing and using models (p. 56)*
3. Planning and carrying out investigations (p. 59)*
4. Analyzing and interpreting data (p. 61)*
5. Using mathematics and computational thinking (p. 64)*
6. Constructing explanations and designing solutions (p. 67)*
7. Engaging in argument from evidence (p. 71)*
8. Obtaining, evaluating, and communicating information (p. 74)*

## Dimension 2: Crosscutting Concepts
*The unifying ideas across science disciplines.*

**THINK**

1. Patterns (p. 85)*
2. Cause and effect (p. 87)*
3. Scale, proportion, and quantity (p. 89)*
4. Systems and system models (p. 91)*
5. Energy and matter (p. 94)*
6. Structure and function (p. 96)*
7. Stability and change (p. 98)*

## Dimension 3: Core Ideas of Knowing Science and Core Ideas of Using Science

### Knowing Science
*The fundamental ideas within science disciplines.*

**KNOW**

**Physical Science (p. 105)***
**P1:** All matter in the Universe is made of very small particles. (p. 20)**
**P2:** Objects can affect other objects at a distance. (p. 21)**
**P3:** Changing the movement of an object requires a net force to be acting on it. (p. 22)**
**P4:** The total amount of energy in a closed system is always the same but can be transferred from one energy store to another during an event. (p. 23)**

**Earth and Space Science (p. 171)***
**E1:** The composition of the Earth and its atmosphere and the natural and human processes occurring within them shape the Earth's surface and its climate. (p. 24)**
**E2:** The Earth and our solar system are a very small part of one of many galaxies within the Universe. (p. 25)**

**Life Science (p. 142)***
**L1:** Organisms are organized on a cellular basis and have a finite life span. (p. 26)**
**L2:** Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms. (p. 27)**
**L3:** Genetic information is passed down from one generation of organisms to another. (p. 28)**
**L4:** The unity and diversity of organisms, living and extinct, is the result of evolution. (p. 29)*

### Using Science
*The application of science and engineering.*

**USE**

**U1:** Scientists explain phenomena using evidence obtained from observations and or scientific investigations. Evidence may lead to developing models and or theories to make sense of phenomena. As new evidence is discovered, models and theories can be revised. (p.30 & 31)**

**U2:** The knowledge produced by science is used in engineering and technologies to solve problems and/or create products. (p.32)**

**U3:** Applications of science often have ethical, social, economic, and/or political implications. (p. 23)**

**A Framework for K-12 Science Education, 2011* ***Working with Big Ideas of Science Education, 2015*

Updated May 2025

## Dimension 3: Core Ideas of Knowing Science and Core Ideas of Using Science

**Knowing Scien**
***The fundamental ideas within sc***

**Using Science**
***The application of science and engineering.***

**USE**

**U1:** Scientists explain phenomena using evidence obtained from observations and or scientific investigations. Evidence may lead to developing models and or theories to make sense of phenomena. As new evidence is discovered, models and theories can be revised. (p.30 & 31)**

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| **U1**: Scientists explain **phenomena** using evidence obtained from observations and or scientific investigations. Evidence may lead to developing models and or theories to make sense of phenomena. As new evidence is discovered, models and theories can be revised. | **U2**: The knowledge produced by science is used in **engineering** and technologies to solve problems and/or create products. | **U3**: Applications of science often have ethical, social, economic, and political **implications.** |
|---|---|---|
| **Kindergarten - 7**<br>**1st Grade - 8**<br>**2nd Grade - 8**<br><br>**3rd Grade - 8**<br>**4th Grade - 8**<br>**5th Grade - 9**<br><br>**6th Grade - 11**<br>**7th Grade - 11**<br>**8th Grade - 8**<br><br>**HS Physical Science - 7 Essential, 13 Plus**<br>**HS Earth & Space Science - 6 Essential, 13 Plus**<br>**HS Life Science - 8 Essential, 14 Plus**<br><br>**139** | **Kindergarten - 1**<br>**1st Grade - 2**<br>**2nd Grade - 1**<br><br>**3rd Grade - 0**<br>**4th Grade - 1**<br>**5th Grade - 1**<br><br>**6th Grade - 1**<br>**7th Grade - 1**<br>**8th Grade - 1**<br><br>**HS Physical Science - 1 Essential, 2 Plus**<br>**HS Earth & Space Science - 0 Essential, 1 Plus**<br>**HS Life Science - 0 Essential, 0 Plus**<br><br>**13** | **Kindergarten - 0**<br>**1st Grade - 1**<br>**2nd Grade - 1**<br><br>**3rd Grade - 0**<br>**4th Grade - 2**<br>**5th Grade - 2**<br><br>**6th Grade - 2**<br>**7th Grade - 0**<br>**8th Grade - 3**<br><br>**HS Physical Science - 2 Essential, 1 Plus**<br>**HS Earth & Space Science - 1 Essential, 3 Plus**<br>**HS Life Science - 3 Essential, 0 Plus**<br><br>**21** |

**Phenomenon is not just an instructional strategy.**

**Making sense of phenomena is at the HEART of the AZSS.**

FROM
***learning about***
*TO*
***figuring out***

# Meaningful Phenomena

**Everyday phenomena**: which all students will be able to experience in class or have experienced outside of class

**Contemporary scientific phenomena:** which relate to current science, most often science that is in the news today because it is unsettled or sparks controversy

**Societally relevant phenomena**: which relate to science-technology intersections, connects to care and concern and enables students to see connections to social and socio-ecological justice

**Culturally relevant phenomena:** which are grounded in the worlds of specific communities in culturally significant ways and allows students to draw on ways of knowing from families and cultural communities.

Suárez & Bell, 2019

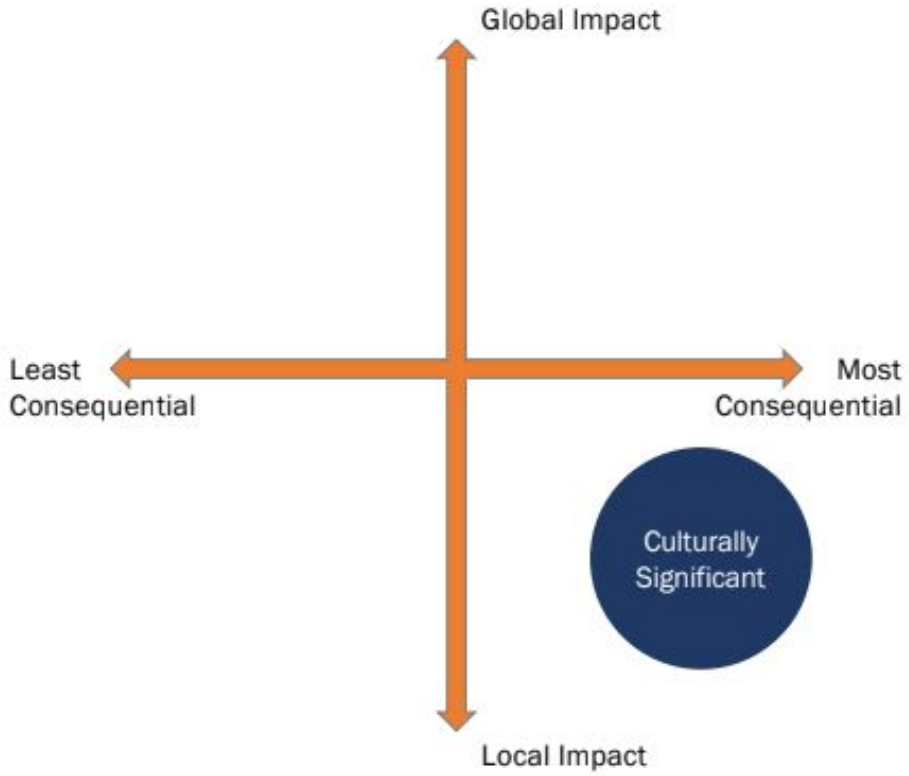
# Culturally Significant Phenomena

1. Grounded within the **practices and lifeworlds** of specific communities

2. Significant **social gravity**

3. Opportunities for **cultural thriving** to members of the community

4. Support through engaging in familiar **ways of knowing, being, and valuing**




Suárez & Bell, 2019

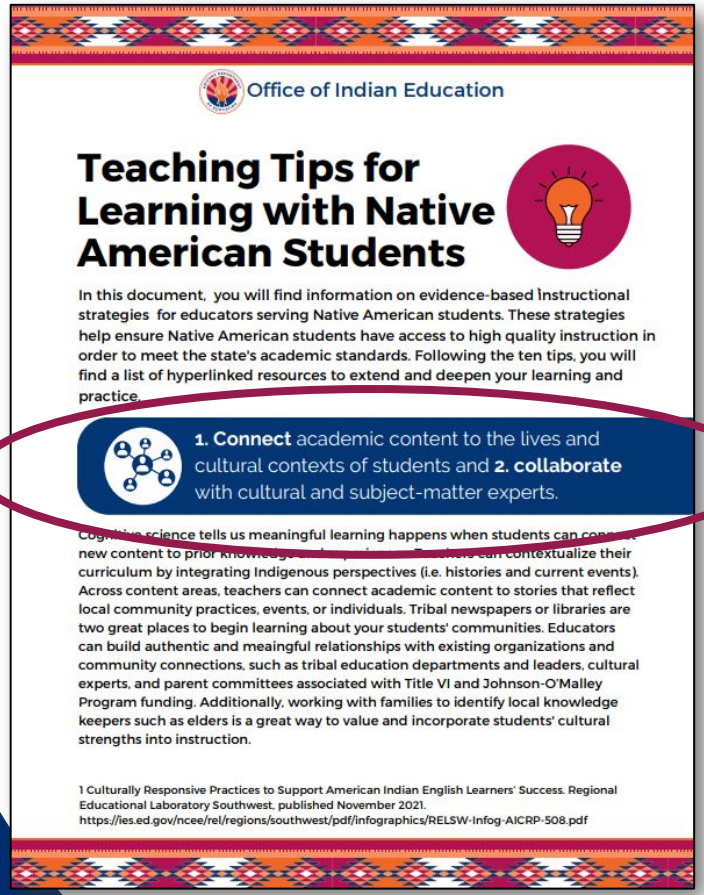
# Processing Pause



## In the chat…

In your own words, what is a scientific phenomenon?

# Why Local Phenomena?
# Why Indigenous Phenomena?



Office of Indian Education

# Teaching Tips for Learning with Native American Students

In this document, you will find information on evidence-based instructional strategies for educators serving Native American students. These strategies help ensure Native American students have access to high quality instruction in order to meet the state's academic standards. Following the ten tips, you will find a list of hyperlinked resources to extend and deepen your learning and practice.

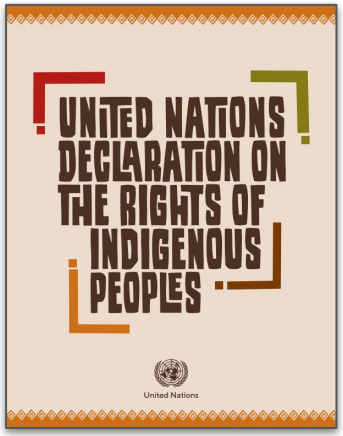
**1. Connect** academic content to the lives and cultural contexts of students and **2. collaborate** with cultural and subject-matter experts.

Cognitive science tells us meaningful learning happens when students can connect new content to prior knowledge and experiences. Teachers can contextualize their curriculum by integrating Indigenous perspectives (i.e. histories and current events). Across content areas, teachers can connect academic content to stories that reflect local community practices, events, or individuals. Tribal newspapers or libraries are two great places to begin learning about your students' communities. Educators can build authentic and meaingful relationships with existing organizations and community connections, such as tribal education departments and leaders, cultural experts, and parent committees associated with Title VI and Johnson-O'Malley Program funding. Additionally, working with families to identify local knowledge keepers such as elders is a great way to value and incorporate students' cultural strengths into instruction.

1 Culturally Responsive Practices to Support American Indian English Learners' Success. Regional Educational Laboratory Southwest, published November 2021. https://ies.ed.gov/ncee/rel/regions/southwest/pdf/infographics/RELSW-Infog-AICRP-508.pdf

*Meaningful learning happens when students can connect new content to prior knowledge and experiences. Teachers can contextualize their curriculum by integrating Indigenous perspectives (i.e. histories and current events). Across content areas, teachers can connect academic content to stories that reflect local community practices, events, or individuals* (ADE OIE, 2023, p. 1).

# Why Indigenous Phenomena?




**Article 15**

1. Indigenous peoples have the right to the dignity and diversity of their cultures, traditions, histories and aspirations which shall be appropriately reflected in education and public information.



**A.R.S. § 15-244**

Duties of OIE include: "Provide technical assistance to schools and Indian nations to develop culturally appropriate curricula and instructional materials."

**6.L2U1.13**

Develop and use models to demonstrate the interdependence of organisms and their environment including biotic and abiotic factors.

## Standards

What a student needs to know, understand, and be able to do by the end of each grade. Standards build across grade levels in a progression of increasing understanding and through a range of cognitive demand levels. Standards are adopted at the state level by the State Board of Education.

## Curriculum

The resources used for teaching and learning the standards. Curricula are adopted at a local level by LEAs, districts and schools.

## Instruction

The methods used by teachers to teach their students. Instructional techniques are employed by individual teachers in response to the needs of the students in their classes to help them progress through the curriculum in order to master the standards.

**PHENOMENA**




**“Because sometimes I feel, as an educator, really constrained by, well, maybe by the standards or curriculum elements, right? I have to meet all of these goals.**

**But you know what? I don’t have to do it with the same tired examples that every other biology faculty member in the world is teaching.”**

Dr. Robin Wall Kimmerer

ADE’s ISP Professional’s Panel


Indigenous Knowledge
Western Science

# Saw this the other day…

## DID YOU KNOW

Roughly 60% of the world's food supply can be attributed to Native American agricultural practices.



# Case Study

## The Salt Water Plant Experiment

An elementary school girl in Hawai‘i participated in a science fair and entered her science experiment on the conditions needed to support plant growth. As the result of climate change, ocean salt water is intruding into areas where native crops are grown in her community. She did a controlled comparison showing how taro plants respond to different concentrations of salt water. She received a low score from judges because she used a small number of taro plant samples. However, taro plants are sacred to her as ancestors and living relations of her Native Hawaiian cultural community, so she tried to minimize the number of taro plants that would be injured in her science experiment. She thought the sample size was adequate.




Bell, P., Bang, M., Suárez, E., Morrison, D., Tesoriero, G. & Kaupp, L. (2019). *Learning to See the Resources Students Bring to Sense-Making*. [OER Professional Development Session from the ACESSE Project] Retrieved from http://stemteachingtools.org/pd/sessiong

# Case Study Reflection

**Identifying Strengths**

- What does this student understand about her community that others might not?
- What scientific and cultural considerations influence her choices?




**Examining Assumptions**

- What assumptions might the judges have made about what constitutes a ‘good’ investigation?
- How might different worldviews lead to different research decisions?

**Valuing Multiple Ways of Knowing**

- How might we honor both scientific inquiry and cultural values in this situation?
- How can science learning make space for ethical and cultural decision-making?

Whose knowledge, values, and decision-making count in science learning?

**Elevating Indigenous Knowledge**

- What cultural knowledge informed this student's scientific investigation?
- In what ways does the student's relationship with taro differ from viewing it as simply a research specimen?

“Accurately understanding and exploring (rather than judging or ignoring) students’ thinking in cultural context is a foundation for excellent teaching- especially when students’ cultures and ways of knowing differ from their educators’” (Conrad, 2022, p. 7).

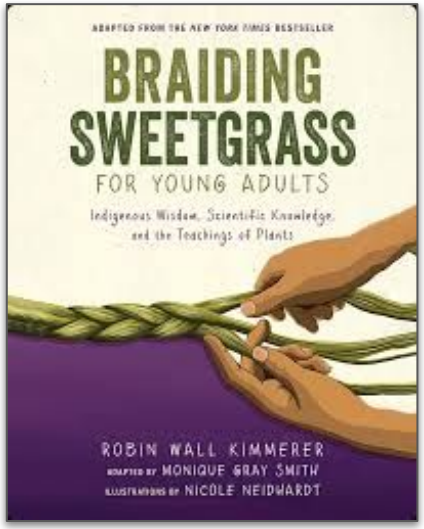
Conrad, J. (2022). *Supporting non-Native educators with Since Time Immemorial. In R. Efird & L. Lynn (Eds.), Indigenous perspectives and environmental education: Connecting youth with plants, places, and cultural traditions (pp. 7-9). CLEARING: Resources for Place-Based Environmental Education in the Pacific Northwest.* https://clearingmagazine.org/wp-content/uploads/2022/09/CLEARINGsummer22Full-1.pdf

# Resources

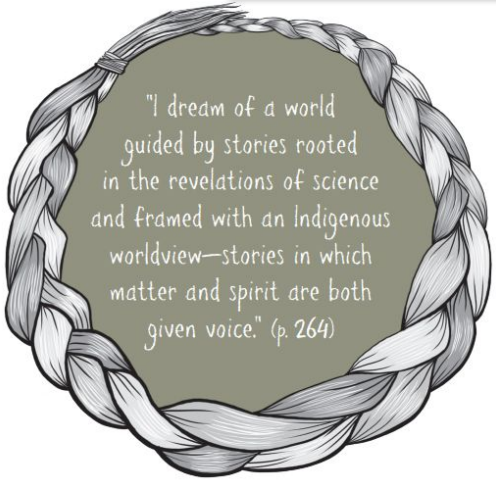
# Braiding Sweetgrass

***Braiding Sweetgrass for Young Adults: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants***

By Dr. Robin Wall Kimmerer
Adapted for young adults by Monique Gray Smith




- Place-Based Phenomena
- Localizing Knowledge & Learning
- Centering Indigenous Ways of Knowing in Science Instruction



Indigenous STEAM

https://indigenoussteam.org/

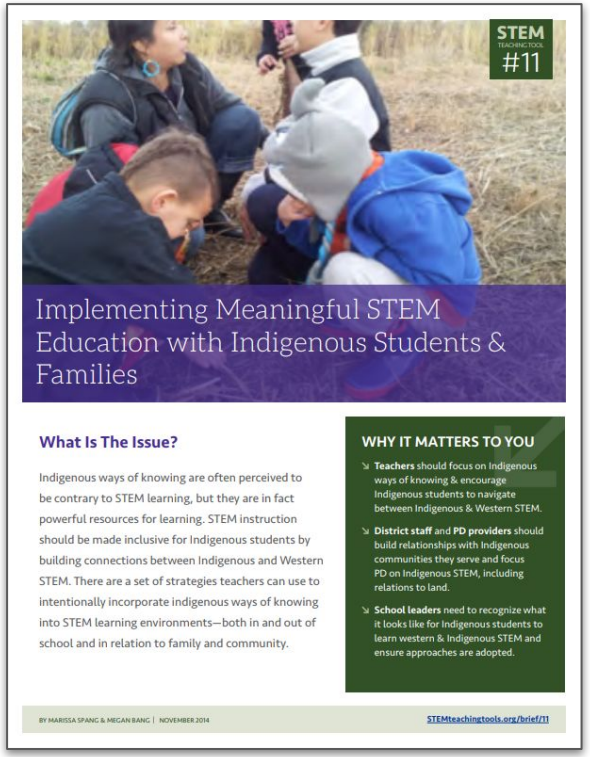
The Indigenous STEAM Collaborative co-designs, implements, and shares land based educational materials developed in collaboration with families, communities, and educators and research. We foreground Indigenous knowledge systems – roles, relations, responsibilities, and gifts between and within human and other-than-human communities – and intergenerational arrangements in teaching and learning. These materials are intended to contribute to creating the conditions for collective thriving and deliberately support generative navigation, as distinct from historically powered, between and amongst different ways of knowing. This includes practices and organization of activities that assume learners make sense of the multiplicities of Indigenous Knowledge systems they are tasked to learn and continue – not an erasing or reduction to a singular view of Indigenous knowledge systems.

ARIZONA DEPARTMENT OF EDUCATION



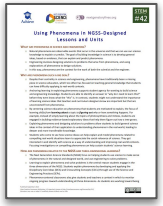
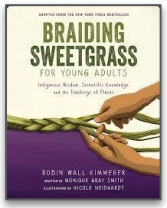
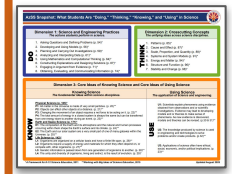

STEM Teaching Tool #10:

[Teaching STEM In Ways that Respect and Build Upon Indigenous Peoples' Rights]




STEM Teaching Tool #11:

[Implementing Meaningful STEM Education with Indigenous Students & Families]

| Image | Resource Citation and Link (if available) |
| --- | --- |
|  | Efird, R., & Lynn, L. (Eds.). (2022). I*ndigenous perspectives and environmental education: Connecting youth with plants, places, and cultural traditions. CLEARING: Resources for Place-Based Environmental Education in the Pacific Northwest. Creative Educational Networks.* ttps://clearingmagazine.org/wp-content/uploads/2022/09/CLEARINGsummer22Full-1.pdf |
|  | STEM Teaching Tools. (2016, September). *Using phenomena in NGSS-designed lessons and units (STEM Teaching Tool No. 42)*. University of Washington. https://stemteachingtools.org/assets/landscapes/STEM-Teaching-Tool-42_Using_Phenomena_in_NGSS_23.pdf |
|  | Kimmerer, R. W. (2022). B*raiding sweetgrass for young adults: Indigenous wisdom, scientific knowledge, and the teachings of plants* (M. Gray Smith, Adapt.). Zest Books. |
|  | Arizona Science Standards AZSS Snapshot https://www.azed.gov/sites/default/files/2025/05/AZSS%20Snapshot%20%20-%20%20Updated%20May%202025v2.pdf |

# Questions?

Reach out.

Johanna.Kaiser@azed.gov