Indigenous Foods Teaching Toolbox

This toolbox was created through a grant by the Natural History Museum in partnership with Utah Diné Bikéyah, Red Butte Garden and the Native American Agriculture Fund.

To find all of the links associated with the lessons in the box please visit:
www.nhmu.utah.edu/educators/teaching-toolboxes/indigenousfood/teacher

The specimens in this Teaching Toolbox can be handled and touched by teachers and students, so long as these actions are done with great care. We work hard to find and collect the best specimens available, so please treat the items respectfully. This Toolbox will reach hundreds of students throughout the course of the school year, and while we will do our best to see that all the resources remain in top shape, we need your help with their care, too. We ask you to please make sure the materials are returned to the Box in a way that you yourself would like to receive them.

We hope you and your students enjoy using this resource! Please feel free to photocopy any resources and bookmark the teacher webpage to return to later.

If you have any questions, please contact the Teaching Toolbox Team at the Natural History Museum of Utah.
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To see other Teaching Toolboxes available for check-out, please visit:
http://www.nhmu.utah.edu/educators/teaching-toolboxes

NATIVE AMERICAN AGRICULTURE FUND

UTAH DINE BIKEYAH

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THE UNIVERSITY OF UTAH

THE CURRICULUM

How to Best Use It

This curriculum is divided into three main parts titled Potato Biology, Food Sovereignty, and Deep History. While teachers are welcome to pick and choose individual lessons from this curriculum, each part includes a series of lessons that are designed to follow a meaningful storyline when used all together. Therefore, at a minimum, we recommend that teachers use the lesson titled **Introducing the Four Corners Potato** followed by the series of lessons in at least one of the three parts.

The Standards

This curriculum is aligned to meet some of Utah's SEEd standards and history standards for High School Grades. While we did not provide English standards connections, many parts of this curriculum would lend themselves to the English classroom.

Interdisciplinary in Nature

Since lessons within this curriculum connect to the history, science, and English standards, this curriculum, as a whole, is interdisciplinary in nature. Therefore, it would be extremely beneficial for students if taught within an interdisciplinary or integrated setting. As a result, we encourage Utah's history, science, and English teachers to collaborate in order to get the most out of the lessons offered.

FOUR CORNERS POTATO

Lesson #1: *Introducing the Four Corners Potato*

Purpose
To introduce students to the Four Corners Potato and the related research.

Time Required: About 1 hour

Materials Needed
A computer/projector for showing **University of Utah's** film titled **Four Corners Potato**, highlighters or pens, and 1 copy per student of the **Conserving Traditions of the Four Corners Potato** handout. Alternatively, feel free to replace the handout with any of the articles provided under the **Additional Resources** heading (courtesy of Lisbeth Louderback and Bruce Pavlik).

Directions

1. Tell students that this curriculum is centered around a little, but mighty potato called the Four Corners Potato. Their goal in this lesson is to learn about this potato, *Solanum jamesii*, and the ongoing research that connects to it.
2. Pass out a copy of the **Conserving Traditions of the Four Corners Potato** handout (or different article of your choice from under the **Additional Resources** heading) to each student and have them pull out highlighters or a pen for highlighting parts of the text.
3. To capture the essence of this text with students and to see what details capture your students' interest, plan to use the following adaptation of the **Word-Phrase-Sentence** visible thinking routine from the Harvard Graduate School of Education. Using a routine like this can help students better capture the essence of a text and facilitate a productive discussion. Additionally, in this routine, teachers are encouraged to participate along with their students.
4. First, have your students read the text (15-20 minutes). Encourage active reading and highlighting. Also, be sure to tell students what they may quietly work on if they finish the reading before other students.
5. Once all students have finished reading the text, give them 10 minutes to review the text and select:
    a. A **word** that captured your attention or struck you as powerful.
    b. A **phrase** that moved, engaged, or provoked you.

    c. A **sentence** that was meaningful to you, that you felt captures the core idea of the text.
6. In groups of 4 to 6, ask students to share and record their choices, explaining why they selected them (10 minutes). Sharing and discussion should occur in rounds, so the discussion is facilitated. The first participant shares a word and explains why she chose it, inviting others to comment and discuss. The word is recorded and then the next person shares, records, and discusses until everyone has their turn. The group then moves to phrases and finally to sentences.
7. Once everyone has shared all of their selections, each group should assign a recorder and work together to answer the following questions (10 minutes):
    a. *What common themes are emerging from the group's responses?*
    b. *Are important parts of the text not represented? If so, why do you think this is?*
8. Finally, share the thinking with the whole class (10 minutes). Post documentation from all the groups around the room. Allow students time to quietly walk around and view the sentences, phrases, and words chosen and the themes and conclusions drawn. Invite each group member to reflect briefly on his or her current understanding of the text and how using the routine contributed to his or her understanding of it.
9. Next, tell students that they will get to watch a short, 6 minute introductory **Four Corners Potato** video that was put together by the **University of Utah**.
10. Watch the video and allow time for students to ask questions or make comments at the end. Depending on which lessons you plan to do with your class, you may want to leave some of their questions unanswered so that they can discover the answers on their own as they work through the other lessons.

Additional Resources

Bitsoi, Alastair. "Tiny Tuber 'Rematriated' to Indigenous Farmers." *Navajo Times*, 27 May 2021, navajotimes.com/ae/culture/tiny-tuber-rematriated-to-indigenous-farmers.

Gulliford, Andrew. "On the Trail of Tiny Tubers: Four Corners Potato a Staple of Native American Diets." *Durango Herald*, 11 Jan. 2020, www.durangoherald.com/articles/on-the-trail-of-tiny-tubers-four-corners-potato-a-staple-of-native-american-diets.

Maxwell, Amiee. "How a Potato Is Fueling the Fight to Protect a National Monument." *Atlas Obscura*, 2 Mar. 2020, www.atlasobscura.com/articles/four-corners-potato.

Works Cited

"Four Corners Potato." *YouTube*, uploaded by University of Utah, 3 July 2017, www.youtube.com/watch?v=sMCIutu4d68.

"Word-Phrase-Sentence." *Project Zero*, Harvard Graduate School of Education, 2019, www.pz.harvard.edu/sites/default/files/Word-Phrase-Sentence.pdf.

POTATO BIOLOGY

Overview of Lessons

The goal of the lessons that follow are two-fold; to introduce and empower the Native American ways of knowing and relating to plants, and to help students learn the necessary basics about potato plant biology. To start with, students will explore Native American plant knowledge and relationships through oral histories, traditions, and familial expertise. Additionally, they will be encouraged to expand their own relationship with plants through artistic expression and reflective practices. Following this, the remaining lessons take a more Western science approach and help students build their plant knowledge so that they can better understand the biological features that make the Four Corners Potato such a special plant. With this foundation of Native American and Western science knowledge, students will be well prepared to tackle the next topics covered in this curriculum.

ENGAGE

Native American Ways of Knowing and Relating to Plants

Target Grade Levels	9th - 12th (can be adapted for grades 6th-8th)
Essential Understanding	To develop an awareness of and appreciation for indigenous ways of knowing and relating to plants.

Alignment to Utah's Core State Standards for Social Studies

UT Strand 1: NATIVE INNOVATIONS AND ADAPTATIONS
UT Standard 1.4: Students will analyze primary and secondary sources to explain causes and effects of European-American exploration, including the response and involvement of Utah's American Indian tribes. (history)
UT Strand 4: UTAH IN THE WORLD
UT Standard 4.4: Students will use data and other evidence related to a cultural, ethnic, or religious group in Utah to interpret the group's historic/current conditions and experiences. (history, geography)

Section Overview

Following a brief introduction to the Four Corners Potato, this series of lessons is designed to get students thinking about Native American ways of knowing and relating to plants. Students will begin by exploring their own relationship with plants. Next, they will read from the Native Plant Stories book to highlight some of the ways indigenous peoples have known and related to plants. Students will then watch video footage of Arnold Clifford, a Navajo botanist, to deepen their understanding and appreciation for indigenous plant knowledge and relationships. Last, but not least, students will either create art using plant materials or take time to reflect in the presence of a chosen plant to help them connect on a deeper level with the beauty and spirit of plants.

Lesson #1: Our Relationship with Plants

Purpose
To reflect on how we interact with and depend on plants.

Time Required
50 minutes

Materials
Paper, pencil, clipboard or notebook, whiteboard or several pieces of poster paper, whiteboard markers, and 2 sticky notes per student.

Directions for Think, Pair, Share

1. Tell students that they are going to reflect on their current relationship with plants.
2. **THINK** - Instruct students to reflect silently, without talking or writing, as you display the following question on the board or projector:

   How do you interact with and use plants?

   Tell students that they will now have 10-15 minutes to silently write as many ideas as they can think of to respond to this question. Some students may need several minutes to sit with this question before they feel ready to write. However, if you notice students struggling to think of what to write, you can try prompting them with additional questions such as the following:

   What are some of the things your family does with plants? When do you notice the presence of plants? What resources do you use that come from plants? When do you see, touch, or hear plants?
3. **PAIR** - Tell students that they will now have 10-15 minutes to discuss their ideas with a partner. Have each student share their ideas with their partner. Next, instruct the partners to circle any ideas that are unique to each of their lists. Finally, ask students to spend any remaining time together brainstorming additional ideas to add to their lists.
4. **SHARE** - Give each student 2 sticky notes (or more if desired). Ask them to take 5 minutes to write the following on each of their sticky notes (each sticky note should have a different connection on it):
   a. Their favorite plant connection from their own list.
   b. A plant connection from either list that they think other people might not have thought about.

   Next, have students place their sticky notes on a whiteboard or on pieces of poster paper. Be sure to have them spread out the sticky notes so that they will

have room to walk around the room and view each other's comments. Give students 10 minutes to do a silent gallery walk where they walk around the room reading each other's sticky notes and responding to them. To give this more structure, you could divide the room into areas and have students rotate every 2-3 minutes to a new area. Help students respond appropriately to the ideas of others by instructing them to do the following for each idea shared on the sticky notes:
    a. Put a star on ideas they had not yet heard.
    b. Add a plus sign to ideas they also thought of and agreed with.
    c. Ask a question about the idea below the sticky note using a pencil or whiteboard marker.
5. Come back together as a whole class and discuss some of the observations the students made about each other's ideas. Consider discussing the following questions:
    a. *What plant connections appeared to be the strongest or most obvious for students?*
    b. *What plant connections surprised students?*
    c. *What plant connections elicited questions from students and why?*
6. To hammer home how much we all rely on plants, share the following statistics about medicinal plants from the **Medicinal Plants at Risk** document published by the **Center for Biological Diversity** (Roberson):
    a. *Worldwide, between 50,000 and 80,000 flowering plants are used medicinally (IUCN Species Survival Commission, 2007; Marinelli, 2005). In the United States, of the top 150 prescription drugs, at least 118 are based on natural sources: 74 percent come from plants, 18 percent from fungi, 5 percent from bacteria, and 3 percent from vertebrate species such as snakes or frogs (Ecology Society of America, 1997).*
    b. *Plant-derived anti-cancer drugs such as taxol, first isolated from the Pacific yew, save at least 30,000 lives per year in the United States (Daily, 1997).*
    c. *Many indigenous and local communities are immense reservoirs of traditional knowledge that can benefit biotechnology, agriculture, pharmaceutical development, and health care.*
7. You could also share this list that explains some of the many ways we use plants inside and outside of the home (Royal Horticultural Society):
    a. *Buildings - all houses in the UK and many around the world use wood, whether in the framework, floors, doors, windows, skirting boards, roofs, etc. It will be mostly softwood grown in managed forests.*
    b. *Furniture - hardwoods and softwoods of all kinds are used for kitchen cabinets, tables, chairs, wardrobes and much more. Plant stems are also used, such as willow, bamboo and rushes.*

c. *Floor coverings - can be made from wood, cork, coconut fibre, jute, viscose, linoleum and sisal, to name but a few.*
d. *Wall coverings - plant ingredients are vital for both wallpaper and household paint. Linseed, soya beans, pine resin and wood pulp are all used.*
e. *Writing and drawing - paper, inks, paints, pencils and erasers are just a few of the items we use to draw and write with that are made from plants and plant extracts.*
f. *Medicine - plants have long been used for their natural healing properties. Many are still used in modern medicines today. For example; the leaves of the foxglove contain a substance that is used to treat heart conditions. In correct doses, it helps the heart to beat more slowly and strongly. Large doses are likely to be fatal.*
g. *Many plant derivatives are used in their natural states, such as evening primrose oil, echinacea, castor oil, aloe vera, ginseng, chamomile and garlic.Plants are also used in the production of bandages (cotton), antiseptics (tea tree oil)and plasters (cotton).*
h. *The bark of willows has given us acetylsalicylic acid, which led to the creation of aspirin, the commonly used painkiller.*
i. *Plants use energy from the sun to make food, which is the start of every food chain. Without plants, therefore, there would be no animals and no people.*

Works Cited

Roberson, Emily. “Medicinal Plants at Risk.” *Biological Diversity*, Center for Biological Diversity, May 2008, www.biologicaldiversity.org/publications/papers/Medicinal_Plants_042008_lores.pdf.

Royal Horticultural Society. “Plants in Our Daily Life.” *RHS Campaign for School Gardening*, Royal Horticultural Society, 2015, https://schoolgardening.rhs.org.uk/resources/Info-Sheet/Plants-in-our-daily-life.

Lesson #2: *Native Plant Stories*

Purpose
To develop awareness around indigenous ways of knowing and relating to plants.

Time Required
60 minutes for ***Listen to the Plants***
60 minutes for ***Blue Dawn***

Materials
Paper for notetaking, pencils, highlighters, and 1 copy per student of the ***Listen to the Plants*** (Bruchac xix-xxv) and ***Blue Dawn*** texts (Bruchac 51-58) from the **Native Plant Stories** book.

Directions - *Listen to the Plants*

1. To capture the essence of this text with students, plan to use the following adaptation of the **Word-Phrase-Sentence Visible Thinking Routine** from the **Harvard Graduate School of Education** (Project Zero). Using a thinking routine like this can help students better capture the essence of a text and facilitate a productive discussion. Additionally, in this routine, teachers are encouraged to participate along with their students.
2. First, have your students read the ***Listen to the Plants*** text (15-20 minutes) from **Native Plant Stories** book (Bruchac xix-xxv). Encourage active reading and highlighting. Also, be sure to tell students what they may quietly work on if they finish the reading before other students.
3. Once all students have finished reading the text, give them 10 minutes to review the text and select:
    a. A **word** that captured your attention or struck you as powerful.
    b. A **phrase** that moved, engaged, or provoked you.
    c. A **sentence** that was meaningful to you, that you felt captures the core idea of the text.
4. In groups of 4 to 6, ask students to share and record their choices, explaining why they selected them (10 minutes). Sharing and discussion should occur in rounds, so the discussion is facilitated. The first participant shares a word and explains why she chose it, inviting others to comment and discuss. The word is recorded and then the next person shares, records, and discusses until everyone has their turn. The group then moves to phrases and finally to sentences.

5. Once everyone has shared all of their selections, each group should assign a recorder and work together to answer the following questions (10 minutes):
    a. What common themes are emerging from the group's responses?
    b. Are important parts of the text not represented? If so, why do you think this is?
6. Finally, share the thinking with the whole class (10 minutes). Post documentation from all the groups around the room. Allow students time to quietly walk around and view the sentences, phrases, and words chosen and the themes and conclusions drawn. Invite each group member to reflect briefly on his or her current understanding of the text and how using the routine contributed to his or her understanding of it.

Directions - *Blue Dawn*

1. Next, have students read the ***Blue Dawn*** Pueblo Isleta legend using the **Listening Triads** strategy from the **During Reading** section of the **SERP Institute's Reading to Learn Science** webpage (Bruchac 51-58) (Strategic Education Research Partnership). Think about how you want to divide up the reading into sections so that every student gets a turn or two serving in each of the 3 roles (questioner, explainer, recorder). Here are the directions they give for **Listening Triads**:
    a. Listening triads are an easy strategy for structuring small group reading and discussion. They give students practice in active listening and monitoring their own comprehension as they read.
    b. Divide students into groups of three and give them a text to read. During or after reading the text, the members of each group discuss and build understanding of the meaning of the text by acting out three roles: those of questioner, explainer, and recorder.
    c. The **questioner** asks questions about the text. For example:
        i. What does that mean?
        ii. Why do you think that is?
        iii. Can you explain what's similar/different about _____?
    d. The **explainer** uses the text to attempt to answer the questions. For example:
        i. I think it means that...
        ii. I think what the text says is true/false because...
        iii. This is similar to/different from _____ because…
    e. The **recorder** keeps the group on-task and records notes on the questions and their answers.
    f. The students can rotate between roles periodically (for example, every three minutes during discussion *[or divide the reading into sections]*), so that everyone gets a chance to take on the different cognitive tasks.

Works Cited

Bruchac, Joseph. *Native Plant Stories*. Illustrated, Fulcrum Publishing, 1995.

Project Zero. “Word-Phrase-Sentence.” *Project Zero*, Harvard Graduate School of Education, 2019, www.pz.harvard.edu/sites/default/files/Word-Phrase-Sentence.pdf.

Strategic Education Research Partnership. “Reading to Learn in Science - Strategies for the Classroom.” *Strategic Education Research Partnership*, 2021, www.serpinstitute.org/reading-science/classroom-strategies.

Lesson #3: *Meet Arnold Clifford, a Navajo (Diné) Botanist*

Purpose
To provide an example of a Native American career path as a botanist.
To foster an appreciation for the depth of plant knowledge being carried forward by indigenous botanists.

Time Required
30-45 minutes

Materials
A computer/projector for showing a video and the **Arnold Clifford video**.

Directions

1. Tell students that they will be watching a 20 minute video of Arnold Clifford, a Navajo botanist with a depth of familial expertise. The goal of watching this video is to foster an appreciation for the depth of plant knowledge being carried forward by indigenous botanists. This lesson is also part of the ***Native American Career Pathways*** lessons, which are meant to highlight a variety of Native Americans in unique and distinguished careers.
2. Play the video and pause in places deemed appropriate for discussion, or just play the whole video from start to finish.
3. Once finished showing the video, ask students to share what they learned, what surprised them, and other insights from the video.
4. If time allows, consider sharing some or all of the article titled **Nature the Navajo Way** with your students (Murphy). Some of the information in this article could give students a better understanding of Arnold's career path.

Additional Resources

Brown, Patricia. "To Navajo Plant Expert, Habitats Sing Songs in Ancient Harmonies." *Chicago Tribune* [Alcalde, New Mexico], 24 Oct. 2004, www.chicagotribune.com/news/ct-xpm-2004-10-24-0410240323-story.html.

"Navajo Cultural Uses of Native Plants in the Four Corners Region." *YouTube*, uploaded by School for Advanced Research, 16 Mar. 2015, www.youtube.com/watch?v=6sve04NRSp4.

Works Cited

Murphy, Andi. “NATURE THE NAVAJO WAY - Botanist Arnold Clifford Is on a Scientific Mission to Document Life—Ancient, Modern, and Endangered.” *New Mexico Magazine*, May 2020, www.newmexico.org/nmmagazine/articles/post/nature-the-navajo-way.

Lesson #4: *Connecting with Plants*

Purpose
To foster an appreciation for the beauty, spirit, and power of plants.
To closely observe the diversity of textures, colors, patterns, and shapes found in plant structures.

Time Required
60-90 minutes

Materials
A wide variety of plant parts from the local landscape (which can be collected by students), appropriate sun protection and clothing for being outside, one water bottle per student (if needed), scissors, glue, bags for collecting plant material, any other desired materials, and a copy of the **Andy Goldsworthy Photos**.

Directions

1. If possible, it is recommended that you complete the second part of this lesson in an outdoor space. Depending on the length of your class time and the time it takes to reach an appropriate outdoor location, this lesson may take two class periods. In advance, please remind your students to bring appropriate outdoor clothing, sun protection, and a water bottle for the day you plan to be outdoors.
2. **Part #1 - Introducing the Activity (15-20 Minutes):** This part of the lesson may be completed indoors. Tell students that this lesson is an opportunity to connect with and learn from plants. For this reason, students will have a choice between creating art using plant materials they find in your outdoor location or engaging in a reflection while sitting next to a plant of their choosing. However, regardless of their choice, all students must complete their activity individually and in silence.
    a. If students choose to create plant art, remind them that they will have to collect plant materials in such a manner that they do not cause harm to any plants (several leaves or flowers pulled here or there from healthy plants is probably okay, but encourage them to think carefully about what they take). If students choose to do a reflection instead, tell them that they can do this activity in a variety of ways. For example, if they would like to bring a notebook to journal or draw in, please allow them to do so. If all they want to do is sit quietly, then that too is a choice they have. However, tell students that their reflection time must stay focused on their connection to plants.

b. Next, share the website, **Native American Plant Wisdom: Local Plants Can Teach And Heal,** with your students and read the text if time allows (LaTona, 2019). After this, show them several examples of plant art such as the one on the website or some of the images of art by Andy Goldsworthy.
c. To further motivate and inspire your students, you might also consider introducing them to the **Interconnectivity Tree Research Project** (HeartMath Institute, 2021). Read the paragraph on the website and play the short video. This brief introduction is enough to provide a glimpse of the deeper connections that become possible when we take the time to listen to and connect with plants.

3. **Part #2 - Doing the Activity (45-60 minutes):** This part of the lesson must be completed outdoors in a location that has both living and dead plant material available for creating plant art. Alternatively, your students may also collect plant material in a bag while walking to the location where you plan to stay put for creating and reflecting time.
    a. Once at your desired location, instruct students to find a space for themselves where they are at least 5 feet removed from others and where they can focus on the task at hand without becoming distracted.
    b. Give your students time to create and reflect. Depending on the length of your walk, the length of your class period, and the engagement of your students, this amount of time may vary quite a bit. However, we recommend giving your students a minimum of 20 minutes, especially because it can take time for students to adjust to the silence and get involved in the activity.
    c. Give students 10 minute and 5 minute warnings so that they have the opportunity to bring closure to their artwork or reflection time.
    d. Finally, before returning to the classroom, remember to save time for students to share their artwork along with any insights gained from this experience. Consider asking them the following questions to help stimulate a deeper conversation:
        i. How did your closeness to plants make you feel and why?
        ii. What new appreciation do you have for plants? Please explain.
        iii. What did you notice about your connection to plants that you have never noticed before? Please explain.
        iv. What specific parts of a plant or plants stood out to you and why?

    If you have students who are shy about sharing in front of a whole group, have them write down their thoughts on index cards, collect their cards, and share their insights anonymously. Once all students have had an opportunity to share, return to the classroom.

Works Cited

Goldsworthy, Andy. *Andy Goldsworthy: A Collaboration with Nature*. F First American Edition, Abrams, 1990.

HeartMath Institute. “Interconnectivity Tree Research Project.” *HeartMath Institute*, HeartMath Institute, 2021, www.heartmath.org/resources/videos/interconnectivity-tree-research-project.

LaTona, Brita. “Native American Plant Wisdom: Local Plants Can Teach And Heal.” *Golden Poppy Herbal Apothecary*, Golden Poppy Herbal Apothecary, 2019, www.goldenpoppyherbs.com/native-american-plant-wisdom-local-plants-can-teach-and-heal.

EXPLORE

Exploring Our Knowledge of Plants

Target Grade Levels	9th - 12th (can be adapted for grades 6th-8th)
Essential Understandings	1. Photosynthesis, cellular respiration, food transport, food storage, water intake, and mineral intake are all essential functions of plants. 2. Photosynthesis happens only in the presence of solar energy whereas cellular respiration happens both in the light and dark. 3. The majority of photosynthesis happens in the leaves. 4. Glucose, the product of photosynthesis, is transported to all parts of the plant for energy or stored for later use.

Alignment to Utah's SEEd Standards

Science and Engineering Practices
Developing and Using Models: Students develop physical, conceptual, and other models to represent relationships, explain mechanisms, and predict outcomes. *(Lessons #1 and #5)* **Planning and carrying out investigations:** Students plan and conduct scientific investigations in order to test, revise, or develop explanations. (*Lesson #2*) **Analyzing and interpreting data:** Students analyze various types of data in order to create valid interpretations or to assess claims/conclusions. (*Lesson #2*) **Constructing explanations:** Students construct explanations about the world using observations that are consistent with current evidence and scientific principles. *(Parts #2, #3, and #4)* **Engaging in argument from evidence:** Students support their best explanations with lines of reasoning using evidence to defend their claims. *(Lessons #2, #3, and #4)* **Obtaining, evaluating, and communicating information:** Students obtain, evaluate, and derive meaning from scientific information or presented evidence using appropriate scientific language. They communicate their findings clearly and persuasively in a variety of ways including written text, graphs, diagrams, charts, tables, or orally. *(Lesson #2)*

Crosscutting Concepts

Systems and System Models: Students use models to explain the parameters and relationships that describe complex systems. *(Lessons #1 and #5)*
Energy and Matter: Students describe cycling of matter and flow of energy through systems, including transfer, transformation, and conservation of energy and matter. *(All Lessons)*

Disciplinary Core Ideas

Standard BIO.2.3
Develop and use a model to illustrate the cycling of matter and flow of energy through living things by the processes of photosynthesis and cellular respiration. Emphasize how the products of one reaction are the reactants of the other and how the energy transfers in these reactions. (PS3.D, LS1.C, LS2.B) *(All Lessons)*

Section Overview

In contrast to the ENGAGE lessons, the remaining lessons follow a more Western science approach. More specifically, the lessons provided in the EXPLORE section are designed to uncover students' prior knowledge and address any content gaps or misunderstandings they may have related to plant functions.

Here are the most common misconceptions to keep an eye out for:

- Many students mistakenly think plants get their food directly from their environment (i.e. soil, minerals, sunlight, etc.) rather than making it internally through photosynthesis.
- They might also think breathing and respiration mean the same thing when, in fact, they do not. Although the processes are related, breathing refers to the physical process of exchanging gases whereas respiration refers to the process of producing energy at the cellular level.
- Finally, students often get tripped up with misconceptions related to respiration. For example, they might think respiration only happens in animals, that plants respire only at night, that plants use only carbon dioxide, or that photosynthesis is the plant's way of releasing energy. However, plants, like animals, use oxygen for respiration during both day (light) and night (dark) and this is the process that releases energy for the plant, not photosynthesis.

Lesson #1: *Plant Inputs and Outputs Diagram*

Purpose
To pre-assess student knowledge and identify possible misconceptions of basic plant functions such as photosynthesis, cellular respiration, gas exchange, and food storage.

Time Required
30-45 minutes

Materials
Paper, pencils, 1 copy per student of the unlabeled **Potato Plant Input Output Diagram** (CIP International Potato Center), 2 blue sticky notes per student, and 2 pink sticky notes per student. **Potato Plant Input Output Answer Key**

Directions

1. Give every student an unlabeled copy of the **Potato Plant Input Output Diagram** and instruct them to put their name on the back side of the diagram, not on the front (CIP International Potato Center). This detail is important for an activity they will do later.
2. Tell students that they will have 10 minutes to work individually on the task.
3. Reassure students that this assignment is meant to show what knowledge of plants they already have and it will not be graded based on performance. This means that students will not lose points if their diagram does not include all of the information shown on the answer key.
4. Explain to students that their task is to label the blank diagram with all of the inputs (materials that must enter the plant for it to survive) and outputs (materials that exit the plant) they can think of for a plant. In addition, you could challenge them to also include information about what processes the inputs are for and what processes result in the outputs. If the diagram is too small for students to fit what they would like to write, they can label the diagram with numbers and make a number key on a separate piece of paper that includes the more detailed information they would like to include.
5. While students are working, pass out 2 blue and 2 pink sticky notes to each student. They will need these for the next part of the lesson.
6. When students have finished their diagrams, explain to them that they will now participate in a gallery walk where they will get to view each other's diagrams anonymously and give each other constructive feedback.

7. Collect all of the papers from students and let the students watch you mix them up. The purpose behind doing this is to help keep the diagrams anonymous in order to create a safe space for making mistakes and providing feedback.
8. Tell students that they will now have 10 minutes to move around the room and view each other's diagrams. While viewing each other's diagrams, they must provide their peers with 2 pieces of positive feedback (i.e. "I like how you…") and 2 pieces of constructive criticism (i.e. "I wonder why…" or "I wonder where…"). Students should place each of their sticky notes on a different diagram and once a diagram has received 2 pinks and 2 blues, no more sticky notes should be added. This way, every student should receive the same amount of feedback. Encourage students to be as specific as possible. Comments that say "I like it." are unacceptable because they are not specific, and therefore, not helpful.
9. Redistribute the diagrams around the classroom. Start the gallery walk.
10. While students move around and give feedback, be on the lookout for strong comments (i.e. those that include helpful details) and weak comments (i.e. those lacking the necessary details). When appropriate, pause the gallery walk and share these examples to help students better understand how to give each other constructive feedback.
11. At the end, ask students to find their paper, read the comments, and turn it in to you. Look over the diagrams and the comments to get an understanding of where your students are at with their knowledge of plant inputs, outputs, and processes necessary for survival.
12. If you find that students missed important information in their diagrams, you have several ways to proceed. You can continue with the other parts of this lesson, which should help you further tease out possible misunderstandings and pinpoint what concepts you need to cover before moving on. Alternatively, you can show the answer key to your students, discuss it, and move on to the next lesson. Just be aware that it is extremely common for students to have significant misconceptions about plant structure and function and these should be addressed in some form before you proceed to the next lesson (the EXPLAIN section).

Works Cited

CIP International Potato Center. "How Potato Grows." *CIP International Potato Center*, https://cipotato.org/potato/how-potato-grows/. Accessed 3 Aug. 2021.

Lesson #2: *Photosynthesis and Respiration in Elodea*

Purpose

To observe that carbon dioxide is consumed by plants during photosynthesis (which happens only during the day when light energy is present).
To observe that carbon dioxide is produced by plants during cellular respiration (which happens all of the time, regardless of the presence of light energy).
To observe that plants recycle some of their byproducts.
To gain experience using indicators to show the presence or absence of certain molecules.
To practice conducting a controlled experiment.

Time Required

This lab requires two 45 minute class periods separated by 1-2 days.

Materials Needed

8 live *elodea* plant leaves per group (these are aquatic plants that can be found at your local pet store), bromothymol blue, distilled water, light source(s) for illuminating some of the elodea, 8 test tubes per group, 1 test tube rack per group, tape and marking pens for each group, enough parafilm or corks for covering test tubes, 2 clean straws for every student (1 straw per day), one 250 ml flask per group, one 100 ml graduated cylinder per group, 1 copy of the **Student Handout** per student, pencils, notebooks, and 1 copy of the teacher lab background packet titled **Photosynthesis and Respiration in *Elodea*** ("Elodea").

Directions

Please refer to the teacher lab background packet titled **Photosynthesis and Respiration in *Elodea*** for specific directions on how to plan for and run the lab. Please note that the diagram on the next page shows the expected results for this lab. Be prepared for your students to make mistakes that could affect the outcome of this lab and think through how you will handle those situations, as it is extremely important that students do not walk away from this lab furthering their misconceptions.

Works Cited

"Elodea." *Cornell Institute for Biology Teachers*, 24 June 2008, blogs.cornell.edu/cibt/labs-activities/labs/elodea.

Lesson #3: *Apple Tree Science Probe*

Purpose
To uncover students' ideas and possible misconceptions about plant structure and where photosynthesis takes place.

Time Required
30-60 minutes

Materials
Pencils, 1 copy per student of the **Apple Tree Science Probe** from the book **Uncovering Student Ideas in Life Science, Vol. 1**, and 1 copy of the teacher notes from the **Apple Tree Science Probe** (Keeley 57-62). Also, if the teacher chooses to administer the science probe using the Sticky Bars option, plan to have one sticky note per student.

Directions

1. Science probes are typically used as a formative assessment tool to help teachers better understand their students' thinking around a topic or concept, as well as to identify possible misconceptions students may have. As a result, science probes can help teachers make more informed decisions about what content needs to be reviewed or covered and what misconceptions need to be addressed before moving forward in a unit. For this reason, we hope you use this science probe to check in with your students' background knowledge of plant structure and photosynthesis. If you notice content gaps or misunderstandings, you may need to pause moving forward with this curriculum until after you have addressed these issues with your students.
2. This science probe can be administered in a variety of ways. However, for the purposes here, only two variations will be described.
3. Regardless of the method you choose below, please first read the teacher notes that accompany the **Apple Tree Science Probe** (Keeley, "Uncovering").
4. Also, if you choose to administer the science probe using option #2 or option #3, then please consider instructing your students to use the Claim-Evidence-Reasoning (CER) method for writing their explanation. Resources for helping students with the CER method are listed here:
    a. **Constructing Cl-Ev-R Explanations in Science** presentation by Page Keeley
    b. **Cl-Ev-R Poster** adapted and created by Page Keeley
    c. **CER Activate Learning Poster** by ActivateLearning.com

5. At the end, it could be valuable to give students a few minutes to reflect on what information they might add, delete, or change from the **Potato Plant Input Output Diagrams** they completed in Lesson #1 (CIP International Potato Center). This could be done in the form of an exit ticket.

Option #1: #55 Sticky Bars (Keeley, "Science," 178-180).
Option #2: #21 Friendly Talk Probes (Keeley, "Science," 102-104).
Option #3: #12 Explanation Analysis (Keeley, "Science," 79-82).

Works Cited

CIP International Potato Center. "How Potato Grows." *CIP International Potato Center*, https://cipotato.org/potato/how-potato-grows/. Accessed 3 Aug. 2021.

Keeley, Page. *Science Formative Assessment: 75 Practical Strategies for Linking Assessment, Instruction, and Learning*. 1st ed., Corwin, 2008.

Keeley, Page. *Uncovering Student Ideas in Life Science, Volume 1: 25 New Formative Assessment Probes*. 1st ed., Corwin, 2016.

Lesson #4: *Respiration Science Probe*

Purpose
To address possible misconceptions students may have about plants and cellular respiration.

Time Required
30-60 minutes

Materials
Pencils, 1 copy per student of the **Respiration Science Probe** from the book **Uncovering Student Ideas in Science, Vol. 3: Another 25 Formative Assessment Probes**, and 1 copy of the **Respiration Science Probe** teacher notes (Keeley 131-137). Also, if the teacher chooses to administer the science probe using the Card Sorts option, plan to have one reusable **Respiration Probe Card Set** for each group of students.

Directions

1. Science probes are typically used as a formative assessment tool to help teachers better understand their students' thinking around a topic or concept, as well as to identify possible misconceptions students may have. As a result, science probes can help teachers make more informed decisions about what content needs to be reviewed or covered and what misconceptions need to be addressed before moving forward in a unit. For this reason, we hope you use this science probe to check in with your students' background knowledge of plant structure and photosynthesis. If you notice content gaps or misunderstandings, you may need to pause moving forward with this curriculum until after you have addressed these issues with your students.
2. This science probe can be administered in a variety of ways. However, for the purposes here, only two variations will be described.
3. Regardless of the method you choose below, please first read the teacher notes that accompany the **Respiration Science Probe** (Keeley, "Uncovering," 132-137).
4. Also, if you choose to administer the science probe using option #2, then please consider instructing your students to use the Claim-Evidence-Reasoning (CER) method for writing their explanation. Resources for helping students with the CER method are listed here:
    a. **Constructing Cl-Ev-R Explanations in Science** presentation by Page Keeley

    b. **CI-Ev-R Poster** adapted and created by Page Keeley
    c. **CER Activate Learning Poster** by ActivateLearning.com
5. At the end, it could be valuable to give students a few minutes to reflect on what information they might add, delete, or change from the **Potato Plant Input Output Diagrams** they completed in Lesson #1 (CIP International Potato Center). This could be done in the form of an exit ticket.

Option #1: #4 Card Sorts (Keeley, "Science," 56-59).
Option #2: #30 Justified List (Keeley, "Science," 123-126).
Option #3: #12 Explanation Analysis (Keeley, "Science," 79-82).

Works Cited

CIP International Potato Center. "How Potato Grows." *CIP International Potato Center*, https://cipotato.org/potato/how-potato-grows/. Accessed 3 Aug. 2021.

Keeley, Page. *Science Formative Assessment: 75 Practical Strategies for Linking Assessment, Instruction, and Learning*. 1st ed., Corwin, 2008.

Keeley, Paige. *Uncovering Student Ideas in Science, Volume 3: Another 25 Formative Assessment Probes*. Current, National Science Teachers Association, 2008.

Lesson #5: *Revise Plant Inputs and Outputs Diagram*

Purpose
To recheck student understanding about plant structure and function, photosynthesis, and cellular respiration.

Time Required
30-45 minutes

Materials
Paper, pencils, colored pens (a color that will stand out from pencil), highlighters, 1 blank copy of the **Potato Plant Input Output Diagram** per student, and each student should also have the original diagram they completed in Part #1 for comparison (CIP International Potato Center).

Directions

1. Instruct students to use all of the feedback and knowledge gained from Parts #1-3 of this lesson to revise the original diagram they completed in Part #1.
2. However, rather than altering their original diagram, they will now be given a new black copy of the **Potato Plant Input Output Diagram** and will make a new version (CIP International Potato Center). Again, if the diagram is too small for students to fit what they would like to write, they can label the diagram with numbers and make a number key on a separate piece of paper that includes the more detailed information they would like to include.
3. Once finished with the new version, have students look for growth in their understanding by highlighting any new or different information they included on their new version.
4. Display the answer key from the **Potato Plant Input Output Diagram** on the board and have students study it for a few minutes (CIP International Potato Center).
5. Ask students if they have questions about the answer key and whether they notice any information on the answer key that they missed on their own diagram. Using a colored pen, have students add any missed information or corrections to their diagram.
6. Have students save this diagram for a future reference tool.

Sources

CIP International Potato Center. “How Potato Grows.” *CIP International Potato Center*, https://cipotato.org/potato/how-potato-grows/. Accessed 3 Aug. 2021.

EXPLAIN

Potato Plant Structures and Their Functions

Target Grade Levels	9th - 12th (can be adapted for grades 6th-8th)
Essential Understandings	1. Vascular plants have special tissues to conduct water, minerals, and food throughout the plant. 2. While individual vascular plant species are unique, they all share universal structures (i.e. roots, stems, leaves, and conductive tissues). 3. The Four Corners Potato (*Solanum jamesii*) is an herbaceous vascular plant that is native to the American Southwest. 4. Potato plants have some unique features such as stolons (underground stems), tubers (swollen stem parts that store food), and the ability to reproduce vegetatively.

Alignment to Utah's SEEd Standards

Science and Engineering Practices
Obtaining, evaluating, and communicating information: Students obtain, evaluate, and derive meaning from scientific information or presented evidence using appropriate scientific language. They communicate their findings clearly and persuasively in a variety of ways including written text, graphs, diagrams, charts, tables, or orally. *(All Lessons)*
Crosscutting Concepts
Structure and function: Students relate the shape and structure of an object or living thing to its properties and functions. *(All Lessons)*

Section Overview

In this section, students will start by learning about the universal structures of vascular plants and their functions. After watching a video to introduce these topics, they will work to complete a diagram of a potato plant showing the structures and functions that are shared with other vascular plants, as well as those that are unique to potato plants. In the final lesson, students will be introduced in more detail to the biology of the Four Corners Potato (*Solanum jamesii*) through both a reading exercise and a slideshow that provides helpful visuals.

Lesson #1: *Vascular Plant Structure and Function Video*

Purpose

To learn about the structures shared by all vascular plants and the functions of those structures.

Time Required

30-45 minutes

Materials

Pencils, 1 copy of the **Vascular Plant Structure and Function** worksheet per student or 1 computer or tablet per student, internet access for the **Vascular Plants = Winning! Crash Course Biology #37** video (CrashCourse), and a computer/projector for showing the video.

Directions

1. Before showing the video, tell students that the Four Corners Potato is an herbaceous vascular plant. For this reason, it will be helpful for them to be familiar with the structures that are shared by all vascular plants, as well as the functions of those structures.
2. Hand out the **Vascular Plant Structure and Function** worksheet to each student.
3. Read through the worksheet questions as a class to help prime students for what to listen and look for while watching the video.
4. Be prepared to stop the video at the times indicated on the worksheet answer key.
5. Watch the video **Vascular Plants = Winning! Crash Course Biology #37.**
6. When stopping the video, check for understanding with your students. Ask if they have any questions or if they need anything clarified. If there is confusion, you may want to replay the previous section of the video to help students better process the new information in that section.
7. Once you have finished watching the video, ask students to complete the Exit Ticket at the end of their worksheet.

Works Cited

CrashCourse. “Vascular Plants = Winning! - Crash Course Biology #37.” *YouTube*, uploaded by CrashCourse, 8 Oct. 2012, www.youtube.com/watch?v=h9oDTMXM7M8

Lesson #2: *Potato Plant Structure and Function Diagram*

Purpose
To learn about potato plant structures and their functions.

Time Required
45 minutes

Materials
Pencils, colored pens, 1 blank copy per student of the **Potato Plant Structure Diagram** (page 1), word bank (page 2), answer keys for the teacher (pages 3-9), projector for displaying the answer keys for students (CIP International Potato Center).

Directions

1. Tell students that the goal of this lesson is to learn about potato plant structures and their functions.
2. Pass out a blank copy of the **Potato Plant Structure Diagram** (page 1) to every student and ask students to pull out both a pencil and a colored pen (CIP International Potato Center).
3. After displaying the word bank in the form of your choosing (projector, whiteboard, back side of the student handout), have students work with a partner to fill in the names of the structures on the potato plant. Remind students to use a pencil here so they can make corrections later if necessary.
4. Once all students have finished, project the answer key shown on page 3. If needed, tell students to correct any mistakes.
5. Next, ask students to pull out some colored pens, pencils, or markers. If this is not possible, then they can just use a pencil.
6. Guide students through a review of the functions of each structure. Start with the leaves. However, before projecting the leaves answer key on page 4, ask students what they remember about the functions performed by leaves. If possible, have them put the functions into their own words. Then, if needed, display the leaves answer key.
7. Follow the same format as above for stems (page 5) and remember to point out that stems contain vascular tissue (a.k.a. conductive tissues or the xylem and phloem) since potatoes are herbaceous vascular plants.
8. Then, follow the same format for roots (page 6) and for sexual reproduction (page 7), which may require more assistance depending on the level of background knowledge students have.

9. Once finished reviewing this material, tell them that they will now add information about the functions of potato specific structures. Project page 8 for them to see. Ask them if they are surprised by any of the information shown. Sometimes students might be surprised to learn that stolons are actually stems. Additionally, it is important to point out that potato plants form starch (for long term food storage) from the glucose made through photosynthesis.
10. Finally, if desired, you can project the full answer key shown on page 9.

Works Cited

CIP International Potato Center. “How Potato Grows.” *CIP International Potato Center*, https://cipotato.org/potato/how-potato-grows/. Accessed 3 Aug. 2021.

Lesson #3: *The Four Corners Potato (Solanum jamesii)*

Purpose
To learn about the biology of the Four Corners Potato (*Solanum jamesii*).

Time Required
45-60 minutes

Materials
1 copy per student of the **Potato Biology Reading**, highlighters, pencils, and a computer/projector for showing Bruce Pavlik's Potato Biology Presentation.

Directions

1. Read the **Potato Biology Reading** together with your students. Have them highlight features that are unique to the Four Corners Potato. Also, when you come to a bold word in the text, check in with your students and see if they can provide a definition for the word. If they need help, look up the word or provide a definition for them. Have students write definitions for all bold words in the side margins of their paper.
2. Show students Bruce Pavlik's Potato Biology Presentation and review the main points from the reading. This slideshow provides a nice visual for students following the reading.

Works Cited

Kinder, David H., et al. "*Solanum Jamesii*: Evidence for Cultivation of Wild Potato Tubers by Ancestral Puebloan Groups." *Journal of Ethnobiology*, vol. 37, no. 2, 2017, pp. 218–40.

Louderback, Lisbeth A., and Bruce M. Pavlik. "Starch Granule Evidence for the Earliest Potato Use in North America." *Proceedings of the National Academy of Sciences*, vol. 114, no. 29, 2017, pp. 7606–10. *Crossref*, doi:10.1073/pnas.1705540114.

Pavlik, Bruce M., et al. "Evidence for Human-caused Founder Effect in Populations of Solanum jamesii Found at Archaeological Sites: Breeding Experiments and the Geography of Sexual Reproduction." Conservation Department, Red Butte Garden, University of Utah, pp. 1-26.

Spooner, David M., et al. “Wild Potatoes (Solanum Section Petota; Solanaceae) of North and Central America.” *Systematic Botany Monographs*, vol. 68, 2004, p. 1. *Crossref*, doi:10.2307/25027915.

ELABORATE

Potato Plant Reproduction and Life Cycle

Target Grade Levels	9th - 12th (can be adapted for grades 6th-8th)
Essential Understanding	1. Potato plants can reproduce both sexually and asexually (vegetative reproduction), but only sexual reproduction increases genetic diversity unless a mutation occurs. 2. Sexual reproduction in potato plants happens when pollen (containing sperm) from one plant's stamen enters the ovule (containing an egg) inside the pistil of another plant. 3. Asexual vegetative reproduction in potato plants happens when tubers form buds that grow into new plants.

Alignment to Utah's SEEd Standards

Science and Engineering Practices
Obtaining, evaluating, and communicating information: Students obtain, evaluate, and derive meaning from scientific information or presented evidence using appropriate scientific language. They communicate their findings clearly and persuasively in a variety of ways including written text, graphs, diagrams, charts, tables, or orally. *(All Lessons)*
Crosscutting Concepts
Structure and function: Students relate the shape and structure of an object or living thing to its properties and functions. *(All Lessons)*
Disciplinary Core Ideas
Standard BIO.4.2 Construct an explanation based on evidence that natural selection is a primary cause of evolution. Emphasize that natural selection is primarily caused by the potential for a species to increase in number, the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, competition for limited resources, and the proliferation of those organisms that are better able to survive and reproduce in the environment. (LS2.D, LS4.B, LS4.C) *(Relates to All Lessons)*

Standard BIO.4.3
Analyze and interpret data to identify patterns that explain the claim that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. Emphasize analyzing shifts in the numerical distribution of traits and using these shifts as evidence to support explanations. (LS4.B, LS4.C) *(Relates to All Lessons)*

Standard BIO.4.4
Engage in argument from evidence that changes in environmental conditions may cause increases in the number of individuals of some species, the emergence of new species over time, and/or the extinction of other species. Emphasize the cause and effect relationships for how changes and the rate of change to the environment affect distribution or disappearance of traits in a species. Examples of changes in environmental conditions could include deforestation, application of fertilizers, drought, or flood. (LS4.C) *(Relates to All Lessons)*

Section Overview

Students complete a flower dissection and learn about the female and male parts that play a role in sexual reproduction for flowering plants like potatoes. Next, they are shown a short slideshow to learn how potato plants asexually reproduce through vegetative propagation. Finally, students watch a short video that serves as a review of the potato life cycle and the two forms of reproduction found in potato plants.

Lesson #1: *Flower Dissection*

Purpose
To learn the structures and functions of a flower.
To understand the basics of how sexual reproduction happens in flowering plants.

Time Required
60 minutes

Materials
Please refer to the **Dissect a Flower** lab instructions for a detailed list of materials (Lohner).

Directions
Please refer to the **Dissect a Flower** lab instructions (Lohner).

Works Cited

Lohner, Svenja. “Dissect a Flower.” *Scientific American*, Scientific American, 2 May 2019, www.scientificamerican.com/article/dissect-a-flower.

Lesson #2: *Potato Reproduction and Life Cycle*

Purpose
To learn how sexual and asexual reproduction happens in potato plants.
To review the basic life cycle of a potato plant.

Time Required
20-30 minutes

Materials
A computer/projector for showing the video **POTATO How Does it Grow?** and the slideshow **Potato Reproduction**.

Directions

1. Use the **Potato Reproduction** slideshow to review sexual reproduction and show how it is different from asexual reproduction, also referred to as vegetative propagation in potato plants. Remind students that the Four Corners potato populations found in Utah have only been found to reproduce vegetatively so far. Most likely, this is because these are smaller populations that show signs of manipulation by humans.
2. Stop the video at 0:24 to ask students, *What term would you use to replace "plant root" here?* Hopefully, someone can remember that potatoes are tubers that grow on specialized stems underground called stolons.
3. Stop the video at 0:45 to remind students that the potatoes they refer to in this video are *Solanum tuberosum*, a different species from *Solanum jamesii*, which is native to the American Southwest (not the Andes).
4. Stop the video at 1:40 to ask students to elaborate on what the narrator means when she says "same type of potato." Ideally, students will point out how the word "type" could be confusing here. *Does she mean the same variety of potato (breed or strain)? Or, is she referring to something else?* Help the class come to the conclusion that she is referring to genetics here. Since this is vegetative reproduction, the potatoes will be clones of the parents.
5. Stop the video at 2:50 to remind students about how the Four Corner Potato has shown promising signs of disease resistance, which could provide some major help to the potato industry.
6. Finish the video and ask students if they have any questions related to how potatoes reproduce.

Works Cited

"POTATO | How Does It Grow?" *TRUE FOOD TV*, uploaded by TRUE FOOD TV, 16 Feb. 2016, www.youtube.com/watch?v=lkJ0aJNzf1g.

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FOOD SOVEREIGNTY

Overview of Lessons

In the Engage lesson, students learn the definition of *indigenous* and trace the origins of several Native American food dishes back in time to begin uncovering important past events that connect to the current health disparities seen within many indigenous communities. They learn that Fry Bread, a recipe with tradition, is not actually an indigenous food because it was developed during post-colonial times when Native Americans were forced to rely on nutrient-poor, government-rationed foods after being removed from their ancestral lands. Next, in the Explore section, students continue digging deeper towards the roots of some of these health disparities by learning about micronutrients and the critical roles they play in helping to maintain a healthy body. More specifically, students begin to see the stark micronutrient differences between nutrient-poor foods like Fry Bread and nutrient-rich indigenous foods like the Four Corners Potato. Lastly, students pick a micronutrient to study even more closely and present their findings to their peers in the Explain section. With their increased knowledge of the nutrients that make the Four Corners Potato a superfood, students are then better equipped to understand why indigenous food sovereignty is so important to today's Indigenous people and communities. In the Elaborate section, students learn about indigenous food sovereignty and are pushed to think about what this means for tribes here in Utah. Last, but not least, students engage in a discussion around whether the Four Corner Corners potato is a resource that should stay within its localized community or be shared widely with others through widespread marketing and production. This discussion helps students to think more deeply about how the decisions we all make today could have a meaningful impact on the future health of our land, communities, and bodies.

Important Background Information

Bears Ears Indigenous Food Movement

“No matter where you go in the world, cultural food traditions are deeply rooted and spiritually connected to the land and all living beings. Food brings us together as families, as communities, and as nations. For Native Americans, what we eat ties us to Mother Earth, to Father Sky, and to all beings who make up our shared home. Traditional foods literally shape who we are as people by giving us life, and elevating our happiness, nourishment and gratitude for all that surrounds us.

For most Native American Tribes in the U.S., our traditional foods, knowledge systems, and practices have gradually been eroded. They have been replaced by introduced ingredients that our ancestors would not recognize and that are less healthy than the foods we have nurtured for thousands of years. As people, we have recently been displaced from our most biodiverse and ecologically rich ancestral lands, and we have been forced to apply our ancient agricultural practices to marginal landscapes where many of our reservations have been established. Further compounding this problem, our Indian reservations have also been disproportionately targeted by mining companies and polluters further eroding community health and the productivity of lands we control.

Places like Bears Ears National Monument and public lands in general are increasingly important to our cultural survival as Native peoples. Tribes have 11,000+ years of experience of sustainable gathering, hunting, farming, and nurturing of wild food crops. Strangely, though, we have seldom been asked to teach newcomers what we know about caring for these shared resources. Bears Ears National Monument provides us with an opportunity to simultaneously teach others about our historical relationship with the land, and at the same time, restore the health of our lands and people. We invite you to join us by engaging in a powerful journey of healing and revitalization of how the sustenance and well-being of our people are tied to the Bears Ears region.

Compared to other ethnic groups, Native Americans experience significant nutrition-related health disparities. We are struggling with obesity, diabetes, heart disease, and many other afflictions that cultural food,medicines and practices can help heal. Colonization has taken its toll, but unlike other ethnic groups, our cultural history remains vibrant here on Mother Earth’s soil. Our elders still hold Native wisdom that has been passed down from generation to generation. It is based on oral stories and hands-on experimentation with the indigenous food cultivation, collection, and preservation tied to our people and shared ancestral lands. We have the necessary wisdom to heal the challenges our people face, but we also need strong allies from all sectors of society to ensure that our leaders’ strong voices are being heard” (Utah Diné Bikéyah).

ENGAGE

The Origins of Native American Foods

Target Grade Levels	9th - 12th (can be adapted for grades 6th-8th)
Essential Understanding	1. While all *traditional* Native American food dishes serve as a window into the histories of Native peoples and cultures, only some dishes are truly ***indigenous***.

Alignment to Utah's Core State Standards for Social Studies

UT Strand 1: NATIVE INNOVATIONS AND ADAPTATIONS
UT Standard 1.2: Students will analyze and explain the interactions and interconnections between the physical characteristics of Utah and American Indian cultures using a range of texts, oral histories, and geographic inquiry. (geography)
UT Strand 4: UTAH IN THE WORLD
UT Standard 4.4: Students will use data and other evidence related to a cultural, ethnic, or religious group in Utah to interpret the group's historic/current conditions and experiences. (history, geography)

Section Overview

In this lesson, students will learn the definition of *indigenous* and trace the origins of a Native American food dish back in time. They will then teach one another which food dishes are truly *indigenous* in origin (meaning food dishes that would have been recognized by the ancestors of a particular region long before Europeans ever set foot on this continent). In addition, students will learn about the painful history of Fry Bread. Although it is considered to be a traditional food dish by some, Fry Bread is not an *indigenous* food dish because it was developed in the 1800s when Native Americans had to rely on government rationed foods (white flour, sugar, lard, etc.) after being forcibly removed from their ancestral homelands and food systems. In contrast, the Three Sisters and Coal Roasted Gete Okosomin Bisque recipes are food dishes that are *indigenous* because they have been passed down since pre-colonial times and use ingredients that would have been recognizable and available to pre-colonial ancestors.

Lesson #1: *The Origins of Native American Foods*

Purpose
To learn about the origins of several Native American food dishes.
To understand what makes a food dish truly *indigenous*.
To appreciate how these food dishes serve as a window through which to better understand the past.

Time Required
90-120 minutes

Materials
Pencils, notebooks, 10 copies (or enough for your number of students) of each set of reading materials shown below, a colored copy of recipe from the **Recipe Photos** document, and a computer and projector for playing the videos posted within the **RELISH: Brian Yazzie's Indigenous Ingredient-Rooted Three Sisters Dish** website article (Baca)(Maillard)(Melin).

Reading Materials for the Coal Roasted Gete Okosomin Bisque Dish

- **Indian Uses of Juniper in the Grand Canyon Region** - old naturalist accounts from the Grand Canyon National Park Service (McHenry).
- **Silly Old Man's Squash** from CBC News Canada (Parker).
- **Gete Okosomin Squash** from the Baker Creek Heirloom Seed Company (Rareseeds).
- **Blue Corn, Bear Root, and Resilience** from the PBS Native America program (Baca).
- **Native American Recipes** (Baca)(Maillard)(Melin).

Reading Materials for the Three Sisters Dish

- **Yes, Succotash Has a Luxurious Side** from the New York Times (Tanis).
- **Meet the Three Sisters Who Sustain Native America** from the PBS Native America program (Murphy).
- **RELISH: Brian Yazzie's Indigenous Ingredient-Rooted Three Sisters Dish** from Twin Cities PBS Originals (Melin).
- **Native American Recipes** (Baca)(Maillard)(Melin).

Articles for the Fry Bread Dish

- **Author's Note** section from the book ***Fry Bread: A Native American Family Story*** written by Kevin Maillard and illustrated by Juana Martinez Neal (Maillard).
- **Native American Recipes** (Baca)(Maillard)(Melin).

Directions

1. Tell students that they will be learning about the origins of several Native American food dishes in this lesson.
2. Show students the **Recipe Photos** (Baca)(Maillard)(Melin). Explain that while all of these dishes are considered to be *traditional*, only some of them are also *indigenous*.
3. Ask students what they think the term *indigenous* means. After giving them some time to think, call on several students to hear some of the ideas they have. Share the following definition of *indigenous*: "*originating in and characteristic of a particular region or country; native"* (Definition of Indigenous | Dictionary.Com).
4. Next, expand on this and ask what criteria have to be met in order for a food dish to be considered *indigenous*. See what ideas students come up with. Explain that this is a more complicated question since it depends on the definition of *indigenous*. Read the following excerpt for students from the **Why Aren't We Talking About Indigenous Food?** Article (Lee):

> *"Why aren't we talking about Indigenous food? The answer to this question will vary depending on whom you ask.*
>
> *Well, are you talking about pre-colonial, post-colonial, American Indian, Native American, or today?" poses M. Karlos Baca (Tewa/Diné/Nuche), an Indigenous foods activist. "And where? Spanish, Mexican, or Protestant-colonized from the east?"*
>
> *David Rico, of the Choctaw Nation and a line cook at José Andrés' America Eats Tavern, presses further, "What even is Indigenous cooking? The techniques? Ingredients? Cooking off the land solely, using whatever it gives you? Or can you use non-pre-colonial ingredients as well? Are you responsible for removing invasive species? It all depends on your concept of [Indigenous] identity.*
>
> *Because Rico's elders were forcibly removed from their lands again and again, there were no lasting memories, lessons, or relationships with one home or place to pass down. "It feels like we're just now waking up, looking around and asking: What just happened? What even is ours, and what was imposed upon us?"*

5. Tell students that the term *indigenous foods or cooking* can bring up a lot of questions and complex issues. However, for the purposes of this lesson, we will consider *indigenous foods* to be anything that would be recognized by the ancestors of a particular region long before Europeans (pre-colonial) ever set foot on this continent.
6. Next, explain that students will embark on a short research project to learn about the origins of one of the three food dishes shown earlier. Using the reading materials provided for their chosen food dish, they will research its origins and decide whether or not the dish should be considered *indigenous* or not. In addition, each student will be responsible for teaching several other students about their chosen food dish, its origins, and any other interesting information they would like to share.
7. Use the **JigSaw** method to structure this research project so that all students have a responsibility for both their own learning and the learning of others (The Jigsaw Classroom).
8. Divide the students into 3 *expert* groups. Assign each group one of the food dishes and provide each student in the group with a copy of the necessary reading materials. If the *expert* group has more than 4 students, split it into 2 or more smaller groups of 3-4 students. Have the expert groups work together to read their materials and discuss their ideas.
9. Once all students have had enough time to become *experts* on their food dish, create *jigsaw* groups where each group will contain 1 *expert* (or 2 if needed) on each of the 3 food dishes. Then, have each student or *expert* share what they learned about their dish with the other students in their group. Move around the room and listen to students' insights and thoughts while they teach one another. When everyone is finished, bring the whole class back together. Invite students to share any insights or thoughts with the whole class.
10. Take time to review and highlight many of the *indigenous* ingredients (corn, beans, squash, juniper berry, purslane, wild onion, wild plums, milkweed pods, dandelion greens, etc.) found in the Three Sisters and Coal Roasted Gete Okosomin Bisque recipes.
11. Read the first section of the **Author's Note** to all students, as well as the section titled ***Fry Bread is History*** (Maillard). Ask students to share how much of this history is new to them. Consider probing deeper and asking why they have never heard some of this history before. This could lead into a deeper discussion around why it is important to get our history from multiple diverse perspectives (to get a more complete understanding of the past), rather than just from those who hold the power.

12. This could be a great time to ask students how they would recommend making fry bread recipes healthier? For example, what ingredients could be substituted to make this a healthier recipe? What ingredient does the author use in place of lard and why? Tell students that some people now use blue corn meal (an indigenous ingredient) in place of the flour and substitute healthier cooking oils like coconut oil in place of lard.
13. Share the videos from the **RELISH: Brian Yazzie's Indigenous Ingredient-Rooted Three Sisters Dish** website to show an example of how Native Americans like Brian Yazzie are working to bring nutritious *indigenous* food dishes back (Melin).
14. If time allows, consider sharing the YouTube video produced by Zagat titled **North America's Original Cuisine - Foodways with Jessica Sanchez, Episode 8**. This video introduces students to another indigenous chef, Karlos Baca, and his efforts to bring nutritious *indigenous* food dishes and food knowledge back.

Additional Resources to Consider Using

Foster, Nelson, and Linda Cordell. *Chilies to Chocolate: Food the Americas Gave the World*. 1st Edition, University of Arizona Press, 1992.

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“North America’s Original Cuisine - Foodways with Jessica Sanchez, Episode 8.” *YouTube*, uploaded by Zagat, 6 Apr. 2016, www.youtube.com/watch?v=uAvPUBS3EFg.

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Tanis, David. “Yes, Succotash Has a Luxurious Side.” *The New York Times*, 14 Aug. 2015, www.nytimes.com/2015/08/19/dining/yes-succotash-has-a-luxurious-side.html.

“The Jigsaw Classroom.” *Jigsaw Classroom*, Social Psychology Network, www.jigsaw.org.
Accessed 10 Aug. 2021.

EXPLORE

Micronutrients and Their Importance

Target Grade Levels	9th - 12th (can be adapted for grades 6th-8th)
Enduring Understandings	1. Sometimes, it can be tricky to discern how nutrient dense a food is from its nutrition facts label. 2. Nutrient dense foods (*superfoods*) have a lot more beneficial nutrients (vitamins and minerals) packed into each calorie compared to nutrient poor foods.

Alignment to Utah's SEEd Standards

Science and Engineering Practices
Analyzing and Interpreting Data: Students analyze various types of data in order to create valid interpretations or to assess claims/conclusions. *(Lesson #1)* **Obtaining, evaluating, and communicating information:** Students obtain, evaluate, and derive meaning from scientific information or presented evidence using appropriate scientific language. They communicate their findings clearly and persuasively in a variety of ways including written text, graphs, diagrams, charts, tables, or orally. *(Lesson #3)*
Crosscutting Concepts
Cause and Effect: Students investigate and explain causal relationships in order to make tests and predictions. *(Lesson #3)* **Scale, Proportion, and Quantity:** Students compare the scale, proportions, and quantities of measurements within and between various systems. *(Lesson #1)*
Disciplinary Core Ideas
Standard BIO.2.1 Construct an explanation based on evidence that all organisms are primarily composed of carbon, hydrogen, oxygen, and nitrogen, and that the matter taken into an organism is broken down and recombined to make macromolecules necessary for life functions. Emphasize that molecules are often transformed through enzymatic processes and the atoms involved are used to make carbohydrates, proteins, fats/lipids, and nucleic acids. (LS1.C) *(Related to Lessons #1 and #3)* **Standard BIO.2.2** Ask questions to plan and carry out an investigation to determine how (a) the structure and function of cells, (b) the proportion and quantity of organelles, and (c) the shape

of cells result in cells with specialized functions. Examples could include mitochondria in muscle and nerve cells, chloroplasts in leaf cells, ribosomes in pancreatic cells, or the shape of nerve cells and muscle cells. (LS1.A) *(Related to Lessons #1 and #3)*
Standard BIO.2.4
Plan and carry out an investigation to determine how cells maintain stability within a range of changing conditions by the transport of materials across the cell membrane. Emphasize that large and small particles can pass through the cell membrane to maintain homeostasis. (LS1.A) *(Related to Lessons #1 and #3)*

Alignment to Utah's Core State Standards for Social Studies

UT Strand 4: UTAH IN THE WORLD
UT Standard 4.4: Students will use data and other evidence related to a cultural, ethnic, or religious group in Utah to interpret the group's historic/current conditions and experiences. (history, geography) *(Lessons #1 and #2)*
UT Strand 5: LOOKING TOWARDS UTAH'S FUTURE
Possible Guiding Questions to Consider: ● How do we create and sustain safe and healthy communities? **UT Standard 5.2:** Students will use geographic tools and resources to investigate a current issue, challenge, or problem facing Utah or their community, and propose a viable solution. (geography) *(Lessons #1 and #2)*

Section Overview

Students are briefly introduced (or reintroduced) to the Four Corners Potato. They then use a data table showing nutritional content to analyze and compare the nutrients found in the Four Corners Potato with two other foods, Native American Fry Bread and Organic Red Potatoes. Through some probing, questioning, and discussion, students learn that determining a food's nutrient density requires one to analyze the nutrition facts label quite carefully. To finish this lesson, students read an article about the Four Corners Potato that highlights some of its nutritional benefits. Next, as part of the ***Native American Career Pathways*** thread, students are introduced to Cynthia Wilson, a Diné woman who holds a degree in nutrition. She offers students a chance to see how a degree in nutrition could serve *indigenous* communities in myriad ways. Lastly, in Lesson #3, students research one of the main micronutrients found in the Four Corners Potato. Working in groups, they gather information on what their micronutrient is, how it helps maintain a healthy body, what happens when people have a deficiency or when people have too much, and what foods can help people obtain it. Once their research is complete, student groups decide on how they want to present their research to their peers and work on completing their presentations or informational products.

Lesson #1: *The Littlest Mighty Tuber*

Purpose
To analyze, interpret, and make fair comparisons of nutritional information.
To learn about the many positive nutritional benefits of the Four Corners Potato and other *indigenous* foods.

Time Required
60 minutes

Materials Needed
Pencils, colored pens, calculators, 1 copy of the **Nutrition Data Handout** per student, 1 copy of the teacher answer key from the **Nutrition Data Handout**, and 1 copy of the **Ancient 'Four Corners Potato' Makes Culinary Debut** article per student.

Directions

1. Tell students that the goal of this lesson is to help them learn how to analyze, interpret, and make fair comparisons of nutritional information. In addition, they will also learn about the nutritional content and positive health benefits of the Four Corners Potato and compare it to Fry Bread, which is far less nutritious overall due to its more nutrient poor ingredients.
2. Before moving on, tell or remind students that the Four Corners Potato, *Solanum jamesii*, is a potato species that is *indigenous* to the American Southwest, whereas the Organic Red Potatoes referenced in this lesson are a different species of potato called *Solanum tuberosum* that are *indigenous* to the Andes region of South America. All of the potato varieties that we commonly find and buy at the grocery store are *S. tuberosum* potatoes.
3. Pass out a copy of the **Nutrition Data Handout** to each student and preview questions #1-6 (do not have them do #7 yet) on the second page with your students.
4. Give students time to work through answering questions #1-6 (do not have them do #7 yet). Have students work together with a partner or in groups. Encourage them to discuss and share ideas while working together. If students finish early, challenge them to add more details to their responses for questions #5 and #6 and/or have them create a list of foods that they eat regularly and circle the foods they would consider to be healthy. Have them justify (using evidence if possible) why they labeled a food healthy or unhealthy.
5. As a class, go through questions #1-6 and have several students share their answers for each question. Use the teacher's answer key (page 3 of the handout)

to help students make corrections where necessary and to highlight information that they may not have noticed on their own.

6. Complete question #7 as a class and provide your students with the definition given on the teacher's answer key (page 3 of the handout). Ask them: *How does this definition help you to better understand the nutritional value of different foods? What does nutritional density take into account that calories alone or amounts by themselves do not?* Discuss students' ideas. Highlight the concept of density here if students do not bring it up on their own.
7. Next, have students study ***Nutrition Data Table #2*** (on page 1 of the handout) and explain the positive benefits of the Four Corners Potato. Point out that all foods have positive and negative attributes just like the Four Corners Potato. Those foods that are considered *superfoods* are nutrient dense foods that have far more positive attributes than negative attributes, meaning they have a whole lot of beneficial nutrients (vitamins and minerals) packed into each calorie. When foods have really small amounts of nutrients per calorie, we typically refer to these foods as nutrient poor. The Four Corners Potato is considered to be a *superfood* because of its high nutrient density. However, it does have some negative attributes and will not provide us with everything we need all on its own. For this reason, it is important to have a varied and balanced diet of nutrient dense foods, which is exactly why *indigenous* people who relied on the Four Corners Potato throughout history also ate a wide variety of other nutrient dense foods (i.e. berries, roots, game meat, and the three sisters crops - corn, beans, squash). Fry Bread, on the other hand, is generally a nutrient poor food because most traditional Fry Bread recipes use nutrient poor ingredients like white flour, sugar, and lard. While Fry Bread does contain some positive attributes, its nutrient density (amount of positive attributes per calorie) is much lower compared to the Four Corners Potato, as well as compared to other fresh fruits and vegetables.
8. As a class, read the **Ancient 'Four Corners Potato' Makes Culinary Debut** article. Make sure that students know the geographic locations of Bears Ears and Escalante. Show students a map that shows these two regions, if needed.

Works Cited

"Ancient 'Four Corners Potato' Makes Culinary Debut." *Potato Grower Magazine*, 8 Oct. 2018, www.potatogrower.com/2018/10/ancient-four-corners-potato-makes.

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“Potato Nutrition Facts | Nutrients, Calories, Benefits of a Potato.” *Potato Goodness*, Potatoes USA, 26 July 2021, www.potatogoodness.com/nutrition.

Lesson #2: *Meet Cynthia Wilson, Diné (Navajo) Nutritionist*

Purpose
To provide an example of a Native American career path as a nutritionist.
To foster an appreciation for how a degree in nutrition could serve *indigenous* communities.

Time Required
15 minutes

Materials Needed
A computer and projector for showing the **video interview with Cynthia Wilson**.

Directions

1. Tell students that they will be watching a 5 minute video of Cynthia Wilson, a Diné nutritionist with a depth of cultural expertise. The goal of watching this video is to foster an appreciation for how a degree in nutrition could serve *indigenous* communities.This lesson is also part of the ***Native American Career Pathways*** lessons, which are meant to highlight a variety of Native Americans in unique and distinguished careers.
2. Play the video for students. Discuss any insights or questions students may have during and/or at the end of the video.

Lesson #3: *Micronutrient Research Project*

Purpose
To explore the essential roles micronutrients play in maintaining a healthy body.
To understand the importance of having nutrient dense foods in one's diet.

Time Required
90-120 minutes

Materials Needed
Pencils, computers with internet access, 1 copy of the **Nutrition Data Handout** per student, and 1 copy of the **Micronutrient Research Project** per student.

Directions

1. Tell students that they will be working in groups to research the essential roles micronutrients play in maintaining a healthy body.
2. Pass out a copy of the **Micronutrient Research Project** handout to every student.
3. Read through the project's purpose, definitions, and instructions with your students and point out the recommended resources for getting started.
4. Ask students to pull out their **Nutrition Data Handout** and have them look over the ***Nutrition Data Table #2*** to see what micronutrients are found in Four Corners Potatoes.
5. Decide how you would like to form student groups. For example, do you want to let students choose their own groups based on interest or will students work better if the groups are assigned? Ultimately, regardless of how you form groups, make sure that each group researches a different micronutrient. Again, use the lists shown in ***Nutrition Data Table #2*** on the **Nutrition Data Handout** to see what micronutrients are found in the Four Corners Potatoes.
6. Before beginning their research, help students remember how to tell whether or not a source is providing them with reliable information. There are many free lessons posted on the internet that cover this topic.
7. Tell students that they may begin working their research. Remind them that each student in the group must complete and turn in the **Micronutrient Research Project** handout at the end of the project.
8. Move around the room and check in repeatedly with each group to make sure they get help when needed and stay on track.
9. Give students 45-60 minutes to complete the research and another 45-60 minutes to work on their presentations or informational products. More time may

be needed depending on the enthusiasm of your students and which formats they choose for presenting their research.

10. Presentations will happen at a later time.

Suggested Resources for Students

Merck Manual Consumer Version Website: https://www.merckmanuals.com/home
Centers for Disease Control (CDC) Micronutrients Facts Webpage: https://www.cdc.gov/nutrition/micronutrient-malnutrition/micronutrients/index.html
National Institutes of Health (NIH): https://ods.od.nih.gov/factsheets/list-all/#

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"Vitamins and Minerals (for Teens) - Nemours Kidshealth." *KidsHealth*, Jan. 2021, kidshealth.org/en/teens/vitamins-minerals.html.

EXPLAIN

Micronutrient Presentations

Target Grade Levels	9th - 12th (can be adapted for grades 6th-8th)
Enduring Understandings	1. Micronutrients (a.k.a. macrominerals, trace minerals, and vitamins) are responsible for doing a wide range of important jobs in our bodies. 2. It is important to have a variety of nutrient rich foods in one's diet because micronutrients are essential for maintaining a healthy body.

Alignment to Utah's SEEd Standards

Science and Engineering Practices
Obtaining, evaluating, and communicating information: Students obtain, evaluate, and derive meaning from scientific information or presented evidence using appropriate scientific language. They communicate their findings clearly and persuasively in a variety of ways including written text, graphs, diagrams, charts, tables, or orally. *(Lesson #1)*
Crosscutting Concepts
Cause and Effect: Students investigate and explain causal relationships in order to make tests and predictions. *(Lesson #1)* **Energy and Matter:** Students describe cycling of matter and flow of energy through systems, including transfer, transformation, and conservation of energy and matter. *(Lesson #1)*
Disciplinary Core Ideas
Standard BIO.2.1 Construct an explanation based on evidence that all organisms are primarily composed of carbon, hydrogen, oxygen, and nitrogen, and that the matter taken into an organism is broken down and recombined to make macromolecules necessary for life functions. Emphasize that molecules are often transformed through enzymatic processes and the atoms involved are used to make carbohydrates, proteins, fats/lipids, and nucleic acids. (LS1.C) *(Related to Lesson #1)* **Standard BIO.2.2** Ask questions to plan and carry out an investigation to determine how (a) the structure and function of cells, (b) the proportion and quantity of organelles, and (c) the shape of cells result in cells with specialized functions. Examples could include mitochondria in muscle and nerve cells, chloroplasts in leaf cells, ribosomes in pancreatic cells, or

the shape of nerve cells and muscle cells. (LS1.A) *(Related to Lesson #1)*
Standard BIO.2.4
Plan and carry out an investigation to determine how cells maintain stability within a range of changing conditions by the transport of materials across the cell membrane. Emphasize that large and small particles can pass through the cell membrane to maintain homeostasis. (LS1.A) *(Related to Lesson #1)*

Section Overview

Students present their slideshows, videos, brochures, and informational posters to one another with the goal of teaching each other about the wide range of essential roles micronutrients play in maintaining a healthy body. Students should be able to explain how their chosen micronutrient helps maintain a healthy body, what happens when people have a deficiency, what happens when people have too much, and what foods can help people obtain it. Students also should take notes on the other micronutrient information presented by their peers.

Lesson #1: Micronutrient Presentations

Purpose
To learn about the wide range of essential roles micronutrients play in maintaining a healthy body.
To understand the importance of having nutrient dense foods in one's diet.

Time Required
60 minutes

Materials Needed
Students will need the presentations/informational products they created in Lesson #3 of the EXPLORE section, pages 5-6 from their **Micronutrient Research Project** handouts, and the classroom will need a computer for projecting any slideshows or videos students created.

Directions

1. Tell students that they will now teach one another about the micronutrient they became an expert on in order to learn about the wide range of essential roles micronutrients play in maintaining a healthy body.
2. Explain that students will use pages 5-6 from their **Micronutrient Research Project** packet to take notes on presentations and/or informational products created by other student groups.
3. Following each presentation or informational product viewing, students should pick one essential function they learn about for that particular micronutrient and describe it in detail under the correct heading on pages 5-6.
4. Have each group present their research findings. If enough groups chose to create brochures or posters, you could consider doing a gallery walk where students can slowly move around the room and read the brochures and posters on their own. Be sure to provide a time limit for this, as well as to have some probing questions ready to challenge the students who rush through the activity to learn more from it.
5. Finish the lesson with a brief whole class discussion. Ask students: *What surprised you? Does learning this information about micronutrients change how you might approach food in the future? What challenges might you face when trying to add more nutrient dense foods to your diet (i.e. willpower, money, resources, knowledge, etc.)? How might nutrient deficiencies be related to social justice issues (i.e. available resources, money, access to fresh fruits/vegetables, etc.)? Explain.*

ELABORATE

Indigenous Food Sovereignty

Target Grade Levels	9th - 12th (can be adapted for grades 6th-8th)
Enduring Understandings	1. Today, indigenous people in the United States (and all over the world) are reclaiming their spiritual, political, and cultural identities through ***food sovereignty***. 2. Indigenous food activists focus on using local, indigenous ingredients that place an emphasis on their connection to the land. 3. The future of the Four Corners Potato will depend on the food system that it becomes a part of.

Alignment to Utah's Core State Standards for Social Studies

UT Strand 1: NATIVE INNOVATIONS AND ADAPTATIONS
UT Standard 1.5: Students will describe the cultural change and continuity of at least one of Utah's current sovereign nations as it has responded to changing political, social, and economic forces. Students will use a variety of resources that may include written primary and secondary sources, oral histories, photographs, artifacts, and art. (economics, civics)
UT Strand 4: UTAH IN THE WORLD
UT Standard 4.4: Students will use data and other evidence related to a cultural, ethnic, or religious group in Utah to interpret the group's historic/current conditions and experiences. (history, geography)

Section Overview

In the first lesson, students learn about work from Utah Diné Bikéyah and how this connects to food sovereignty. Building on this, the second lesson is part of the ***Native American Career Pathways*** thread and introduces students to Indigenous cook and food activist, Karlos Baca. Students can watch an exclusive interview with Karlos that covers his views around indigenous food sovereignty, as well as his knowledge of

indigenous food-related practices such as foraging and reading the land. Lastly, in the third lesson, students discuss their ideas around whether the Four Corner Corners potato is a resource that should stay within its localized community or be shared widely with others. This primes students to think more deeply about how the decisions we all make today could have a meaningful impact on the future.

Lesson #1: *What is Indigenous Food Sovereignty?*

Purpose
To build a greater understanding of what food sovereignty is, what role traditional foods play in food sovereignty and how Native American communities are reclaiming their spiritual, political, and cultural identities through **food sovereignty**.

Time Required
30 minutes

Materials Needed
A computer and projector for showing the **Traditional Foods Video** produced by Utah Diné Bikéyah for their Traditional Foods Program.

Directions
1. Share the purpose of this lesson with students.
2. Share with students the following definitions of food sovereignty:

> *"Food sovereignty is the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. It puts the aspirations and needs of those who produce, distribute and consume food at the heart of food systems and policies rather than the demands of markets and corporations."*
>
> *– Declaration of Nyéléni, the first global forum on food sovereignty, Mali, 2007*

However, when we consider food sovereignty for the indigenous people of the United States, then the following explanation of food sovereignty provided by the **First Nations Development Institute** is also quite helpful:

> *"For many tribal communities, the term sovereignty is used as a term that recognizes the right of Native peoples to retain their cultural identity and to acknowledge and reserve fundamental rights granted in treaties and other legal documents. Strongly connected to this is the notion that Native people have the right to choose what they eat as individuals and as a culturally distinct community. For many centuries, this right has not been honored and the foods Native people now dominantly consume were introduced through imposing a diet on Native people and their communities.*

> *Food sovereignty is about unraveling that diet and decolonizing local food systems — from consumption to production. In many ways, food sovereignty is a method that supports the revitalization of traditional land-management practices and upholds cultural continuity. But at its heart, food sovereignty promotes Native economic and political sovereignty and traditional food knowledge as a means to promote strong and healthy Native communities and people"* (Food Sovereignty Assessment Tool).

Ask a few students to rephrase in their own words. Discuss with students what this might mean in relation to the Four Corners Potato or other food they have learned about so far.

3. Introduce students to the grassroots nonprofit **Utah Diné Bikéyah**, which works "*to promote healing of people and the earth through conservation of cultural lands.*" Then, tell students they are going to watch a short video that shows some of the efforts being taken in the Four Corners region to reclaim indigenous food practices and systems.
4. Before watching the **Traditional Foods Video** produced by Utah Diné Bikéyah for their Traditional Foods Program, ask students to keep an eye out for indigenous food collection, preparation, and consumption practices that may be unique or different from more conventional, non-indigenous practices in the United States. Once finished showing the film, ask students to share their observations of indigenous food practices with a partner, then with a larger group, and finally with the whole class.
5. Pose the following questions to the students:
   What practices and resources should stay within their localized community versus being shared widely with others? Why?
   Tell students that this is the same question that people are grappling with as they discuss the future of the Four Corners Potato. Take some time to hear some ideas and reassure students that they will have a chance to return to this question later.

Extension Activity

To extend on this lesson, you could also have your students read the following article written by Andi Murphy and published by Eater Magazine on October 17, 2018: **The Navajo Nation Is Reclaiming Its Native Food Culture.**

Works Cited

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Lesson #2: *Meet Karlos Baca, Indigenous Foods Activist*

Purpose
To provide an example of a Native American career path as an indigenous cook, forager, and food activist.
To learn about what it means to be an indigenous cook, forager, and food activist.

Time Required
30 minutes

Materials Needed
A computer and projector for showing the **video interview with Karlos Baca.**

Directions

1. Tell students that they will be watching a 20 minute video interview of Karlos Baca, a Tewa/Diné/Nuche indigenous cook, forager, and food activist. The goal of watching this video is to foster an appreciation for how indigenous culinary expertise could serve *indigenous* communities.This lesson is also part of the ***Native American Career Pathways*** lessons, which are meant to highlight a variety of Native Americans in unique and distinguished careers.
2. Play the video for students. Discuss any insights or questions students may have during and/or at the end of the video.

Additional Resources

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Lesson #3: *The Four Corners Potato and Food Sovereignty*

Purpose
To learn about the efforts by Native Americans to reclaim the Four Corners Potato.
To consider what the future of the Four Corners Potato should look like.

Time Required
30-40 minutes

Materials Needed
A computer and projector for showing the **Indigenous Farmers slideshow** and **Marketing the Four Corner Potato**, and printouts of the **Four Corners Potato Gazette** for students.

Directions

1. Tell students that the purpose of this lesson is to show students how Native Americans are working to reclaim the Four Corners Potato. In addition, they will be tasked with using all that they have learned about Native American history, indigenous food systems, and indigenous food sovereignty to carefully consider what the future of the Four Corners Potato should look like.
2. Next, share the **Indigenous Farmers** slideshow with your students OR have your students read three publications of the **Four Corners Potato Gazette**. Point out how researchers from the University of Utah have been working together with indigenous farmers to learn more about the Four Corners Potato and help bring it back to indigenous communities. If time allows, show students the slideshow titled **Marketing the Four Corner Potato** from the May 2021 Four Corners Potato workshop in Bluff, Utah. This slideshow goes into more detail and depth about what has been learned so far and how much interest there is in both indigenous and non-indigenous communities around this potato.
3. Next, give students several minutes to silently consider the following question and jot down their responses to it:

   > *Is the Four Corners Potato a resource that should stay within its localized community or be shared widely with others? Why? Be prepared to share and defend your thinking with others.*

   After some reflection time, tell students that they will soon pick a place on a line in your classroom where one end of the line represents those who 100% agree that the Four Corners Potato should stay localized within its community and where the other end of the line represents those who 100% think the potato should be shared widely with others. Before letting them find their place on the line, remind students of the following:

What is important here is that we can truly listen to one another's ideas and carefully consider the perspective that each one of us has to offer.

Next, give students a minute to place themselves on the line. Once in place, have several volunteers share their thoughts about the issue from different places along the line. Invite students to respectfully disagree, but most importantly, make sure that they defend their thinking by explaining why they chose their spot on the line.

4. Once students have had a chance to share, have students take a few minutes to decide if their thinking has changed at all. To capture this, you can have students return to the line, but this time, allow them to pick a new place on the line if they choose. Alternatively, you could ask them to draw on a piece of paper where they would place themselves on the line now and have them explain why below their drawing.
5. Finish the class by pointing out that questions like these are often complex, and therefore, it can take a lot of time, discussion, and compromise before a solution arises that works for everyone. However, despite the time and effort required, all people benefit when everyone's perspectives and voices are both heard and taken into account, just like in our classroom.

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DEEP HISTORY

Overview of Lesson

The Engage section begins with several lessons that challenge students to engage with their own thoughts about how people gather evidence about the past, what archaeological findings can offer us, and how archaeology has, at times, been in conflict with some cultures. Next, in the Explore section, students read an article about the FBI raid that resulted in the arrests of people in the town of Blanding, Utah, who had illegally looted thousands of indigenous ancestral artifacts in the Four Corners region. After sharing their reactions to the article, students then learn about the laws that have been put in place to protect and repatriate indigenous artifacts. Lastly, as a part of the ***Native American Career Pathways*** thread, students are introduced to Dr. Joe Watkins, a Native American (Choctaw) archaeologist who coined the term Indigenous Archaeology. They also get a chance to see how several archaeologists are working to include indigenous communities in their work, and by doing so, how they are uncovering a more holistic picture of the past. In the Explain section, students work together to develop their background knowledge of some relevant archaeological terms. They then read about and draw conclusions from the archaeological findings of the Four Corners Potato obtained from the North Creek Shelter in Escalante, Utah. Finally, in the Elaborate section, students learn about the wide-sweeping impacts that the South American potato, *Solanum tuberosum*, has had on the world. Students are then challenged to use this story as an inspiration for the telling of their own story; one that is about the past, present, and future of the Four Corners Potato. They are also reminded of the power that storytelling can have to both celebrate learning and pass down information, as well as the important role that storytelling plays in many indigenous cultures. As a culmination of their learning, students share their stories in a variety of formats with their classmates and, if possible, with the larger community.

ENGAGE

Why and How We Learn About Past Peoples?

Target Grade Levels	9th - 12th (can be adapted for grades 6th-8th)
Essential Understandings	1. Archaeology is one way, out of many different ways, to learn about past peoples and their ways of life. 2. Examining our past helps us to understand and wrestle with today's challenging issues by uncovering how the past has shaped (and continues to shape) our world.

UT Strand 1: NATIVE INNOVATIONS AND ADAPTATIONS
Possible Guiding Questions to Consider: ● What can the study of archaeology tell us about the economies, communities, and other aspects of the cultures of these early peoples? ● Why is it vital to protect archaeological sites in Utah? ● Is conflict inevitable when cultures interact? *(Relates to Lessons #1 and #2)*
UT Strand 5: LOOKING TOWARDS UTAH'S FUTURE
Possible Guiding Questions to Consider: ● How should issues be resolved that involve state, federal, and American Indian lands? **UT Standard 5.2:** Students will use geographic tools and resources to investigate a current issue, challenge, or problem facing Utah or their community, and propose a viable solution. (geography) *(Relates to Lesson #2)*

Section Overview

Students are challenged to brainstorm about why and how people gather evidence to uncover what has happened in the past. Next, they are given a definition of ***archaeology*** and are pushed to think about the challenges that archaeologists might face when trying to gather evidence in culturally responsive and appropriate ways.

Lesson #1: *Why and How We Learn About Past Peoples, Cultures, and Events?*

Purpose
To think deeply about why and how we learn about past peoples, cultures, and events.
To encourage the sharing of many ideas in a short period of time.
To talk with and listen to different individuals in the room.
To include everyone and have all student voices be heard.

Time Required
60 minutes

Materials Needed
A chair, pencil, and notepaper for every student.
Optional: Student clipboards, post-it notes, flip chart sheets, and markers for flip chart titles.

Set-Up
Put 4 chairs back to back at the hub of the wheel and 4 chairs on the outer circle facing the chairs at the hub. The teacher then selects 4 ideas or questions to explore. Please note that you can use a different number of chairs for each wagon wheel depending on your total number of students, but if possible, keep the number of chairs at 4 or more for the hub of the wheel so that students get to discuss their ideas with 4 different people.

Directions
Borrowed and adapted from the **National School Reform Faculty Wagon Wheel Brainstorm Protocol**

1. Have students get a notebook and pencil and fill in the seats in the wheel(s).
2. Ask them to take notes on both their own ideas as well as the ideas of others.
3. The people on the outside of the wheel will be moving one seat to their right at each rotation; people at the hub remain in their seats.
4. Explain that they will be working on discussing their ideas about one topic or question with each partner for approximately 5-6 (allow more time if needed) minutes — i.e. they will work with 4 different partners during the activity.
   Optional Variation: *If you are worried about some students not talking or talking too much, you could instruct only the hub students to talk for the first 2 minutes, then only the rim students for the following 2 minutes, and leave the final 2 minutes for discussion or note taking. Then, on the next rotation, switch things up and have the rim students share first and the hub students share second.*

5. For each topic or question, have the students share their ideas with one another and record all ideas. At the end of each rotation, ask each participant sitting on the outside of the wheel to rotate one seat to the right. After they settle down, give them the next topic or question.
6. **Recommended questions to explore:**
    a. Why might people want to know about past peoples, cultures, and events?
    b. How would you look for evidence about what has happened in the past?
    c. Here is the definition of archaeology provided by the **Society for American Archaeology**: *"Archaeology is the study of the ancient and recent human past through material remains. Archaeology analyzes the physical remains of the past in pursuit of a broad and comprehensive understanding of human culture."* How do you feel about what archaeologists do and WHY?
    d. If it were up to you to learn as much as possible about the recent and ancient history of the Four Corners Potato, how would you look for evidence? Where would you start? What would you have to do to accurately uncover the history of the Four Corners Potato?

Ideas for Going Deeper

- Have a whole class discussion around each topic or question. Encourage students to share their favorite idea or response they heard from someone else.
- Have students pick their favorite ideas for each topic and write them down on post-its. Put large flip chart sheets with the topic or question on the top around the room and have participants post their favorite ideas on the appropriate sheet.
- Create focus groups to further explore a specific topic or question.

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Lesson #2: *The Challenges and Conflicts of Archaeology*

Purpose
To think deeply about the challenges and conflicts that can surround archaeology.
To silently reflect and generate ideas.
To include everyone and encourage all ideas to be shared.

Materials Needed
Whiteboard and whiteboard markers or paper roll on the wall and markers.

Directions
Borrowed and adapted from the **National School Reform Faculty Chalk Talk Protocol** (Wentworth).

1. Before class begins, write the definition of archaeology provided by the **Society of American Archaeology** on the whiteboard or wall paper so that everyone can see it: "*Archaeology is the study of the ancient and recent human past through material remains. Archaeology analyzes the physical remains of the past in pursuit of a broad and comprehensive understanding of human culture.*"
2. Remind and show students the definition of archaeology.
3. Next, explain to students that a chalk talk is a completely silent activity where they will respond to a new question by writing their comments on the whiteboard or wall. Students can also comment on each other's ideas by drawing a connecting line to the original comment they are responding to. Also, the teacher can participate in the chalk talk as well by circling ideas, commenting on students' ideas, and writing new questions next to comments that push students to think even more deeply.
4. Write the following question on the whiteboard or wall (or you can project it from your computer): *Imagine that you are an archaeologist. How do you gather evidence about human history in respectful and culturally appropriate ways? What challenges might you face when trying to do this? How do you conduct your research in an inclusive manner, so that you are involving all people with a connection to your work?*
5. Provide students with markers and allow them the time and space to write as they feel moved. It is natural for long silences to happen during chalk talks, so give your students plenty of wait time before deciding to end the activity. As a result, the time needed to complete this activity will vary a lot from group to group and it could take anywhere from 10-30 minutes.
6. Once you feel enough ideas have been shared and responded to, stop your students for a few minutes and pose a new question: *Some archaeological sites were used throughout history by several different cultural groups or tribes that*

still exist today (i.e. Pueblo and Navajo). How might you, the archaeologist, navigate a situation where these cultural groups have different, and possibly opposing, ideas about what is considered acceptable when gathering evidence about the past?

7. Repeat the chalk talk for another 10-30 minutes.
8. At the end of the second chalk talk, you might choose to share the following anecdotal notes from a Four Corners Potato workshop held in the spring of 2021: *According to the Hopi, one must consult with the tribe's spiritual leaders before visiting an archaeological site. In the Pueblo tradition, visiting an archaeological site requires that one be initiated ceremonially. The Navajo, however, are taught to stay away from archaeological sites altogether. As we can see from these examples, there are different protocols within each tribe or culture for visiting archaeological sites.*
9. If time allows, you can have students share and discuss some of the ideas that stood out to them and why. You could also have students complete an exit ticket before leaving class. Possible exit ticket questions or prompts could include:
    a. Something that surprised me was…
    b. I used to think _____, but now I think _____.
    c. What questions, ideas, and feelings did this lesson raise for you?
    d. 3-2-1: List 3 things you learned from this discussion, 2 questions you still have, and 1 part of today's class that you enjoyed.
    e. Evaluate your participation in class today. What did you do well? What would you like to do differently next time?

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EXPLORE

Archaeology's Troubled Past and the Protection of Indigenous Artifacts

Target Grade Levels	9th - 12th (can be adapted for grades 6th-8th)
Essential Understandings	1. Indigenous artifacts are now protected from excavation or removal on federal and tribal lands. 2. As a result of the *Native American Graves Protection and Repatriation Act (NAGPRA)* law established in 1990, indigenous communities are reclaiming many ancestral artifacts through repatriation from individuals, museums, and others. 3. Historically, the discipline of archaeology has contributed to the unethical acquisition of indigenous artifacts, been troubled by its strong ties to colonialism, and critiqued for its sole reliance on Western ways of knowing and practices. 4. Indigenous archaeology seeks to collaborate with Indigenous people on community-based projects. Their knowledge, values, and traditions are used to help preserve indigenous heritage and correct inequalities that have existed within the field of archaeology.

Alignment to Utah's History Standards

UT Strand : NATIVE INNOVATIONS AND ADAPTATIONS
Possible Guiding Questions to Consider: ● What can the study of archaeology tell us about the economies, communities, and other aspects of the cultures of these early peoples? ● Why is it vital to protect archaeological sites in Utah? ● Is conflict inevitable when cultures interact? *(Relates to All Lessons)* **UT Standard 1.4:** Students will analyze primary and secondary sources to explain causes and effects of European-American exploration, including the response and

involvement of Utah's American Indian tribes. (history) *(Lessons #1)*
UT Standard 1.5: Students will describe the cultural change and continuity of at least one of Utah's current sovereign nations as it has responded to changing political, social, and economic forces. Students will use a variety of resources that may include written primary and secondary sources, oral histories, photographs, artifacts, and art. (economics, civics) *(Lesson #1)*

UT Strand 4: UTAH IN THE WORLD

UT Standard 4.4: Students will use data and other evidence related to a cultural, ethnic, or religious group in Utah to interpret the group's historic/current conditions and experiences. (history, geography) *(Lessons #1 and #2)*
Possible Guiding Questions to Consider:

- How do various ehtnic and religious communities in Utah maintain and celebrate their unique cultures?

UT Strand 5: LOOKING TOWARDS UTAH'S FUTURE

Possible Guiding Questions to Consider:

- How should issues be resolved that involve state, federal, and American Indian lands?

(Relates to All Lessons)
UT Standard 5.2: Students will use geographic tools and resources to investigate a current issue, challenge, or problem facing Utah or their community, and propose a viable solution. (geography) *(Relates to Lesson #2)*

Section Overview

In the first lesson, students begin by reading an article about the FBI raid that resulted in the arrests of people in the town of Blanding, Utah, who had illegally looted thousands of indigenous ancestral artifacts in the Four Corners region. Next, they learn about the laws that currently protect the excavation or removal of indigenous artifacts on federal and tribal lands. In the second lesson, students learn about how current archaeologists are working to right past wrongs in the discipline by collaborating with Indigenous people on community-based projects. Students are also introduced to the Choctaw (Native American) archaeologist, Joe Watkins, and a new branch of archaeology called ***Indigenous archaeology*** that emphasizes the use of indigenous knowledge, values, and traditions to help preserve indigenous heritage and correct inequalities that have existed within the field of archaeology.

Lesson #1: *Protecting Indigenous Artifacts*

Purpose
To increase awareness around the proper (and improper/illegal) handling of Native American artifacts, as well as the laws that exist to protect such artifacts.

Time Required
60-120 minutes

Materials Needed
1 copy per student of the Smithsonian article titled **An Exclusive Look at the Greatest Haul of Native American Artifacts**, highlighters or pens for underlining, and pencils (Sharp).

Directions

1. First, ask students the following: *What would you do if you found an arrowhead on a hike? Would you leave it alone, keep it, examine it and put it back? Explain.* Give students a few minutes to respond to the question. First, have them share their answer with a partner, then have several volunteers with different responses share with the whole class. Once finished, be careful here to emphasize that this lesson is not meant to make anyone feel bad about the answers they shared. Rather, it is meant to help increase awareness around the proper (and improper/illegal) handling of Native American artifacts, as well as the laws that now exist to protect such artifacts.
2. Next, tell students that you have an article for them to read about an event that occurred on June 10, 2009, in the town of Blanding, located in the Four Corners region of Utah. Before handing out the article, post the following questions for students to consider while they read the article: *Are there any ideas, perspectives, or assumptions you want to challenge from the text? What changes in attitudes, thinking, or action are suggested by the text, either for you or others?* (The 4 C's). Leave the questions on the board for students to see throughout class.
3. Pass out a copy of the Smithsonian article to each student and have them pull out highlighters or a pen for highlighting parts of the text.
4. To capture the essence of this text with students, plan to use the following adaptation of the **Word-Phrase-Sentence** visible thinking routine from the Harvard Graduate School of Education. Using a routine like this can help students better capture the essence of a text and facilitate a productive discussion. Additionally, in this routine, teachers are encouraged to participate along with their students.

5. First, have your students read the text (15-20 minutes). Encourage active reading and highlighting. Also, be sure to tell students what they may quietly work on if they finish the reading before other students.
6. Once all students have finished reading the text, give them 10 minutes to review the text and select:
    a. A **word** that captured your attention or struck you as powerful.
    b. A **phrase** that moved, engaged, or provoked you.
    c. A **sentence** that was meaningful to you, that you felt captures the core idea of the text.
7. In groups of 4 to 6, ask students to share and record their choices, explaining why they selected them (10 minutes). Sharing and discussion should occur in rounds, so the discussion is facilitated. The first participant shares a word and explains why she chose it, inviting others to comment and discuss. The word is recorded and then the next person shares, records, and discusses until everyone has their turn. The group then moves to phrases and finally to sentences.
8. Once everyone has shared all of their selections, each group should assign a recorder and work together to answer the following questions (10 minutes):
    a. What common themes are emerging from the group's responses?
    b. Are important parts of the text not represented? If so, why do you think this is?
9. Finally, share the thinking with the whole class (10 minutes). Post documentation from all the groups around the room. Allow students time to quietly walk around and view the sentences, phrases, and words chosen and the themes and conclusions drawn. Invite each group member to reflect briefly on his or her current understanding of the text and how using the routine contributed to his or her understanding of it.
10. Finally, have the class return to a whole group discussion and ask students to respond to the questions posed at the beginning of class: *Are there any ideas, perspectives, or assumptions you want to challenge from the text? What changes in attitudes, thinking, or action are suggested by the text, either for you or others?*
11. Conclude class by sharing a brief overview of the various laws that currently work to protect and repatriate Native American artifacts (Gibbon):

> **The Antiquities Act, ARPA and NAGPRA**
>
> Although the 1906 Antiquities Act laid the groundwork for later laws on archaeological and cultural heritage, the primary laws that impact Native American, Alaskan, and Hawaiian art today are the Archaeological Resources Protection Act of 1979 (ARPA), and the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA). ARPA prohibits excavation without a permit on federal and Indian lands as well as trafficking in archaeological resources that have been illegally removed.

> NAGPRA is focused on the repatriation of human remains and ritual objects to tribes from any museum, institution or State or local government agency that receives federal funds. Other federal laws deal with the theft of objects from sites on government and Indian lands or damaging ruins or graves, considered destruction of federal property.
>
> Both ARPA and NAGPRA contain umbrella provisions that vastly increase their scope. Under the federal regulations dealing with archaeological resources,[i] anything that was excavated or removed in violation of any federal, state, or local law is illegal to sell, purchase, exchange or transport following the passage of ARPA in 1979.

Ask students to think about what questions they might now ask themselves if they come across an arrowhead. *Would they consider picking it up and keeping it? If not, why? If so, under what circumstances?*

Additional Discussion Questions to Consider

- What is lost when artifacts are illegally removed?
- Should artifacts be taken for preservation in museums and private collections? Why or why not?
- How would you share artifacts today?
- How can the authenticity of an art piece or artifact be determined?
- Do you feel that repatriation is a reasonable way to handle artifacts removed from Native sites?
- Are all artifacts equally worthy of repatriation?
- Should human remains be given priority for repatriation over domestic or religious objects?
- Who owns history?

Extension Activity

Read the New York Times article **Should Museums Return Looted Artifacts to Their Countries of Origin** as a class (Daniels). Read the question prompts in the last section of the article so students have an idea of what to think about and look for as they read. Then, have students pick one of the following 3 articles to read in a group or on their own:

- The New York Times article **Return Looted Art to Former Colonies, Dutch Committee Tells Government** (Moses).
- The New York Times article **As Native Americans, We Are in a Constant State of Mourning** (Colwell).
- The New York Times article **To Protest Colonialism, He Takes Artifacts From Museums** (Nayeri).

Once students have read their chosen article, you could have them create small jigsaw groups in which there is at least one student representing each article. Instruct students to share a summary of their article with their group. Lastly, bring the class together and lead them through a discussion of the questions provided in the last section of the original article titled **Should Museums Return Looted Artifacts to Their Countries of Origin** (Daniels).

Works Cited

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Gaffney, Dennis. "Indian Artifacts: Understanding the Law." *Public Broadcasting Service (PBS)*, 7 Apr. 2014, www.pbs.org/wgbh/roadshow/stories/articles/2014/4/7/indian-artifacts-understanding-law.

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Moses, Claire. "Return Looted Art to Former Colonies, Dutch Committee Tells Government." *The New York Times*, 9 Oct. 2020, www.nytimes.com/2020/10/09/arts/design/dutch-restitution-report.html.

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Sharp, Kathleen. "An Exclusive Look at the Greatest Haul of Native American Artifacts, Ever." *Smithsonian Magazine*, 21 Oct. 2015, www.smithsonianmag.com/history/exclusive-greatest-haul-native-american-artifacts-looted-180956959.

"The 4 C's." *Project Zero*, Harvard Graduate School of Education, 2019,

www.pz.harvard.edu/sites/default/files/The%204%20Cs_1.pdf.

"Word-Phrase-Sentence." *Project Zero*, Harvard Graduate School of Education, 2019, www.pz.harvard.edu/sites/default/files/Word-Phrase-Sentence.pdf.

Lesson #2: *Indigenous Archaeology and Dr. Joe Watkins*

Purpose
To provide an example of a Native American career path as an archaeologist.
To show students that it is possible for indigenous cultures and archaeologists to work together in ways that benefit indigenous communities.

Time Required
60 minutes

Materials Needed
A computer, internet connection, and projector for showing videos including the **interview with Dr. Joe Watkins**

Directions

1. Tell students that they will learn about how people within the field of archaeology are currently working with Inidigenous peoples to uncover a more holistic understanding of the past, as well as to benefit indigenous communities. In this lesson, students will also meet the Indigenous archaeologist, Dr. Joe Watkins, who coined the term ***Indigenous Archaeology***. Lastly, this lesson is also part of the ***Native American Career Pathways*** lessons, which are meant to highlight a variety of Native Americans in unique and distinguished careers.
2. Ask students to share what they think the word "*decolonize*" means. Give time and space for students to think and share. You may want to write some of their ideas on a whiteboard or poster.
3. Read the following definition of decolonization to your students (Eyers):
   > *"The first and most basic meaning for "decolonization" is when a nation seeks to become free of the oppressor/oppressed regime imposed on them by a colonial power, and to physically and legally undo the colonial state, or Empire, that has dominated their society."*
4. After listening to this definition, ask students: *What do you think people mean when they say that the discipline of archaeology needs to be decolonized? What are they referring to? How does this topic relate to archaeology?*
5. Show students the YouTube video called **Decolonizing Archaeology** posted by the **Students on Ice Foundation**. Read the following video description to them after showing the video:
   > *"I think decolonizing archeology, and even decolonizing academia, is understanding and looking at the different ways of knowing… To really gain a full understanding of an event in time is to have those different perspectives." Becky Mearns, Dean of Education at the Inuit and University Studies at Nunavut Arctic College, defines what decolonizing archeology looks like. We're grateful to be able to bring a diversity of experts on expedition to contribute to our education program from a variety of perspectives and ways of knowing.*

   Take a few minutes to discuss the video with students. Ask them: *Why is it*

important to decolonize archaeology? What was missing from past archaeological research that did not involve traditional knowledge and insights from indigenous communities? What are the benefits of involving indigenous communities in archaeological research? (Answers could include: getting a more holistic picture of the history in question, getting more indigenous youth interested in archaeology as a career path, getting support for research from the local community, etc.)

6. Introduce students to Dr. Joe Watkins as part of the ***Native American Career Pathways*** here, a Native American (Choctaw) archaeologist. Dr. Joe Watkins helped popularize the term and practice of ***Indigenous Archaeology***.
7. Finally, conclude class by telling students the following:

    In the upcoming lessons, you will be learning about the deep history of the Four Corners Potato. While many non-Indigenous people have contributed to this curriculum, it is important to highlight that all of this curriculum was completed in collaboration with Indigenous people from the Four Corners region of Utah. Like with ***Indigenous Archaeology****, the goal here was to include indigenous perspectives and ways of knowing in order to provide a more holistic educational experience.*

Additional Resources

"Indigenous Perspectives on Archaeology." *YouTube*, uploaded by National Centre for Collaboration in Indigenous Education, 13 Aug. 2020, www.youtube.com/watch?v=iYz_zPDFpNc.

Works Cited

Atalay, Sonya. "Indigenous Archaeology as Decolonizing Practice." *The American Indian Quarterly*, vol. 30, no. 3, 2006, pp. 280–310. *Crossref*, doi:10.1353/aiq.2006.0015.

"Decolonizing Archaeology." *YouTube*, uploaded by Students on Ice Foundation, 23 Aug. 2019, www.youtube.com/watch?v=YG3Lpef2GPc.

Eyers, Pegi. "Decolonization ~ Meaning What Exactly?" *Unsettling America*, 11 Oct. 2017, www.unsettlingamerica.wordpress.com/2017/10/11/decolonization-meaning-what-exactly.

EXPLAIN

The Deep History of the Four Corners Potato

Target Grade Levels	9th - 12th (can be adapted for grades 6th-8th)
Essential Understandings	1. The Law of Superposition helps archaeologists determine the relative ages of objects, whereas radiocarbon dating can help them determine more precise ages of objects. 2. Starch grains are tiny, resilient structures produced by most plants that are found on some ancient ground stone tools and used by archaeologists to determine ancient plant uses. 3. At the North Creek Shelter site, a shift from chipped stone tools to ground stone tools occurred around 9,000 years ago suggesting an increase in plant use around that time. 4. At the North Creek Shelter site, Four Corners Potato starch grain evidence suggests that it was eaten by people for a minimum of 4,000 years and as far back as 10,900 years ago.

Alignment to Utah's SEEd Standards

Science and Engineering Practices
Analyzing and Interpreting Data: Students analyze various types of data in order to create valid interpretations or to assess claims/conclusions. *(Lesson #2)* **Obtaining, evaluating, and communicating information:** Students obtain, evaluate, and derive meaning from scientific information or presented evidence using appropriate scientific language. They communicate their findings clearly and persuasively in a variety of ways including written text, graphs, diagrams, charts, tables, or orally. *(All Lessons)*
Crosscutting Concepts
Patterns: Students observe patterns to organize and classify factors that influence relationships. *(Lesson #2)* **Cause and Effect:** Students investigate and explain causal relationships in order to make tests and predictions. *(Lesson #2)* **Energy and Matter:** Students describe cycling of matter and flow of energy through

systems, including transfer, transformation, and conservation of energy and matter. *(Lesson #1)*

Disciplinary Core Ideas

Standard BIO.2.1
Construct an explanation based on evidence that all organisms are primarily composed of carbon, hydrogen, oxygen, and nitrogen, and that the matter taken into an organism is broken down and recombined to make macromolecules necessary for life functions. Emphasize that molecules are often transformed through enzymatic processes and the atoms involved are used to make carbohydrates, proteins, fats/lipids, and nucleic acids. (LS1.C) *(Related to Lesson #1)*
Standard BIO.2.2
Ask questions to plan and carry out an investigation to determine how (a) the structure and function of cells, (b) the proportion and quantity of organelles, and (c) the shape of cells result in cells with specialized functions. Examples could include mitochondria in muscle and nerve cells, chloroplasts in leaf cells, ribosomes in pancreatic cells, or the shape of nerve cells and muscle cells. (LS1.A) *(Related to Lesson #1)*
Standard BIO.2.4
Plan and carry out an investigation to determine how cells maintain stability within a range of changing conditions by the transport of materials across the cell membrane. Emphasize that large and small particles can pass through the cell membrane to maintain homeostasis. (LS1.A) *(Related to Lesson #1)*

Alignment to Utah's History Standards

UT Strand : NATIVE INNOVATIONS AND ADAPTATIONS

Possible Guiding Questions to Consider:
- What can the study of archaeology tell us about the economies, communities, and other aspects of the cultures of these early peoples?

(Lesson #2)
UT Standard 1.1: Students will make evidence-based inferences about the complex ancient cultures in Utah after studying artifacts from the prehistoric era. (history) *(Lesson #2)*
UT Standard 1.2: Students will analyze and explain the interactions and interconnections between the physical characteristics of Utah and American Indian cultures using a range of texts, oral histories, and geographic inquiry. (geography) *(Lesson #2)*

UT Strand 4: UTAH IN THE WORLD

Possible Guiding Questions to Consider:
- How do various ehtnic and religious communities in Utah maintain and celebrate their unique cultures?

(Lesson #2)

UT Standard 4.4: Students will use data and other evidence related to a cultural, ethnic, or religious group in Utah to interpret the group's historic/current conditions and experiences. (history, geography) *(Lesson #2)*
UT Standard 4.5: Students will describe the historic and present management of natural resources and make recommendations for natural resource management in the future. (geography) *(Lesson #2)*

UT Strand 5: LOOKING TOWARDS UTAH'S FUTURE

Possible Guiding Questions to Consider:

- How should issues be resolved that involve state, federal, and American Indian lands?

(Relates to All Lessons)
UT Standard 5.2: Students will use geographic tools and resources to investigate a current issue, challenge, or problem facing Utah or their community, and propose a viable solution. (geography) *(Relates to Lesson #2)*

Section Overview

First, students read several short paragraphs that outline the most important and relevant archaeological terms used in this lesson. Next, they read a summary of the archaeological findings from the North Creek Shelter excavation and from Chaco Canyon. Questions are posed after each section of reading and should be answered by students before moving on to the next section. The questions are designed to help students make sense of the main points and deepen their understanding of the material. Some students may benefit from completing the questions in a group or as a class depending on their level of background knowledge.

Lesson #1: *Background Knowledge for Archaeology*

Purpose
To develop the background knowledge needed to understand the archaeological findings and deep history of the Four Corners Potato.

Time Required
30-45 minutes

Materials Needed
Pencils, highlighters, 1 copy of the **Archaeology Reading Handout** (pages 1-3) per student, 1 copy of the **Archaeology Glossary** per student (or this can be shared between students), 1 copy of the ***Teacher Answer Key*** from the (pages 5-6), and 1 copy of the SERP Institute's Reciprocal Teaching handout per student group (pages 1-2).

Directions

1. Tell students that they will be doing some background reading in order to better understand the archaeological findings and deep history of the Four Corners Potato.
2. Students should read the following texts on pages 1-3 of the handout: *Law of Superposition, Radiocarbon Dating, and Starch Grains*. After each section of reading, they should answer the provided question(s). Students may complete this reading individually, in partners, or in small groups. If you choose to have your students work together, try using the **Reciprocal Teaching** "during reading" method published by the **SERP Institute** to help students process information.

Works Cited

Jones, Nicola. "Carbon Dating, the Archaeological Workhorse, Is Getting a Major Reboot."
Nature, 19 May 2020, www.nature.com/articles/d41586-020-01499-y?error=cookies_not_supported&code=43916e9e-baa1-4c2c-91e7-97740236acc4.

Louderback, Lisbeth A., and Bruce M. Pavlik. "Starch Granule Evidence for the Earliest Potato Use in North America." *Proceedings of the National Academy of Sciences*, vol. 114, no. 29, 2017, pp. 7606–10. *Crossref*, doi:10.1073/pnas.1705540114.

Mozdy, Michael. "In the Tiny World of Starch Grains, Bigger Is Better." *Natural History*

Museum of Utah, 27 Mar. 2020, nhmu.utah.edu/blog/2016/08/08/tiny-world-starch-grains-bigger-better.

"Strategies for the Classroom | Reading to Learn in Science." *SERP Institute*, 2021, www.serpinstitute.org/reading-science/classroom-strategies.

Lesson #2: *North Creek Shelter Evidence*

Purpose
To explore the archaeological findings and deep history of the Four Corners Potato.

Time Required
45-60 minutes

Materials Needed
Pencils, highlighters, 1 copy of the **Archaeology Reading Handout** (pages 3-4) per student, 1 copy of the **Archaeology Glossary** per student (or this can be shared between students), 1 copy of the ***Teacher Answer Key*** from the (pages 5-6), and a computer/projector for viewing Lisbeth Louderback's **DEEP HISTORY 2021** slideshow and the article titled **Starch Granule Evidence for the Earliest Potato Use in North America** (Louderback and Pavlik).

Directions

1. Tell students that the goal of this lesson is to explore the archaeological findings and deep history of the Four Corners Potato.
2. Have students work in groups of 2-3 students to complete the **Archaeology Reading Handout** (pages 3-4). Students should read each section and then answer the question that follows that section before moving onto the next section.
3. Once finished, go over the answers to the questions with students and help to clear up any misunderstandings. Use the ***Teacher Answer Key*** found on pages 5-6 of the **Archaeology Reading Handout**.
4. Next, tell students that what they read today is a summary of the information found in a scientific, peer-reviewed journal article written by University of Utah archaeologist Lisbeth Louderback and Red Butte Garden's Director of Conservation, Bruce Pavlik. Show them the full journal article titled **Starch Granule Evidence for the Earliest Potato Use in North America** (Louderback and Pavlik). Viewing this article will give students a taste of what a scientific journal article looks like. To help students visualize the information they just read about, show them the figures and read the captions that go with each figure.
5. If time allows, consider showing Lisbeth Louderback's **DEEP HISTORY 2021** slideshow, which provides some additional archaeological photos and evidence.

Works Cited

Louderback, Lisbeth A., and Bruce M. Pavlik. “Starch Granule Evidence for the Earliest Potato Use in North America.” *Proceedings of the National Academy of Sciences*, vol. 114, no. 29, 2017, pp. 7606–10. *Crossref*, doi:10.1073/pnas.1705540114.

Mozdy, Michael. “In the Tiny World of Starch Grains, Bigger Is Better.” *Natural History Museum of Utah*, 27 Mar. 2020, nhmu.utah.edu/blog/2016/08/08/tiny-world-starch-grains-bigger-better.

“Strategies for the Classroom | Reading to Learn in Science.” *SERP Institute*, 2021, www.serpinstitute.org/reading-science/classroom-strategies.

ELABORATE

How Could a Potato Change the World?

Target Grade Levels	9th - 12th (can be adapted for grades 6th-8th)
Essential Understandings	1. Native American agricultural innovations have played an important role in the development of transformative food systems throughout the world. 2. The arrival of the South American potato, *Solanum tuberosum*, along with other Native American foods improved health and contributed to a major population boom in Europe. 3. The Four Corners Potato is a mighty little tuber that has had and could continue to have a big and positive impact on the lives of many people. 4. Storytelling is a powerful way to celebrate learning and pass on important knowledge.

Alignment to Utah's SEEd Standards

Science and Engineering Practices
Obtaining, evaluating, and communicating information: Students obtain, evaluate, and derive meaning from scientific information or presented evidence using appropriate scientific language. They communicate their findings clearly and persuasively in a variety of ways including written text, graphs, diagrams, charts, tables, or orally. *(All Lessons)*
Crosscutting Concepts
Cause and Effect: Students investigate and explain causal relationships in order to make tests and predictions. *(All Lessons)*

Alignment to Utah's History Standards

UT Strand : NATIVE INNOVATIONS AND ADAPTATIONS
Possible Guiding Questions to Consider: ● How do economic systems, such as the trade networks Europeans developed with American Indian communities, shape and spread cultures?

- How do the current ways of life of Utah's Native American tribes reflect changes and continuities?

(All Lessons)

UT Standard 1.1: Students will make evidence-based inferences about the complex ancient cultures in Utah after studying artifacts from the prehistoric era. (history) *(Lesson #2)*

UT Standard 1.2: Students will analyze and explain the interactions and interconnections between the physical characteristics of Utah and American Indian cultures using a range of texts, oral histories, and geographic inquiry. (geography) *(Lesson #2)*

UT Standard 1.4: Students will analyze primary and secondary sources to explain causes and effects of European-American exploration, including the response and involvement of Utah's American Indian tribes. (history) *(Lesson #2)*

UT Standard 1.5: Students will describe the cultural change and continuity of at least one of Utah's current sovereign nations as it has responded to changing political, social, and economic forces. Students will use a variety of resources that may include written primary and secondary sources, oral histories, photographs, artifacts, and art. (economics, civics) *(Lesson #2)*

UT Strand 4: UTAH IN THE WORLD

Possible Guiding Questions to Consider:

- How do various ethnic and religious communities in Utah maintain and celebrate their unique cultures?

(Lesson #2)

UT Standard 4.4: Students will use data and other evidence related to a cultural, ethnic, or religious group in Utah to interpret the group's historic/current conditions and experiences. (history, geography) *(Lesson #2)*

UT Standard 4.5: Students will describe the historic and present management of natural resources and make recommendations for natural resource management in the future. (geography) *(Lesson #2)*

UT Strand 5: LOOKING TOWARDS UTAH'S FUTURE

Possible Guiding Questions to Consider:

- How should issues be resolved that involve state, federal, and American Indian lands?
- How do we create and sustain safe and healthy communities?

(Lesson #2)

UT Standard 5.1: Students will select a recent event they think will be worthy of remembering, recording, or interpreting, and make an argument for its potential historical significance. (history) *(Lesson #2)*

UT Standard 5.2: Students will use geographic tools and resources to investigate a current issue, challenge, or problem facing Utah or their community, and propose a viable solution. (geography) *(Lesson #2)*

UT Standard 5.3: Students will use data regarding the key components of Utah's

economy to make recommendations for sustainable development. (economics) *(Lesson #2)*

UT Standard 5.5: Students will research issues of civic importance in which city, county, tribal, or state governments have a role. Students will use their research to develop and write a policy proposal to the appropriate governmental entity, such as a board, commission, council, legislator, or agency. (civics) *(Lesson #2)*

Lesson #1: *History of the South American Potato*

Purpose
To learn about the origins of *Solanum tuberosum* and the impact of this plant.
To build awareness around the important role that Native American agricultural innovations have played throughout the world.

Time Required
30 minutes

Materials Needed
A computer/projector for showing the 15 minute video titled **How Potatoes Saved The World**.

Directions

1. In this lesson, students will learn about the origins of *Solanum tuberosum* (the South American potato that we all know from our grocery stores) and the significant impact it has had on the entire world. Unfortunately, much of this important history has been left out of traditional textbooks, so this is also an opportunity for students to explore a topic that they probably have not heard much about before.
2. Before watching the video, use a think-pair-share strategy to have students brainstorm how they think the Four Corners Potato could change the world. Once students have shared their ideas with a partner or small group, call on several volunteers to share with the whole class. Write a list of ideas shared on the board.
3. Next, watch the video titled **How Potatoes Saved The World**. Consider pausing the video in places to emphasize the enormous impact the S. tuberosum potato had on the world. Challenge students to keep brainstorming about the Four Corners Potato and its possible impacts as they continue watching the video.
4. Once finished with the video, ask students if they have come up with any additional ideas about possible impacts of the Four Corners Potato. Add new ideas to the list on the board.
5. Tell students that they will have a chance to create their own vision for the future of the Four Corners Potato in the next lesson. In addition, share that you are letting them know this now so that they will have time to ruminate on this and think of more possible ideas.

Additional Resources

Foster, Nelson, and Linda Cordell. *Chilies to Chocolate: Food the Americas Gave the World*. 1st Edition, University of Arizona Press, 1992.

Works Cited

"How Potatoes Saved The World." *YouTube*, uploaded by Cogito, 31 May 2019, www.youtube.com/watch?v=o1L6P_kMNzY.

Lesson #2: *Telling the STORY of the Four Corners Potato*

Purpose
To celebrate learning and honor the indigenous tradition of storytelling; another way to pass down knowledge.
To review all of what students learned about the Four Corners Potato.
To reflect on the important role that the Four Corners Potato has played in the past, is currently playing today, and could play in the future.

Time Required
120-180 minutes

Materials Needed
The materials will depend on the types of projects students choose to do and could involve the use of the following: computers, a projector, paper, pencils, markers, posters, musical instruments, apps or computer programs for creating videos, and possibly more.

Directions

1. Tell students that the goal of this lesson is to celebrate what they have learned and honor the tradition of storytelling (another way to pass down knowledge), which is an integral part of many indigenous cultures in the United States. This lesson is also their opportunity to communicate what they have learned about the Four Corners Potato, to highlight the important role this potato has played throughout history, as well as to share what they envision for the future of this mighty little tuber. *How could the Four Corner's Potato change the world?*
2. Ask them, *What would you want people to know about the Four Corners Potato? What has happened in the past and how has that past shaped the events that followed? What is happening in the present? How might these current events shape the future? What do you think should happen in the future and how can we make these things happen? How could the Four Corner's Potato change the world?*
3. Tell students that this is their chance to tell the story of the Four Corners Potato in a creative way of their choosing. For example, they could write a poem, create a slideshow, write/perform a song, make an infomercial, create an informational poster, write a letter to a government official, etc. In essence, students may choose whatever way they would like to communicate what they have learned about the Four Corners Potato, tell its story, and share what they envision for the future of this mighty little tuber. However, regardless of what format they choose, students should aim to include the following information in their stories:

    a. *3-5 significant historical findings about the Four Corners Potato.*
    b. *3-5 biology facts about the Four Corners Potato that make it special.*
    c. *Share what people are currently doing to learn about, grow, and spread knowledge to others of the Four Corners Potato.*
    d. *Your vision for how this mighty little tuber will change the world.*
    e. *Tell why you think people should pay attention to this little tuber's story.*
4. The scope of this project is really up to the individual teacher. Feel free to alter the criteria for the project to what will work best for you and your classroom. Similarly, it is up to you to decide whether students may work in groups or not. However, no matter how you set things up, view and communicate this project as a celebration of learning, rather than as an evaluation. Stating this from the start will help students feel more comfortable expressing themselves creatively and it will reduce the burden on you that naturally comes when trying to compare projects that are so different in nature.
5. Once students have completed their projects, have them present their work to one another. If possible, invite other members of the community to come see their work as well. By telling the story of the Four Corners Potato in their own unique and creative ways, your students will ensure that this knowledge continues to get passed on, similar to how many Indigenous people continue to pass on knowledge today.

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