



# Indigenous Agriculture & Plant Cultivation Practices in the Southwest

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## Standards

### Arizona

- > **6.L2U3.12:** Engage in argument from evidence to support a claim about the factors that cause species to change and how humans can impact those factors.
- > **6.L2U1.13:** Develop and use models to demonstrate the interdependence of organisms and their environment

### NGSS

- > **MS-LS2-1:** Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- > **WHST.6-8.9:** Draw evidence from informational texts to support analysis, reflection, and research.

## Materials

- > PowerPoint - Indigenous Agriculture & Plant Cultivation
- > Readings (#1 and #2)
- > Paper
- > Colored Pencils

## Overview

This lesson introduces students to the long and rich history of agriculture and food gathering in the Sonoran Desert practiced by Indigenous peoples in the Southwestern US. The activities and content include traditional food cultivation practices, plant science, relationships between various plants, and human-nature relationships. Students will read several writings on nature and plants by Indigenous authors and compare traditional ways of understanding plant relationships to Western science constructs.

## Learning Objectives

Students will be able to:

- Explain the differences and provide examples of wild and domesticated plants.
- Describe the process of plant domestication by using examples found in the Sonoran Desert.
- Compare traditional Indigenous and non-Indigenous agricultural practices in Southern Arizona.
- Identify various domesticated and wild plants that are used for food by humans in the Sonoran Desert.
- Categorize and apply the three types of symbiotic relationships of organisms (mutualism, commensalism, parasitism).
- Experience and interpret different ways that nature and science can be communicated through language.

## Vocabulary

**Abiotic factor:** (noun) Non-living component of an ecosystem.

**Agriculture:** (noun) Growing and harvesting crops and/or raising animals or livestock.

**Biotic factor:** (noun) Living component of an ecosystem.

**Commensalism:** (noun) A symbiotic relationship in which one species benefits while the other species is unaffected.

**Domestication:** (noun) The process of adapting a wild animal or plant for human use or companionship.

**Domesticated plant:** (noun) A plant that has been adapted for human use.

**Ecosystem:** (noun) All the living and nonliving things that interact in an area.

**Hohokam:** (noun) (ho-ho-kahm) The people who resided in the Hohokam region and are the predecessors of the O'odham people, whose traditional homelands extended to Sonora, Mexico, north to Central Arizona, west to the Gulf of California, and east to the San Pedro River. Hohokam were master dwellers of the desert, creating sophisticated canal systems to irrigate their cotton, tobacco, corn, beans, and squash crops. They built vast ball courts and huge ceremonial mounds and left behind fine red-on-buff pottery and exquisite jewelry of stone, shell, and clay. Ref: <http://www.tonation-nsn.gov/tohono-oodham-history/>

## Vocabulary

**Hopi Tribe:** (noun) The Hopi are known as one of the oldest living cultures in documented history, having migrated north to Arizona in the 1100s (AD). The Hopi are guardians of the sacred land they call Hopitutskwa. The Hopi Reservation, located on high and dry land, led the Hopi to develop a unique agricultural practice known as "dry farming," which relies on water-retention methods rather than irrigation. Reference: <https://naair.arizona.edu/hopi-tribe>

**Indigenous:** (adjective) Relating to or being the earliest known inhabitants of a region or their descendants.

**Mutualism:** (noun) A symbiotic relationship in which the two species benefit.

**Parasitism:** (noun) A symbiotic relationship in which one of the species (the parasite) benefits while the other species (the host) is affected negatively.

**Species:** (noun) A group of related organisms with the same characteristic and who are able to reproduce with one another to produce fertile offspring.

**Symbiosis:** (noun) A relationship between two species in which at least one of the species benefits. There are three different types: mutualism, commensalism, and parasitism.

**Teosinte:** (noun) A plant closely related to corn, the wild plant ancestor of corn.

## Set Up

Students will work in small groups and with partners. Each student should have access to pencils and paper to take notes, and for a graphic organizer activity. Powerpoint slides and a computer and projection device are also needed.

## Lesson Procedure

### Day 1: Introduction

**Teacher materials needed:** PowerPoint and the printed out worksheets

**Student materials needed:** Paper and pencil for notetaking and the graphic organizer activity.

1. **Introduction (Slide 2):** Introduce today's objectives. (1 min)
2. **Engagement Activity (Slides 3-4):** In small groups, ask students to discuss the following questions:
  - 1) What are some wild plants that grow in the Sonoran Desert that are edible by humans?
  - 2) What are some types of foods or dishes that you know of that use plants found in the desert?

For question number 1, each group can share one plant their group discussed (1-2 min). Review answers and/or make a list on a whiteboard. Possible responses include cacti and cacti fruit, berries, peppers, seeds, leafy greens, mesquite pods—flour, acorns, nuts, etc.

For question number 2, encourage students to draw on cultural and home knowledge. Possible answers include *nopalitos* or *nopales* (prickly pear cactus in English), mesquite flour—pancakes, bread, etc., prickly pear fruit jam, saguaro fruit jam, saguaro fruit syrup, and corn—tortillas, tamales, etc. Ask students for ideas from their own home and culture or through web research. (5-10 min)

All class sharing out of plants named and foods or dishes that were discussed in small groups. **Use slides 5-6** as examples.

## Lesson Procedure

- 3. Presentation/Discussion (Slides 7-12):** On *slides 7-8*, introduce the Hohokam culture. They are known for being farmers, not primarily hunters or gatherers. They lived in the Sonoran Desert along the Gila and Salt rivers from about A.D. 200 to 1450. The Hohokam directed river water to the fields using irrigation canals. These canals required much planning and thousands of people to build and operate—this was an engineering feat! The irrigation canals were designed to be narrow and deep to decrease water loss due to evaporation and water seepage into the ground. (2 min)

On *slide 9*, ask the students the question, “How many different plants are being grown in each field?” Then, point out the differences in the fields. The Hohokam ate wild green plants (some could consider them weeds). The moisture of the fields caused some wild green plants to grow alongside the cultivated plants, which was beneficial and provided more food sources. The distinction between cultivated plants and wild plants was not very clear. The Hohokam would also allow the desert trees to grow in their fields or near irrigation canals since they would also eat food from the tree, such as mesquite pods, and provide shade. (2 min)

On *slide 10*, ask the students the question, “Which field most closely resembles the Sonoran Desert environment?” Then, point out the differences in the fields. For example, the Hopi method of farming is to cultivate plants to conform to the environment, while non-Indigenous farmers are more likely to change the environment and conditions of the land (1 min).

On *slide 11*, introduce plant domestication. Emphasize that cultivated wild plants seeds change over time due to their close association to humans, as humans select the traits that are the most valuable—selective breeding.

On *slide 12*, introduce teosinte (the wild ancestor of today’s corn), domesticated over 6,000 years ago. The cultivated corn lost its ability to survive in the wild and became dependent on being grown by humans. The domestic corn has less branching which allowed the corn to have larger ears. The hard case (pod) also disappeared over time. Modern corn has large ears with many soft kernels. (2min)

- 4. Discussion/present (Slides 13-14):** On these two slides introduce these eight domesticated plants that are grown in the Sonoran Desert. Ask students if they have grown these in gardens or know people that have farmed these crops. Prompts can include: Why do these plants grow well in the desert? What are some ways these foods are important or used in their families.
- 5. Activity (Slides 15-16):** During this activity, students will work individually. Each student will attempt to list all the wild and domesticated plants seen in class and organize them in a graphic organizer that resembles the one on slide 18. (8 min) Go over plants and their organization as a class. (2 min)
- 6. Exit Ticket or Discussion Prompt (Slide 17):** Ask students to write and/or discuss the following questions:
  - 1) List 2 advantages and 2 disadvantages of relying on primarily wild plants (gathering and foraging)?
  - 2) List 2 advantages and 2 disadvantages for relying only on domesticated plants (agriculture)?

## Lesson Procedure

Encourage students to think about the environment (water and land use) and human factors (travel, dependability of food sources, and variety of foods).

*Possible answers for question 1:* the advantages are that no labor is needed to farm and no land is required for farming, and the disadvantages are that people will need to travel to forage wild plants and people have no control over how many plants or where the plants grow.

*Possible answers for question 2:* the advantages are that people have control over the number of plants to grow, where to grow them, and which types of plants, and the disadvantages are that labor is needed to plant, maintain, and harvest the plants and there is a need for land, water, and the knowledge of the right growing conditions like amount of sun to be successful in growing the plants.

7. **Closure (No slide):** Answer any questions and discuss connections to future lessons and topics. (2 min)

### Day 2: Relationships

**Teacher materials needed:** PowerPoint and copies of *Reading #1-Birth* and *Reading #2-Sweetgrass* for each student

**Student materials needed:** Paper and pencil for notetaking.

1. **Introduction (Slide 18):** Introduce objectives. (1 min)
2. **Engagement Activity (Slide 19-20):** On slide 19, ask students to read the questions before playing the video. Ask students to write the answers to the questions as they watch the video. (10 min) The purpose of this video is to experience agriculture through the lens of traditional Hopi farming practices and traditions. On slide 20, review answers. (5 min)
3. **Activity (Slides 21-23):** During this think-pair-share activity, students will read the poem titled “Birth” by the author Ramson Lomatewama, a Hopi poet. Distribute the reading/notetaker worksheet (Birth). Students will read the poem and answer the questions on the worksheet. (10 min) The objective is to recognize and describe the relationship between corn and the farmer and the biological and environmental factors that support the cultivation of corn. Slide 23 provides possible answers and discussion ideas. Review answers as a class. (5 min)
4. **Presentation/discussion: (Slide 24-26):** On slide 24, introduce symbiosis and its classification: mutualism, commensalism, and parasitism. On slide 25, ask students to classify the relationships. On slide 26, review the definition of mutualism, commensalism, and parasitism, and review the answers. (5 min)
5. **Activity (Slide 27-30):** During this think-pair-share activity, students will read quotes from “*Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants*” by the Indigenous scientist Robin Kimmerer. Distribute Reading #2/notetaker. Students will respond to and share ideas about the connections between Indigenous knowledge and expression and western science (10 min). The objective is to recognize the ecological relationships among plants and other species, including humans. Ecological understandings of the western science idea of symbiotic relationships and the three categories can be discussed in connection to human relationships and human-environment relationships. Slides 29 and 30 provide possible answers and discussion points. (10+ minutes)
6. **Closure (No slide):** Answer any questions and discuss connections to future lessons and topics. (2 min)

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Grant #: 2017-68005-26867

## Lesson Procedure

### Further Exploration (Resources, links, topics, etc.)

- CK-12 Foundation. "17.2 Symbiotic Relationships (Mutualism, Commensalism and Parasitism)." *CK-12 Foundation*, [https://www.ck12.org/book/cbse\\_biology\\_book\\_class\\_xii/section/17.2/](https://www.ck12.org/book/cbse_biology_book_class_xii/section/17.2/).
- Gasser, Robert E. "Hohokam Use of Desert Food Plants." *Desert Plants*, 1982, pp. 216–234., <https://repository.arizona.edu/handle/10150/550941>.
- "Hohokam Culture." *Encyclopædia Britannica*, Encyclopædia Britannica, Inc., <https://www.britannica.com/topic/Hohokam-culture>.
- Kimmerer, Robin. *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plant*. Milkweed Editions. <http://ebookcentral.proquest.com/lib/uaz/detail.action?docID=1212658>.
- Lomatewama, Ramson. *Songs to the Corn: a Hopi Poet Writes about Corn*. Rigby, 1997. <https://edsitement.neh.gov/lesson-plans/lesson-2-hopi-poetry>
- Schaal, Barbara. "Plants and People: Our Shared History and Future." New Phytologist Foundation, John Wiley & Sons, Ltd, 4 Dec. 2018, <https://nph.onlinelibrary.wiley.com/doi/full/10.1002/ppp3.12>.
- "Seeds." *Native Seeds/SEARCH*, <https://www.nativeseeds.org/pages/seeds>.
- "The Hohokam." *The Hohokam | Arizona Museum of Natural History*, <https://www.arizonamuseumofnaturalhistory.org/plan-a-visit/mesa-grande/the-hohokam>.

### Author Biography

**Arisbeth Ibarra Nieblas** grew up in Sonora, Mexico, in a town on the Gulf of California. She obtained her bachelor's degree in chemical engineering at the Technological Institute of Sonora (ITSON), Ciudad Obregon, Mexico. Living in semi-arid regions her whole life, Arisbeth learned first-hand about water being a finite and vulnerable resource which catapulted her pursuit of water issues-related work and graduate studies. She is a fourth-year doctoral student in the Environmental Engineering Program at the University of Arizona. Her graduate research involves persevering water delivery infrastructure by developing a corrosion monitoring system. The system will monitor two measurements: (1) water quality in time (flow, pressure, conductivity, temperature, dissolved oxygen, and pH) and (2) the metal corrosion rate in time using a power supply that measures an electrical current. Also, Arisbeth is a fourth-year Sustainable Bioeconomy for Arid Regions (SBAR) Fellow, where she works developing and teaching science lessons and experiments to middle school students.

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Grant #: 2017-68005-26867