Climate Smart Agriculture Academy Curriculum

By: Ajo Center for Sustainable Agriculture

Thank you to our funder, USDA NRCS.

USDA United States Department of Agriculture
Natural Resources Conservation Service

AJO csa
Center for Sustainable Agriculture

CLIMATE SMART AGRICULTURE

FOREWORD

1. **INTRODUCTION: What is climate smart agriculture generally, how do we define it as indigenous people and specifically as Tohono O'odham, and how do we practice it and teach it, especially to our youth?**

   "The realities of a changing climate are increasingly affecting European farming and forestry. Climate-smart agriculture is an approach that can help farmers and foresters build resilience and adapt to the effects of climate change, and increase productivity and incomes in a sustainable way. Climate-smart practices can focus on ways to reduce emissions in livestock production, to reduce farm inputs (such as fuels, energy, pesticides, mineral fertilizers) for more resource-efficiency, or to keep carbon stored in the soil. Making farming systems more diverse can also make them more resilient in the face of climate change. This brochure highlights a number of EIP-AGRI Operational Groups and other innovative projects in which farmers and foresters are developing and testing climate-smart practices that address local challenges, thus helping to build a more resilient European agriculture and forestry."

   https://ec.europa.eu/eip/agriculture/en/publications/eip-agri-brochure-climate-smart-agriculture.html#:~:text=The%20realities%20of,agriculture%20and%20forestry.

   Clayjuan Patricio- Youth Intern " When I think about climate smart agriculture, I think about permaculture and sustainable agriculture."

Noland Johnson - Traditional Ak-chin Farmer "I believe that our traditional practices is climate smart agriculture. As we use the land and weather like the monsoon rain to water my fields."

Sells Elder- "I'm glad to see you all out here harvesting wild foods, nobody else is doing this anymore."

Eunice Garcia- "I'm proud of you for going out to harvest, I remember when my grandma would go out, every summer we would go with her and pick"

2. **WHAT IS CLIMATE CHANGE, AND HOW IT IS AFFECTING INDIGENOUS PEOPLE AND TOHONO O'ODHAM IN SPECIFIC?**
    a. **Tohono O;odham Climate Change Adaptation Plan by TO Natural Resources Department- Dr. Selso**
    b. **Design youth activities to identify what is climate change, and how it is affecting us - lead questions for youth. Design a visual from youth brainstorming at the upcoming youth forum.**

(What is the definition of Climate Change?)

(Identify factors of Climate Change?)

(What effects does climate change have on the Nation?)

"Climate change refers to long-term shifts in temperatures and weather patterns. Such shifts can be natural, due to changes in the sun's activity or large volcanic eruptions. But since the 1800s, human activities have been the main driver of climate change, primarily due to the burning of fossil fuels like coal, oil and gas.

Burning fossil fuels generates greenhouse gas emissions that act like a blanket wrapped around the Earth, trapping the sun's heat and raising temperatures.

The main greenhouse gasses that are causing climate change include carbon dioxide and methane. These come from using gasoline for driving a car or coal for heating a building, for example. Clearing land and cutting down forests can also release carbon dioxide. Agriculture, oil and gas operations are major sources of methane emissions. Energy, industry, transport, buildings, agriculture and land use are among the main sectors causing greenhouse gasses."

https://www.un.org/en/climatechange/what-is-climate-change#:~:text=Climate%20change%20refers,causing%20greenhouse%20gases.

"Climate change can affect our health, ability to grow food, housing, safety and work. Some of us are already more vulnerable to climate impacts, such as people living in small island nations and other developing countries. Conditions like sea-level rise and saltwater intrusion have advanced to the point where whole communities have had to relocate, and

protracted droughts are putting people at risk of famine. In the future, the number of "climate refugees" is expected to rise."

https://www.un.org/en/climatechange/what-is-climate-change#:~:text=Climate%20change%20can,expected%20to%20rise.

What do you think contributes to climate change?

What does climate change mean to you?

ACTIVITY:

1. **Write down one word that comes to mind when you hear the term climate change.**
2. **Make connections and group similar categories.**
3. **Write down one climate smart practice.**

c. **What can we do?**

- **Grow our own food**
- **Compost**
- **Rainwater harvesting**
- **Utilize reusable materials**
- **Reduce waste**
- **Solar energy "clean energy"**
- **permaculture/horticulture**
- **Reduce technology usage**
- **Growing native crops and plant varieties**
- **Cultivating native wild foods**
- **Build up soil health**

-Tribal sovereignty, food and seed sovereignty. Traditional Agriculture.

What is Sovereignty?

noun,plural **sov·er·eign·ties.**

1. **the quality or state of being sovereign, or of having supreme power or authority.**
2. **the status, dominion, power, or authority of a sovereign; royal rank or position; royalty.**
3. **supreme and independent power or authority in government as possessed or claimed by a state or community.**
4. **rightful status, independence, or prerogative.**
5. **a sovereign or independent state, community, or political unit.**

https://www.dictionary.com/browse/sovereignty#:~:text=noun%2Cplural,or%20political%20unit.

Why do we say Tribal Sovereignty?

"Historically, the O'odham inhabited an enormous area of land in the southwest, extending South to Sonora, Mexico, north to Central Arizona (just north of Phoenix, Arizona), west to the Gulf of California, and east to the San Pedro River. This land base was known as the Papagueria and it had been home to the O'odham for thousands of years.

From the early 18th Century through to the present, the O'odham land was occupied by foreign governments. With the independence of the Republic of Mexico, O'odham fell under Mexican rule. Then, in 1853, through the Gadsden Purchase or Treaty of La Mesilla, O'odham land was divided almost in half, between the United States of America and Mexico.

According to the terms of the Gadsden Purchase, the United States agreed to honor all land rights of the area held by Mexican citizens, which included the O'odham, and O'odham would have the same constitutional rights as any other United States citizen. However, the demand for land for settlement escalated with the development of mining and the

transcontinental railroad. That demand resulted in the loss of O'odham land on both sides of the border.

Following the Plan de Iguala, O'odham lands in Mexico continued to decrease at a rapid rate. In 1927, reserves of lands for indigenous peoples were established by Mexico. Today, approximately nine O'odham communities in Mexico lie proximate to the southern edge of the Tohono O'odham Nation, a number of which are separated only by the United States/Mexico border.

On the U.S. side of the border, the Gadsden Purchase had little effect on the O'odham initially because they were not informed that a purchase of their land had been made, and the new border between the United States and Mexico was not strictly enforced. In recent years, however, the border has come to affect the O'odham in many ways, because immigration laws prevent the O'odham from crossing it freely. In fact, the U.S.-Mexico border has become "an artificial barrier to the freedom of the Tohono O'odham. . . to traverse their lands, impairing their ability to collect foods and materials needed to sustain their culture and to visit family members and traditional sacred sites." O'odham members must produce passports and border identification cards to enter into the United States.

On countless occasions, the U.S. Border Patrol has detained and deported members of the Tohono O'odham Nation who were simply traveling through their own traditional lands, practicing migratory traditions essential to their religion, economy and culture. Similarly, on many occasions U.S. Customs have prevented Tohono O'odham from transporting raw materials and goods essential for their spirituality, economy and traditional culture. Border officials are also reported to have confiscated cultural and religious items, such as feathers of common birds, pine leaves or sweet grass.

The division of O'odham lands has resulted in an artificial division of O'odham society. O'odham bands are now broken up into 4 federally recognized tribes: the Tohono O'odham Nation, the Gila River Indian Community, the Ak-Chin Indian Community and

the Salt River (Pima Maricopa) Indian community. Each band is now politically and geographically distinct and separate. The remaining band, the Hia-C'ed O'odham, are not federally recognized, but reside throughout southwestern Arizona. All of the groups still speak the O'odham language, which derives from the Uto-Aztecan language group, although each group has varying dialects."

http://www.tonation-nsn.gov/history-culture/#:~:text=Historically%2C%20the%20O%E2%80%99odham,has%20varying%20dialects.

What do we mean when we say Seed Sovereignty? Why does this matter?

What is Seed Saving? Seed saving is the process of saving seeds from one harvest for the subsequent harvest. In the past, the process of seed saving was a necessity especially for Indigenous communities that relied on certain crops for not only consumption, but for cultural and social purposes. Many indigenous communities developed highly-evolved systems of seed saving that often included optimal season times for seed saving, seed-saving rotations, containers and storage units that lasted for hundreds of years, processes that considered pollination patterns and systems, and associated cultural meaning to the different stages of the seed-saving process. With the emergence of commercialized seed markets in the 1980s, seed savings may have become informal and may have even decreased. But today, seed savings still remains a vibrant and important tradition in many Indigenous communities for the promulgation of Indigenous seed varieties that have existed in Indigenous communities since time immemorial. With increasing attention on development of local food systems and, in many cases, blow back against genetically-modified seeds, saved seeds are in greater demand, particularly heirloom seeds. However, due to the rise of seed patenting, intellectual property law, trademarking, and focus on seeds as commercial products, seed saving is becoming more problematic, especially for Indigenous communities. What is Seed Sovereignty? Seed Sovereignty is the right of a farmer to save, use, exchange and sell his or her own seeds.1 The primary issue that seed sovereignty seeks to address is the ownership of seeds as a larger majority of seeds are becoming property of several major agricultural/seed corporations. As large commercial agricultural interests begin to claim ownership over seeds, many farmers and

Indigenous communities will have difficulty in saving local seeds that have existed in their communities for centuries.

Source found at www.firstnations.org

What do we mean when we say traditional agriculture?

According to the general definition, traditional farming refers to agricultural practices that have been passed down through generations and have not been modified or industrialized. It often involves small-scale, sustainable methods of growing and harvesting crops and raising livestock.

Some common characteristics of traditional farming include:

- **Use of local and indigenous crops and livestock breeds: Traditional farmers often rely on locally adapted crops and animals that are well-suited to the local climate and soil conditions.**
- **Diversity of crops and animals: Traditional farming systems often involve growing a wide variety of crops and raising a range of livestock, which can help to improve soil health and increase the resilience of the farm.**
- **Use of natural fertilizers and pest control: Traditional farmers may use organic methods of fertilization and pest control, such as crop rotation and the use of natural predators, rather than relying on synthetic chemicals.**
- **Emphasis on sustainability: Traditional farming practices are often designed to be sustainable over the long term, with an emphasis on preserving natural resources and maintaining the health of the land.**
- **Close connection to the land and community: Traditional farming often involves a deep connection to the land and a sense of community with other farmers and local residents.**

There are many different traditional farming systems around the world, each with its own unique set of practices and techniques. Despite the challenges they may face, traditional farmers play a vital role in preserving cultural and agricultural heritage, as well as in producing food in a sustainable and environmentally responsible way.

https://www.threefarmsisland.com/what-is-traditional-farming/#:~:text=According%20with%20general,environmentally%20responsible%20way.

3. TOPICS OF INTEREST (accompanied by teaching objective plus activity for youth)

3.1 GENERAL: why grow food, history of the TO, where does our food come from now; historical trauma, food security, food sovereignty, seed sovereignty movement (include exercises from First Nations Development Institute on Food Sovereignty, specifically for youth) and TOCA's Food Justice Curriculum exercises;

3.2. WILD FOODS: foraged foods have always been a big part of the TO food system, make a case why they are "climate smart"

3.3 TRADITIONAL AGRICULTURE - DRYLAND FARMING and TRADITIONAL CROPS

- **History and description**
- **Small scale - case study of New Fields and Zade Arnold**
- **Large Scale - case study of Pancho Farm**
- **Traditional crops: what makes them unique, why they are climate smart, and what is their cultural significance**
    - **intro to each TO crop**

3.4 MODERN AGRICULTURE

a. **Background for starting a garden/ Security**
b. **Different type of gardens (school, back yard, dry-land farming, etc)**
c. **Bed Variations**
d. **Soil Preparation**
e. **Watering**
f. **Caring for your garden/ weeding animals to beware of/pests**
g. **Intro to seeds; Summer/ Winter Crops**
h. **Seasonal planting (seedling and direct planting)**
i. **harvesting**
j. **seed saving/storage**

3.5 SHARING FOOD AND KNOWLEDGE

- **Traditional foods recipes**
- **Songs (planting songs)**

- **Stories (corn, ciolim, tepary beans)+**

4. **RESOURCES (services and contacts):**

- **NRCS - Sells Office**
- **Ajo CSA**
- **TOCC**
- **San Xavier Co-op Farm**
- **USDA**

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Things to consider before starting to grow:

There are many factors to think about before you start growing in and around your home or land site if you want to be successful when planting. Planning your approach will either set you up for success or failure depending on things such as the time of year, what types of crops you will be growing, whether you are growing for food or seed, how you will secure your area from pests, and most importantly how you will water your crops. There are many challenges and successes when starting a garden or planting in general and lots of trial and error but the experience, the lessons learned, and food grown by you is one of the greatest rewards. But these are only a few elements of growing to keep in mind before you start.

Who are you growing for? Whether you are starting a family, school, or community garden, the types of crops, and your purpose for growing will help you identify the tools, and how much space you will need. Growing a home garden will help provide fresh produce for your family that can go into everyday meals. A school garden might help provide fresh produce for the cafeteria and even classroom tastings. These are just a few examples of the wonderful benefits of growing your own food and being Self-sustainable!

One step at a time though, many think that it is easy and simple to grow your own food. Depending on your experience it varies from person to person on how one might approach the effort of planting. But before we get further in depth let's start with the basics.

Benefits of having a garden:

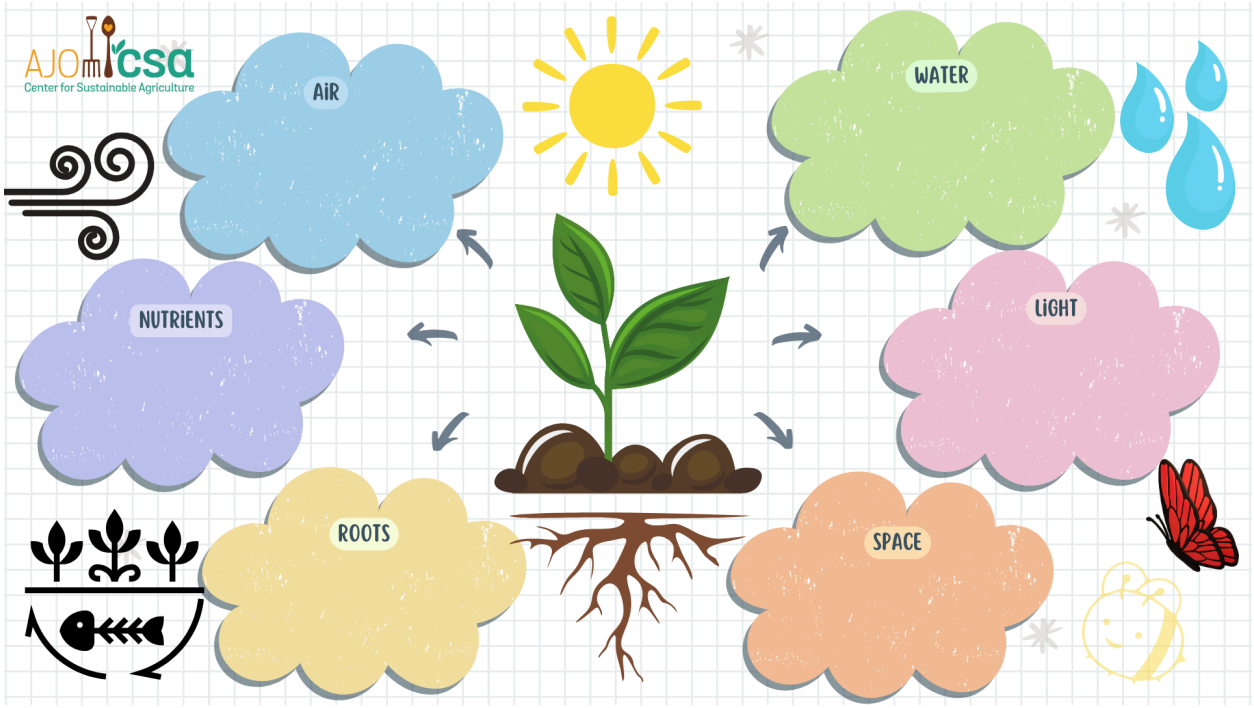
- Boosts self esteem and growth
- Teaches sustainability and self-sufficiency
- Teaches cultural values and tradition
- Teaches students/individuals to plant, care/nurture, and harvest/process
- Teaches life skills and accountability
- Teaches STEM science, technology, engineering and mathematics
- Increases exercise and wellbeing
- Teaches and enhances nutrition
- Students/individuals are more likely to try what they grew
- Improves student/individuals responsibility, pride and wellbeing
- Team building
- Teaches climate and weather patterns and advantages
- Teaches soil properties

The list goes on! What do you think the benefit of having a garden is? Create a list of your own and what you hope to benefit from growing.

So many different benefits can be achieved by simply growing your own food with your community, school, and/or family. There are also a lot of challenges and things to learn about the elements and weather patterns that may benefit, disrupt, or even kill your plants. The weather is something to think about when it comes to your plants. The summer months are very intense when temperatures reach over 100 degrees, which can cause your plants to become stressed if not taken care of properly. Even the

monsoon rains can be too much during the summertime. For example, the watershed of the rain can unearth your seeds when you are planting during the monsoon. Even though we live in the desert our winters can be just as harsh. With long cold nights and below freezing temperatures, your plants are always in need of your attention. So with the weather in mind, and considering these potential outcomes it is important to think about your location.

ACTIVITY: What do plants need to grow? Create a list.
Fill in notes for each category.



Location:

When thinking of putting in a garden or field to plant in, it is important to consider your location and plan for the site you want to grow in. Will your planting site be on the east facing side or the west? North or South? These questions can help you better identify the benefits and challenges that come from the location where you will plant. For example planting on the east side of your home will give your plants morning sun and afternoon shade, and planting on the west will give them morning shade and afternoon sun, keep in mind the summer heat and sun can be harsh to not only your plants but to you as well.

When you are growing crops in your oidag, it's good practice to have the crops in the best soil as possible. Sometimes in your field there might be spaces where your crops will grow bigger than usual or grow faster. Also, you might notice a space where your plant always comes out and it consistently grows every time. This is a space where you want to grow your crops to save seeds for the future. This observation can also help you identify whether there is more moisture in that area as well as available nutrients that other sections of your field or garden may not be evenly getting distributed. So which area do you think would be more beneficial for your growing plot? What to look for when growing?

ACTIVITY:

Learn your directions, where does the sun rise and where does it set?
Does the sun change positions depending on the seasons?
In the cold months where is the sun placed?
In the hotter months where is the sun placed?

Not only is it important to learn where the sun lies throughout the months but also where your water source is and how it will get to your plants. What will you use, hose, water cans, irrigation and timer, or rainwater? Some other factors to keep in mind are included in the bullet points down below.

- History of the site
- Sun/shades - microclimates
- Slope and elevation
- Water source
- Wind (especially with tall plants such as corn)
- Fencing

When you think about the location of where you want to plant, there are various ways to go about it. Technically there is no right or wrong way to start growing your own produce or even flowers. The numerous ways of getting started do depend on what you want to grow, how big that plant might get, how much you want to grow, where you are going to plant, and how. Just because you are growing doesn't mean you have to go full on farmer and have a field or even plant your whole back yard (if you have one). Sometimes starting off small is best for beginners like planting pots, small containers, or even something as simple as a single clove of garlic in the windowsill is an excellent start. I use this example because no matter how small, if you are growing something you are learning and understanding how your plant develops which makes you one step closer to being self-sustainable.

ACTIVITY: Design your own field/garden. Use the information you learned above and draw out your home or where you would like to plant, and do a blueprint of what crops you want to plant that are in season, how and where they will be planted. Another thing to think about is where you will get water.

Types of growing:

Size and types of gardens are important and vary from containers/pots, raised beds, level or sunken beds, these have benefits such as, (reduce evaporation from the soil, lower temperature in summer, generate heat in the winter, and collect more rainwater), stacked tires can be better for the winter, self-watering containers help with consistent watering needs and so on.

Small-scale home Gardening- Growing in pots, small raised beds, or small containers that can be in a well-lit windowsill can all be used in or around the house. Smaller manageable plants can be grown such as bush varieties, flowers, tomatoes, chilies, herbs, and spices. One of the simplest O'odham crops that can be grown in a pot is the I'itoi siwol (creator's onion).

Large-scale backyard Gardening- Growing within a fenced area, in ground garden beds or large raised beds are generally ideal depending on your location and soil. Large plants such as corn, sugarcane, or even vining plants like squash, pumpkins, and melons will need an area with large enough space to grow to their potential.

Dry-land Farming- This method is where there is no set irrigation or consistent water source for the plants and is mostly relied on rainwater, whether it is stored in a cistern which is considered **active water harvesting,** or during a rainy period like monsoon time where water can be catched and slowed down using berms and basins which is a **passive water harvesting** technique. Drought tolerant crops like the O'odham crops are typically utilized for this method because they are already adapted to a certain arid region and can tolerate such conditions of drought and heat.

Bed Variations

There are many ways you can plant a garden, we already mentioned some methods up above like pots, containers, and raised beds. When building a bed, you will want to consider some things like how much space you have, and whether paths can be made that a wheelbarrow can fit in between and around your perimeter. It is important to create walking paths or berms to walk on to not compact your soil in the area you are planting.Berms are made by creating a raised structured strip of soil along fields with the purpose of holding water or to reduce erosion.

Other bed variations and one of the most common methods we at Ajo CSA use is the sunken bed. This is similar to the process of flood watering on a smaller scale but still with a flattened surface that is lower than the ground surface and berms are created around the perimeter of it to keep the water in.

Sunken Beds- These are in-ground beds that are built in lower than soil level to keep in and retain moisture as well as create a cooler environment.

Raised Beds- These beds are built above ground, and most commonly built with cinder blocks, wood pallets, metal horse troughs, and other materials.

The photos below show examples of raised beds. 1. University of Arizona Cooperative Extension, The Garden Kitchen planted basil and other veggies 2. Pascua Yaqui rec center 3. A community on the west end of the Tohono O'odham Nation.

1.

2.

3.

The photos below show an example of a sunken pit bed and a berm.

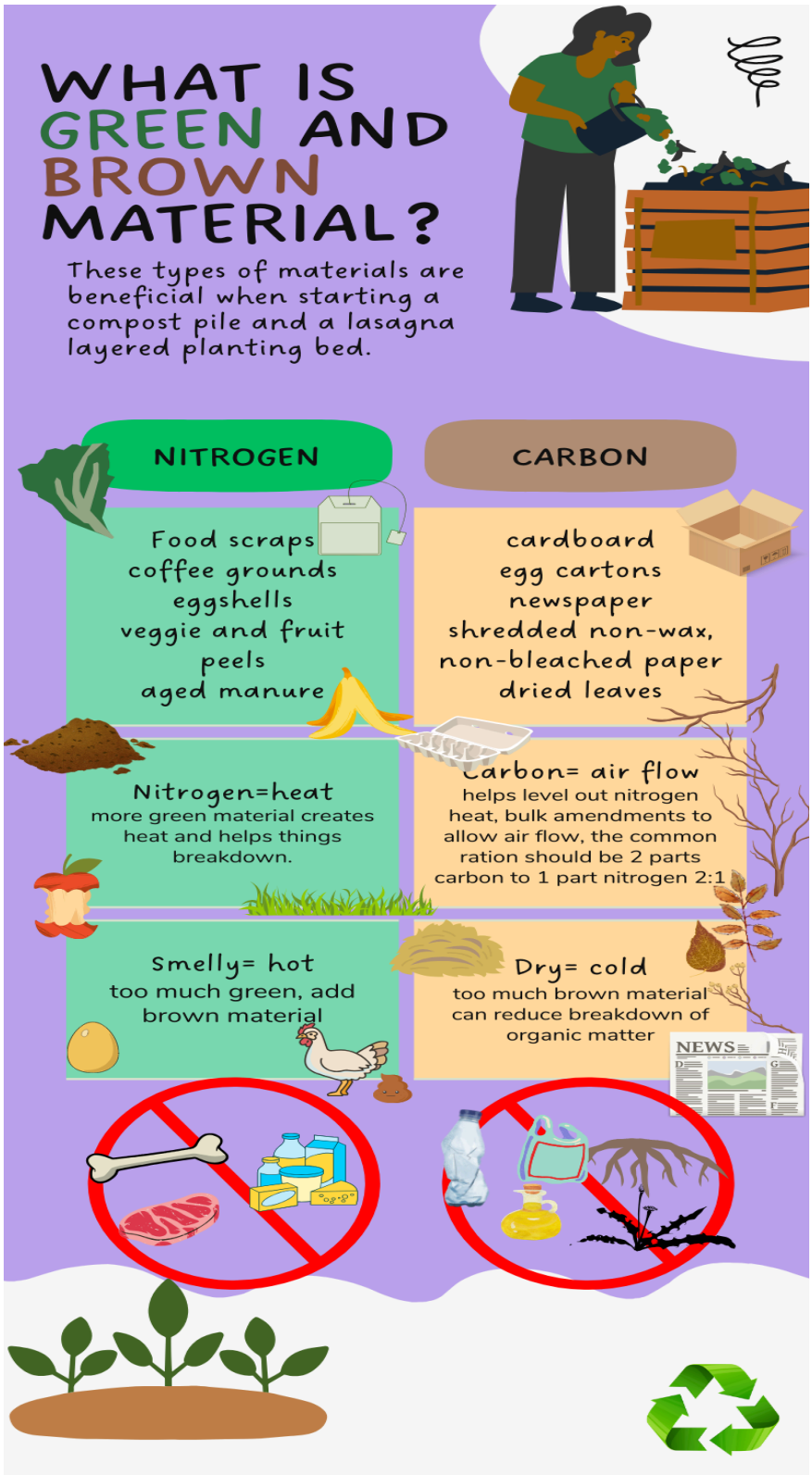
On a larger scale, one of the most common methods that have been utilized is **Ak-chin farming (flood water irrigating)**. The image below shows a rainwater catchment pond, also known as a charco pond or wo'o. The second image is the rainwater getting pumped from the pond into an Ak-chin field at Alexander Pancho Memorial Farm where they grow traditional O'odham crops and irrigate through rainfall from monsoons or from rainwater capture ponds.

Image of Alexander Pancho Memorial Farm

Lasagna planting is a unique method and another bed variation, with the purpose of building up the soil. It is typically for raised beds or if utilizing a sunken bed, make sure it is deep enough, potentially 2 feet or more deep. Lasagna beds are implemented if you want to use a no till method where you do not turn over or disturb the soil. This variation is where you utilize a layering method rather than just soil, a number of organic materials are used. The process of lasagna planting is layering, starting at the bottom of your bed, use branches, wood chips, cardboard, dried leaves, or newspaper which is considered "brown" material because it provides carbon nutrients, then add some soil over the first layer; the next layer would be your "green" material which is a form of nitrogen you can add compost, coffee grounds or food scraps, next material can be a form of straw, and repeat the process, throughout every layer, moisten it with water, and lastly add your soil preferably 12 inches of planting mix or regular soil mixed with compost. By utilizing this method, you are developing a system of soil renewal and a process of natural organic breakdown due to the diverse amount of nutrients, microorganisms and other microbes, and beneficial bugs will have a home and food to break down the soil and create a healthy environment for your plants and roots. This method of lasagna planting is very similar to composting and has the same concept of utilizing food scraps and other organic material to break down into your soil and overtime create amendments that are useful for your garden and the overall soil health.

https://www.menards.com/main/garden-center/lasagna-gardening-the-no-till-gardening-method/c-9797691519260391.htm

ACTIVITY: Learn about some examples of what “green” and “brown” materials are:



Ridges and furrows are mostly used in larger fields and in modernized agriculture. The furrows are the lower trench-like area of soil whereas the ridges are the higher mounds of soil. Crops can be planted on the ridges or in the furrows, it depends on the type of crops and the season.

More examples of growing variations include:

- Waffle beds
- Mound planting
- Trellising
- Aquaponics
- Pallet planting

And more.

Soil Preparation:

Soil prep is crucial when starting a garden or planting in general. Here in the Sonoran Desert, and in the nation, our soil is not as nutrient rich as it once was and will need amendments to provide certain minerals and other natural nutrients that plants need to grow. Most places in the nation the soil can be extremely hard and may have caliche in it, which is a formation of minerals of salt and calcium carbonate that solidify into a hard rock-like structure which is hard for roots to break through as well as water infiltration and retention. Due to lack of infiltration in our soil, the monsoon rains do not have a chance to penetrate through the soil which leads to runoff and sheet flow and causes the soil to harden or erode.

Soil health and structure can be identified in numerous ways, some key things to investigate are identifying what type of soil you have, whether it is sandy, silt, or clay, or a mixture of both. Knowing and analyzing these soil compositions will help you determine how well your soil will help water infiltrate

through it and get to your plant's roots. One way you can test whether your soil has more clay or sand is through the "ribbon test", which is a method where you grab a large pinch of soil from the area you are wanting to plant in, add a little water to moisten, roll and squeeze into a thread and try and create a ribbon by squeezing little pieces of soil out from your fingers, if it breaks when creating the ribbon you have more sand and if it creates a long piece of ribbon, there is more clay. Sandy soils hold less water because the grains are larger, and therefore, create more pores for air and organic matter, clay soils have a smaller finer grain and are more compact which holds water for longer periods of time and can cause issues for root development and infiltration, however, both have their pros and cons and a mixture of the two is what is best practiced. To make sure your plants have adequate air, food, and water there needs to be a balance of both types of soils for a healthy environment in order for you to have successful growth.

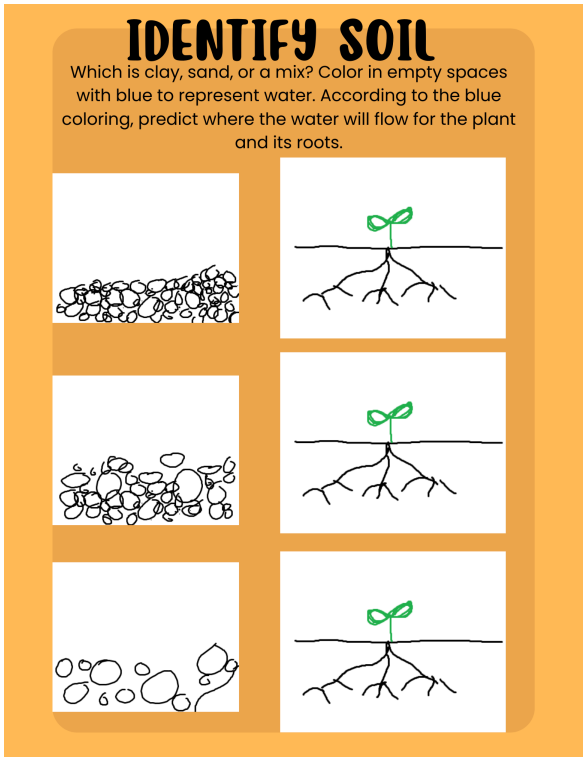
Below are several soil activities that can help better understand how to find what type of soils you may have.

ACTIVITY 1: **IDENTIFY SEDIMENT LAYERS:**

1. Collect several soil samples (palm size) and take out any rocks. Use a soil sifter if you have one. 2. Place soil samples in a clear jar with a lid, add twice the amount of water as soil and shake. 3. Let the soil and sediments settle for 24 hours. Observe and count layers if any.

ACTIVITY 2: **RIBBON TEST (see above)**

ACTIVITY 3: Use the sheet to identify clay, sand or a mix of soil particles and predict water flow and outcome of the plant.



Another method to test your soil is to use a soil testing kit which generally tests for pH, and NPK, nitrogen, phosphorus, and potassium. These are the general nutrients needed for plants to grow successfully. Soil testing kits can be found online, at the local extension office or at a local plant nursery store.

- Nitrogen: helps leaf development and plant growth
- Phosphorous: helps with fruiting process and root development
- Potassium: helps with overall health of the plant (multivitamin)

It is important to test your soil and find out which nutrients are lacking. That way it is clear which nutrients or amendments to add and what does not need to be added. Soil composition and conditioning is an ongoing process and will continually need replenishing after each planting season.

Other factors to consider when identifying your soil is whether that area has been used for any other source such as waste like garbage, oil spills, or other chemical hazards, near a main road way or sewage line which can affect the soil health and your plants especially if wanting to plant food. Consider the potential hazard of contamination of soil if near any of these sources.

Some first steps in soil preparation and revitalization are to break it up, find a spot that will be your garden plot and begin loosening up the soil with a shovel, a broad fork, or a pickaxe if necessary. On a larger scale a rototiller or a tractor can also do the job. Soaking your plot with water and letting it settle overnight will also help break up compact soil, but do not work with muddy or wet soil, it will cause more compaction. You will want your soil to have a little moisture, enough for you to work a shovel with. With the addition of organic matter and biodegradable material like compost, it will help create aeration and soil composition.

Native plants such as shrubs, grasses and flowers are beneficial when wanting to revitalize soil. The implementation of native plants help break up compact soil through their root development as well as adding nutrients through their organic matter. Wild flowers help bring in pollinators and beneficial insects which also benefit your soil and garden through their actions.

Another practice for building up your soil health is planting a cover crop. A cover crop is a mixture of grasses, legumes and other beneficial plants that will help aid and bring nutrients into your soil as they grow. The idea is to plant cover crops after you have had a heavy feeder crop, like corn, instead of planting corn in the same spot you will want to rotate it into a different section as well as your other crops. By rotating your crops it helps deter pests and gives you a chance to build up your soil with a seasonal cover crop.

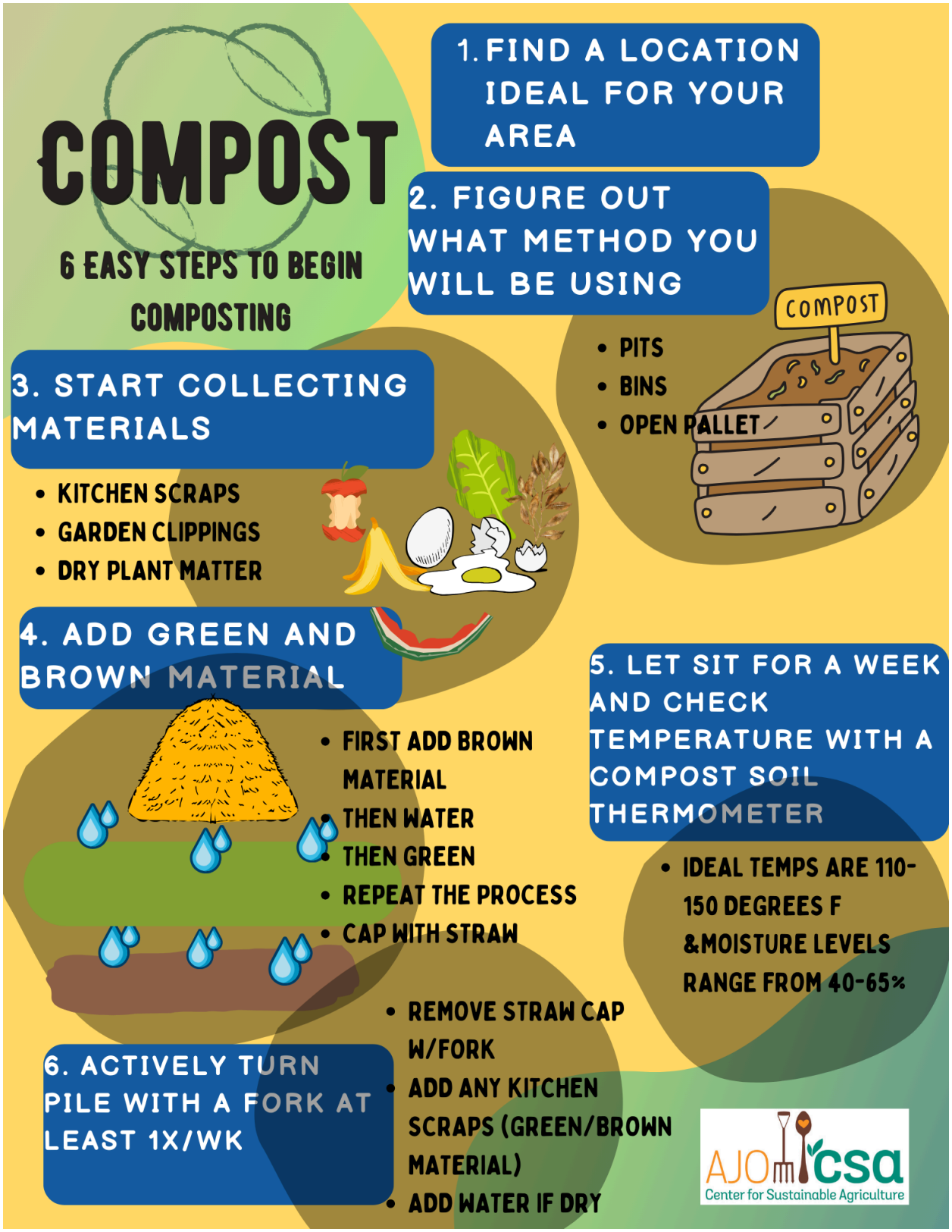
Amendments are needed when building up your soil and preparing to plant. Some common amendments that are utilized are, compost, organic fertilizers, planting soil, peat moss, perlite and horse or chicken manure. Other materials that are inexpensive and usually readily accessible are fallen leaf matter from under trees like mesquite, palo verde, or creosote, broken up egg shells, and coffee grounds.

Here is a general breakdown of what each amendment is and what it provides:

- Compost: is a dark clumpy rich soil amendment that provides food for plants, supports microbes in the soil and is also good for moisture retention.
- Organic fertilizers: include bone mill, blood mill, feather mill, fish emulsion, compost and manures, these provide soil nutrients, support beneficial microbes, plant food on various levels, water retention and over time soil structure.
- Organic or natural Planting soil mix: usually found in plant nurseries, provides organic matter that helps with soil composition and water retention, and most times some form of slow releasing fertilizers. Planting mix is used when planting in the ground or in a large raised bed whereas ‘potting mix’ is utilized for potted plants.

Keep in mind of weeds, some yard clippings may have seed pods which we do not want to add into our garden bed, if weeds are fully dried with no seed pods and are not considered invasive, they can be utilized as possible organic matter. Same thing goes for using manure, you want to have a trusted source of manure, which means the owners know what they are being fed, and if they are free range or not. Horses also eat weeds, if they are free range, which can stay in their poop and if the manure does not break down properly those seeds can potentially create weeds in your garden bed if not careful.

ACTIVITY: Build a compost pile.



Introduction for Traditional O'odham Kaij (seeds):

The Tohono O'odham have been growing crops in the Sonoran Desert for thousands of years. In the process the Kaij (seeds) developed into drought and heat-resistant crops that have adapted to the hot summer months with the temperatures reaching peak heat over 115 degrees fahrenheit. These seeds have adapted to our climate which allows them to thrive in our environment with low water content, low-poor nutrient soil and have been passed down from generations to generations through the practice of seed saving. So, what seeds can grow in the Sonoran Desert? March-August: T.O. traditional crops

August-Sept (Short planting month): Tepary beans, 60 day corn

Bawi: We will start off with Bawi. What is Bawi? It's an O'odham word to describe a type of bean. These are known as Tepary Beans today. The Bawi has ties to traditional O'odham stories that have been passed down to each generation orally, which can be heard during the winter months starting in *'Al Ju:pig Masad* or October. These tepary beans were the sources of food and kept the O'odham alive and healthy, long before there were any wells dug to irrigate the fields. All of the villages in the nation represent something in the O'odham language, the village Topawa means "White Beans" which is a type of Tepary Bean *Tohta Bawi* and is one of the many important beans to the O'odham.

Before the U.S federally recognized us as a tribe, we were known as Papago which means "Bean Eaters". The O'odham grew acres and acres of many varieties of tepary beans in the desert which made them such skilled farmers. Growing tepary beans is a part of the *himdag* (Way of Life) for the O'odham, and bawi has been nourishing us for generations.

The bawi can be planted as early as the end of May and the latest is mid-August. These beans do not like a lot of water, in the beginning stages when they are young sprouts they will need a deep irrigation soak (like all young plants) and then weaned off once they grow their true leaves.

Some people may have experienced the beans growing big and green but do not produce any flowers. The tepary beans need a period of drought stress in order to start producing flowers and bean pods, which is what makes them so unique and adapted to the desert climate so well.

Keep in mind, this legume, like all others, is rich in providing nitrogen to the soil, and various plants can benefit from this source that need nitrogen to grow and produce fruit, like corn. There are many varieties of bawi which are either bush or vining, so trellising may or may not be necessary and considering its hardiness, shade is not necessary, but can always be helpful, overall, these are sun-loving plants.

The beans should be planted 8-16 inches apart and can be flood water irrigated, or drip irrigated, when utilizing regular/daily irrigation keep in mind that, they will produce seeds that may not be as hardy as opposed to dry-land practices that utilize the monsoon rainwater, where the rain provides natural nutrients and minerals as food for the plant. Since they are adapted to our climate, we want to make sure we give a good deep water so the roots can grow deeper into the soil to have good stability and let them rest in between waters until the next watering time. So when utilizing a timer irrigation, it should be set to water for longer periods of time in the beginning stages of the seed and then cut back to minimum inconsistent watering.

A quick nutrition fact on bawi is that it is also known to have a low glycemic index which is great for people with type 2 diabetes or high cholesterol to consume due to a low carbohydrate index, the beans can potentially be a benefit to reducing risk of chronic diseases and as well as help maintain. “The glycemic index is a ranking system of carbohydrates that affect your blood sugar levels such as breads, cereals, dairy products, fruits and vegetables.” (WebMD Editorial Contributors 2021) https://www.webmd.com/diet/what-are-low-glycemic-foods

Can you think of any nutrition that beans can provide in the garden or in your own body?

There are many varieties of Bawi, which are included above. The main types that have been planted, eaten, and sold in the nation in recent years are Toti Bawi, Wepgi Bawi and S-cuk Bawi and many more varieties. They do range in taste and remember when planting, talk to your kaij (seeds) and give them some words of encouragement to grow nice and strong with an abundance of nourishment.

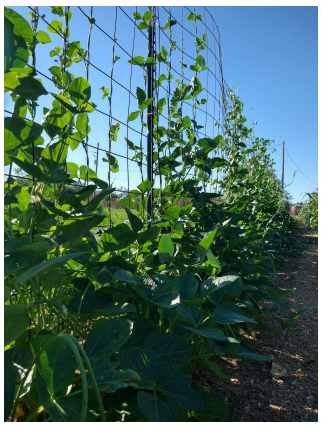
San Pablo Belleza Black Tepary Bean grown at Native Seed Search Conservation Center (dried brown pod) and San Pablo Belleza Black Tepary Bean flower and green pod.

***Oks Mun* or *U'uks Mu:n*–** Black and White Cowpeas: Oks mun, is a speckled black and white cowpea/bean which is larger than a tepary bean but smaller than a lima bean. This bean is similar to a black eyed pea in taste. Plant them 6-8 inches apart and 2 seeds per hole. This plant can benefit from being trained to trellis or can be planted as a bush bean and has also been used as a cover crop for soil conditioning.

Keep in mind cross pollination with certain crops, for example beans can cross pollinate if they are in the same species so you cannot plant two colors of tepary beans at the same time, unless they have a recommended distance apart to prevent crossing. However, cow peas can be planted next to tepary beans without worry of crossing.

U:ks Mu:n cowpea

Some beans are bush beans and others that can be trellised are referred to as pole beans which means they will need support such as a pole or some kind of trellis/fence to climb. Some varieties of cowpeas are either bush or pole beans, the u'uks mu:n can be planted with or without support and does fine in both conditions, however the benefit of trellising is an easier harvest, and utilizing less space on the ground surface. Below are some examples of u'uks mu:n-cowpea and howal-lima beans on a trellis. The material that was used is cattle panel fencing, however other types of fencing or actual trellises can be used as well as poles, stakes, rope nets, pergolas, or ramada/wato. The trellis or fence should ideally be set up before planting or at least before the plant grows larger in order to not harm or disturb the tender leaves, the beans can be planted on both sides of the structure or just one side. Once the beans begin to grow longer they will start reaching for the structure but may still need help climbing up. On a weekly basis or as often as necessary start wrapping the vines along the structure and keep any weeds out by hand pulling or a hand hoe.



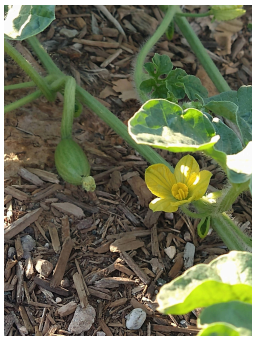

U:ks Mu:n plant on trellis and Hawol lima bean on trellis at Rattlebox Farm.

Beans have complete/perfect flowers, which means they are self-pollinating. They do not need to be hand pollinated, because they have both male and female parts on one flower unlike a squash or melon blossom which has incomplete flowers, separate female and male flowers. A key thing to look for is the size of the flower, which may indicate it is self-pollinating or not, more times than not, the smaller the flower is the more likely it is self-pollinating/fertilizing. However, insects and other small creators are still helpful in transferring pollen which may contribute to crossing.

Hawol -Pima Lima Beans: There are a variety of hawol, and range in color from red, brown, dark brown, orange and white. This bean can be trellised or planted as a bush bean, plant 2 seeds per hole and 6-8 inches apart. The brown shelling of the pods can be used as a brown material for mulch or compost building material.


Hawol lima bean in dried pod and the seeds out of the pod, which can either be eaten or saved for seed.

Mi:lon- Yellow-Meat Watermelon: Everyone's favorite! The yellow melon, also known as suam mi:lon or gepi. This melon grows large in length and can spread up to 4-5 feet, plant at least 2-3 feet apart and 2-4 seeds per hole. Some helpful tips are, weed before the vines get too long and when searching for melons, and they are laying upright, adjust them so that they are laying flat, this will prevent them from getting soft or rotting on one side. Another thing to look for is blossom end rot, which is a nutrient deficiency of calcium or can be caused by inconsistent watering. Inconsistent watering is when you give the plant too much water at one point and then drastically change it to very little or fluctuate the pattern, this goes for most plants, if watering is not approached gradually, you may experience some deficiencies or pests from stressing out the plant.


First image is of fresh yellow-meated melon in slices and the middle image is of a small melon coming into sprout from a female flower. The last image is of the female and male flowers of a watermelon. The female flower has the large plump part right under the flower petal which is known as the ovary and the male does not have it.

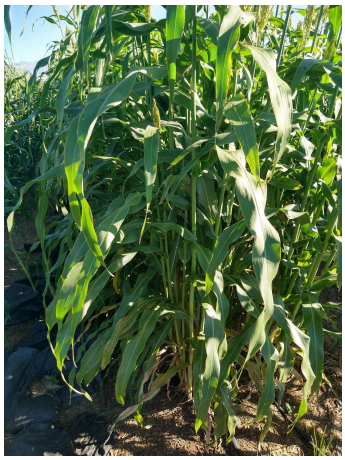
https://stock.adobe.com/uk/images/male-and-female-watermelon-flower-on-a-branch-watermelon-blooms-in-the-greenhouse/280370433


Melon with blossom end rot and a melon blossom.

https://www.canr.msu.edu/news/blossom_end_rot_causes_and_cures_in_garden_vegetables

Keli Baso- "Old man's chest": KB is a type of melon similar to honeydew which has a wrinkly textured outer rind, and the center flesh is white and juicy, same planting method and distance as yellow-meat watermelon. When they are ripe, they will turn a yellow-green color or bright yellow. You can also tell from its tendrils like the watermelon.

Kanya/Kano- Sweet Sorghum (or some may refer to it as sugar cane): The Kano can be planted in the summer along with all the other crops, this plant provides a stalk, like corn without the ears. The stocks are sweet and can be converted into a syrup or just munched on to taste the sweet juice of the stalk. Plant in rows, make a furrow and sprinkle seeds inside the furrow.



Kano plant in full growth, kano seed heads, and kano kaij sugarcane seeds.

The O'odham have always adapted to their environment long before there were any settlers in their areas and they did not plant as much in the cooler seasons. In the 1600's, the O'odham were introduced to the Spanish Missionaries who came into Mexico and the Tohono O'odham Nation Homeland. It was then the O'odham were introduced to new crops like *Pilkan* or wheat, which grows during the winter months in Southern Arizona. This helped the O'odham during the lean months in December through April when nothing grew and were surviving on the fall harvest.

One of the crops that were introduced is known as ***S-moik Pilkan****:* Also known as *s-wepig pilkan*, which is the Sonoran wheat and some may consider it as a softer kind of wheat, which is referring to the grain. It has a longer wheat head and grows taller than the *olas pilkan*. Both wheat varieties are a cool season crop and can be grown at the same time with precautions and recommended distance apart. However, according to various sources, wheat has a low rate of 1% of cross pollination because they are self-pollinating.

Olas Pilkan*:* Also known as Pima wheat, "olas" means round, which refers to the head of the wheat being more rounded and clumped compared to the "s-moik pilkan". This crop is grown as a cool season type, it is typically planted Nov-Jan the latest. It generally takes up to 6 months until harvest, once you see birds coming in, it is an indication the wheat is maturing and ready for picking. Another indication on when wheat is ready for harvest is when ciolim (cholla buds) are coming into season which is late April-May. The grain will become brown and dry, if you roll a piece in your hand and the seeds fall out, it is ready to be harvested and threshed. Plant in tight rows or broadcast in a bed. This crop can also be utilized as a winter cover crop to provide nutrients and moisture to the soil as well as organic matter.

The elders would make the pilkan into a drink, the wheat berries would be parched or roasted and then ground into a flour.

First image is of S-moik Pilkan, middle image is Olas Pilkan, and the third image is a comparison of each.

The O'odham are known for their agriculture as they were able to produce traditional crops on their homelands. One of these crops is the *Hu:n* or Corn which can be found in agricultural-based Native American Tribes. The O'odham Hu:n can grow in the heat of the summer with one variety of corn that

can grow in 60 Days. Hu:n also has a connection to the O'odham stories and some tell a different version on how the corn came into the O'odham possession. The corn has a song that is sung when the O'odham are planting them in the oidag (field/garden).

Ali Hu:n – Baby Corn or Tohono O'odham 60 day Corn: The Ali Hu:n is a smaller corn that is produced within a 60 day period, one of the fastest growing corn which produces a smaller cob and has a small window of harvest. Usually you would want to harvest during the milky stage, which is when it is most juicy and sweet, during this stage the corn is roasted and turned into *gaiwesa* (roasted corn) which is then dried, grounded and stored for later purposes. Once the milky stage has passed the corn is too hard to make the gaiwesa and is typically used for seed saving.


O'odham 60 day Corn sprout and corn on cob and with husk.

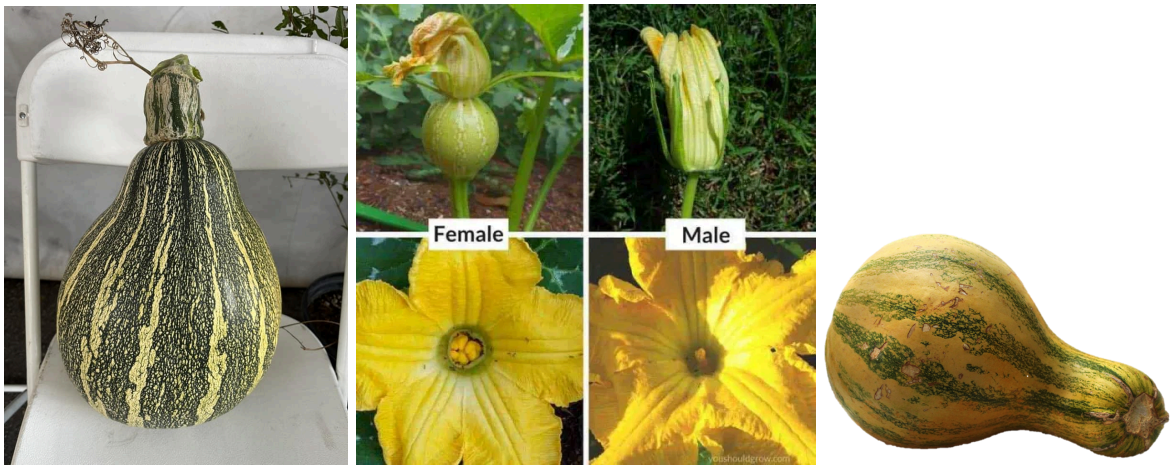


The images above are of hu:n getting roasted after harvest, finished roasted hu:n which will now need to be dried and stored, and a final product of roasted corn and ground roasted corn both are edible and used in soups and stews.

Ge'e Hu:n - June Dent Corn is another variety that is grown during the summer months, this is a larger corn that has little indentations on each cob, hence the name.

Wihol- Tohono O'odham Peas: This crop is a cooler season legume. It is typically planted November-January, it can be trellised or planted as a bush bean. The pods can be harvested and eaten in its green stage as a sweet pea and as a dried pea when it is mature and the pod becomes brown and dry.

Ha:l- O'odham Squash: This is a large squash with a thick rind. It is grown in the summer monsoon season, the plant can grow up to 6-8 feet long. The squash fruit is harvested a couple of ways, one can be harvested at a tender stage and eaten like a zucchini. It is most commonly left on the plant until the stem is thick and dry like the image below, the plant will become dry as well, the squash can grow up to 30lb in weight. The flowers of the plant are also edible and can be used in a number of ways. You would want to eat the male flowers preferably, rather than the female flowers because those are the ones that give you fruit, however be sure to save some males to help pollinate.



https://vinesgardens.org/hand-pollinating-squash-plants/

The O'odham would store the squash in its whole form or preserve it in a dried form. The process is hollowing it out like a pumpkin and hacking off the outer skin and setting it on a post to dry like the picture above. During the process of drying it will need to be checked daily and rotated to avoid mold. Once the whole squash has dried to the point of it having a rubbery consistency it becomes more flexible. This will allow it to cut into a more consistent ribbon and hang to dry for further preservation and storage. When ready to eat it, add a little water to rehydrate, similar to cholla buds.

I'itoi Siwol is similar to a green onion or a scallion. It is a small bunching onion that is grown almost year round. The bulbs are typically separated and planted 2-10 inches apart, they do well in pots, the ground or a raised bed. This crop is one of the simplest and fastest growing of the bunch. The green part of the onion can be harvested like chives and it will continue to grow back. When ready to harvest, use a garden fork to pry them out of the ground before pulling. When ready to replant, separate the bulb, cut the greens and replant or dry and store in a dark cool place for later use, plant one bulb per hole and they will eventually multiply.



I'itoi siwol planted in the ground and then pulled out in a bunch, a spiral of I'itoi siwol at Mission Gardens in the Post Contact TO garden.


I'itoi siwol volunteers are popping up as weeds around the garden. They are smaller in size due to their water intake. Ajo CSA crew Direct seeding I'itoi siwol bulbs (onions) in a furrow at Alexander Pancho Farms.

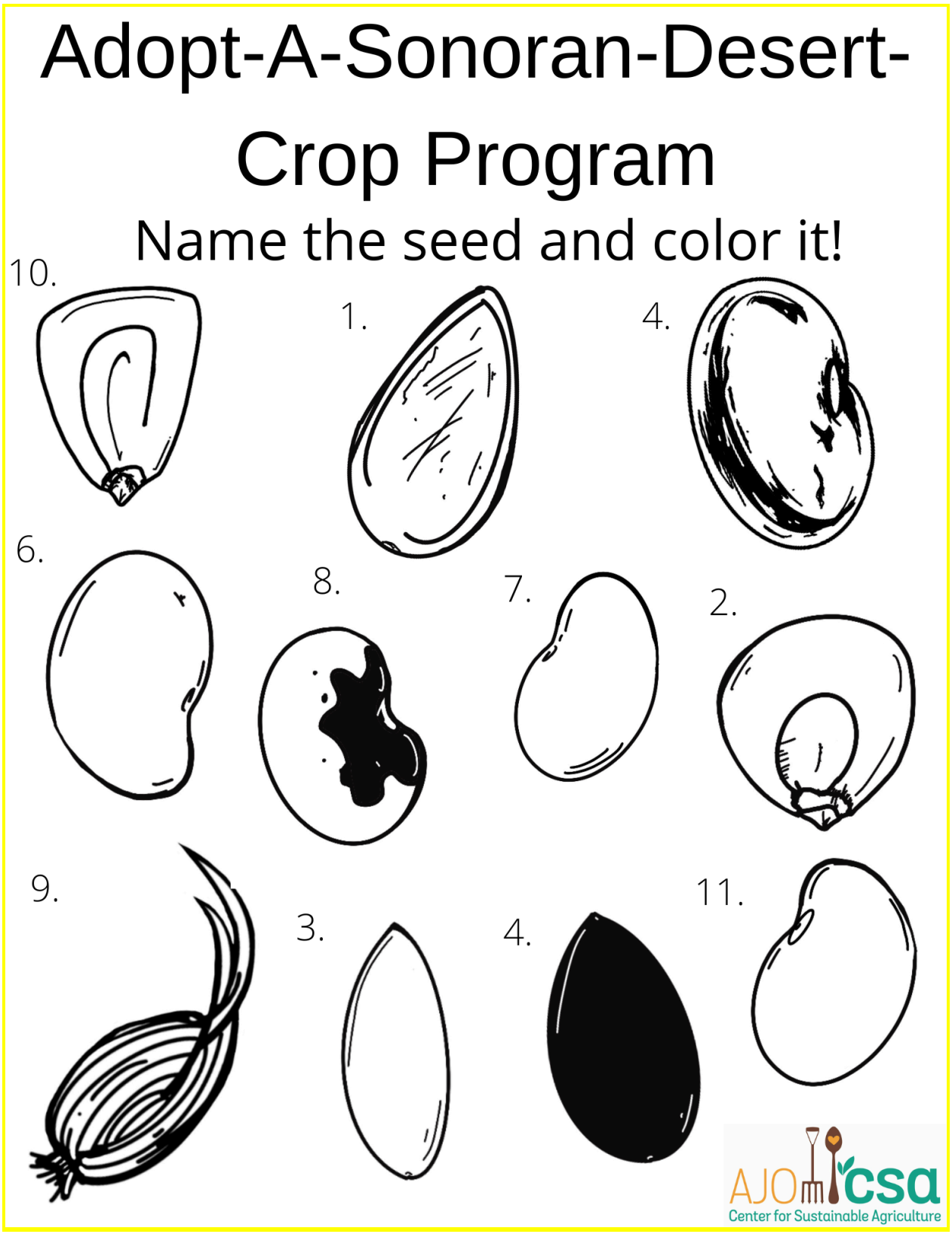
Pomegranates: This fruit tree has been a part of the O'odham community as a popular fruit tree in peoples home gardens and continues to be popular among O'odham communities. Other fruit trees that are adapted to our climate include figs, some citrus, and many others.

Here is a list of Tepary Beans and other crops we are currently growing out for seeds for our Adopt a Sonoran Desert Crop Program at Ajo Center for Sustainable Agriculture.

https://www.ajocsa.com/adopt-a-sonoran-desert-crop

- Keli Baso
- I'itoi Onion
- Magdalena Chard
- Tepary Bean
    - Toti Bawi- White Tepary Beans
    - Wepgi Bawi – Brown Tepary Beans
    - S-cuk Bawi – Black Tepary Beans
    - Suam Bawi – Yellow Tepary Beans
    - S-cukma – Dark Tepary Beans or Chocolate Tepary Beans
- 60 Day Corn
- Red Bisbee Bean
- Pomegranate
- Tohono O'odham Squash
- Yellow Meated Watermelon

ACTIVITY: Name and color the seed of the crop.



Seasonal Planting (Seedling and Direct Planting):

Seasonal planting varies, some are longer and some are shorter. Certain things can be planted for longer or shorter periods of time depending on elevation and location. Here in the Sonoran Desert and on the nation our elevation is in the lower range, which has a pro of being able to extend growing seasons and a con of being hotter and drier. However, some areas in the nation are cooler than others, for example if living by a wash or in the hills it tends to bring in cooler air, especially at night, compared to living in a neighborhood with asphalt and concrete which will bring in more heat. Spring and summer are two of the largest planting seasons here in the desert but the heat and lack of water can be some of the major challenges growers face. A helpful tip for growing is to keep track of the temperature and rainfall, this will help you determine when the best planting times are for your area over time.

Seasonal crops can be sowed directly in the ground, in pots for transplants, and in a greenhouse. Seedlings are when you plant your seeds in transplant pots whether they are plugs, trays or small 4” pots, they are usually planted earlier and before direct seeding into the ground to get a head start on the season. Creating seedlings as transplants can be beneficial by making sure your plants have adequate water and keeping them safe from birds or other wildlife interfering with their growth at their tender stage. Seedlings should also be planted into a seedling mixture or soil that has some form of nutrients whether it is potting mix, seedling starter mix, or a mixture of compost, perlite, coco peat and regular soil. A simple and cost-effective way to create a good mixture of soil is collecting soil from under legume trees like mesquite, palo verde, and ironwood because they have a good amount of organic matter that falls from their dried leaves and flowers which create an environment for microbes.

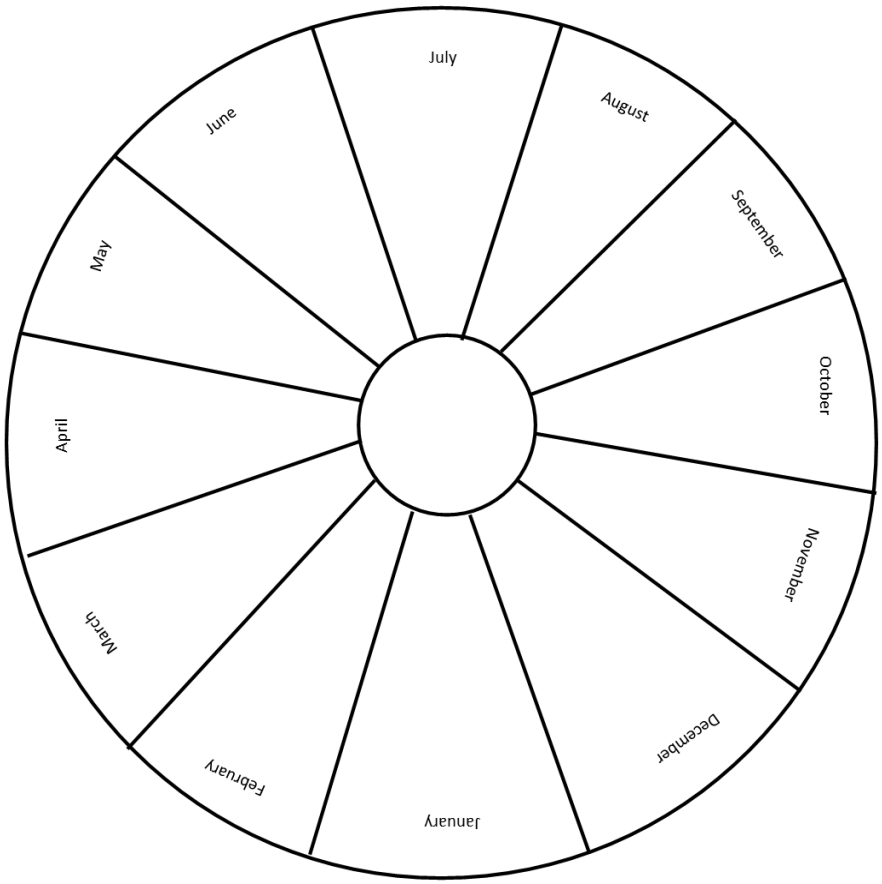
Direct planting/seeding is the method of planting your seeds directly into the soil, in a field or garden bed or garden plot. When planting directly into the ground you will need to turn over and amend your soil with nutrients just like the seedling transplant mix, except for potting mix you would use planting mix which has a higher concentration of organic matter and is more lumpy than just compost or potting soil. The same practice of using organic matter from under trees can be used in your garden bed. Also be sure to pre-irrigate before planting and get your area moist enough for nutrients to break down and seeds to sprout.

Let's start with spring planting for non-O’odham crop varieties. Most veggies grown and harvested in the spring are your leafy greens like kale, collards and lettuce, root vegetables like radishes, turnips and carrots, and brassicas like your cauliflower, broccoli, and cabbages.

Some of the O’odham crops like we mentioned above that can be planted in the spring are the wihol, O’odham peas, pilkan wheat, and I’itoi siwol. However, a majority of the Tohono O’odham crops will be planted during summertime (June-August).

Other resources for planting in your specific region can be found online, from local growers/farmers, local plant nurseries, and extension offices, as well as your local community college and university.

ACTIVITY: The image below is a blank O'odham calendar, try and fill in where the proper O'dham name goes and draw what plants may be growing around that time.



U'us Wihogdag Masad

Sopol 'Esabig

Hasan Ba:k Masad

S-ke:g S-he:pijig Masad

Uam Masad

Jukiabig Masad

Wasai Gakidag Masad

I'al Ju:pig Masad

Ce:dagi Masad

Ge'e S-he:pijig Masad

U:walig Masad

Gakimdag Masad

In the summer time our temperatures reach 115 degrees fahrenheit or higher. It is important to keep you and your crops healthy, cool, and have adequate water. Some things to consider when planting in summer are location and whether your garden bed, plot or pots will be in full-sun all day or if they get a chance of shade. East facing gardens in the summer tend to do better because they get a break from the sun in the afternoon when it is the hottest time of day. Other options such as shade cloth at various percentages of sun blockage can be used over your garden for alternative shade. Or trees nearby for filtered shade however, you'll want to consider a great distance from planting your garden near trees because of their roots, and they will take up your water and nutrients.

Watering Methods and Tips:

Watering is one of the biggest challenges in gardening and agriculture, here in the Sonoran Desert it is crucial for non-native plants. Most of our native plants and crops will thrive in our drought tolerant region.

❓**Can you give an example of a native crop or plant or both?**

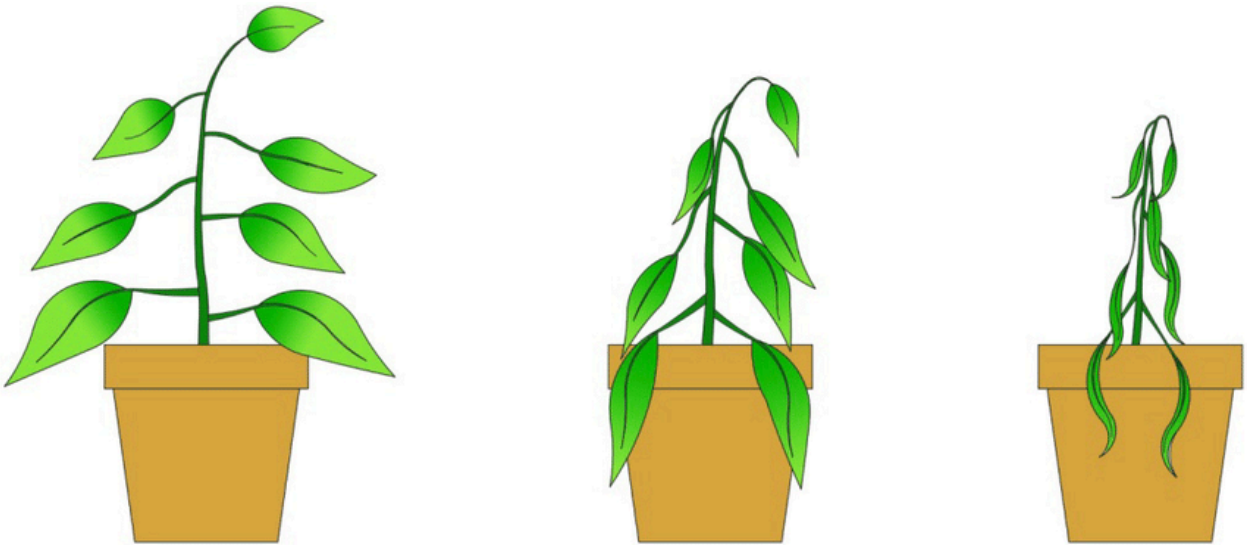
Some general watering methods for gardening or simple potted plants include, hand watering, irrigation system above or underground with drip tape or spaghetti lines, poly, ollas, self watering pots, self watering tools like globes, spikes and many other new resources, it's just a matter of what works for you. Some drip irrigation lines do not have premade holes in them, so an irrigation hole puncher will be needed for poly or other drip lines.

Now time for the biggest question, how often and how much to water? Various factors go into account when considering these two questions, for example, the size of your pot whether it is a 10' pot or a 15 gallon container, the larger container will definitely take more water, and will also hold it for longer periods of time. However, the larger the plant is in the pot the more water it will need as well. Soil is also a big factor in water retention, and weather conditions such as, wind, heat, direct sun, cold temperatures, humidity, etc all play roles when considering how much water or knowing when your plants need watering. You'll develop the eye and skills for watering the more you observe and keep record.

Not only does it depend on the size of your pot or bed, but also the type of plant. A general method to tell whether your plants need water is to feel the soil, stick your finger an inch or two into the soil and feel whether it has any moisture. For deep rooted plants you'll want to stick your finger further into the soil a piece of rebar can also be used to measure the depth of soil moisture and compaction.

Leaves can also help you identify if water is needed, if they look "sad" slightly droopy and not as firm, and color begins to look pale, this is the wilting point and it's time to water. Other clues to look for in leaves when stressed are curled leaves in corn and beans. Corn and beans will curl their leaves inward when they are drought stressed because they are trying to conserve whatever moisture they have and reduce their surface area to prevent more moisture being taken out by the sun and wind.
When watering pots, water until it begins to flow out the bottom of the container or pot if it comes out too fast, it is too dry and needs to be watered thoroughly. If the pot/container is easy to lift, the weight can also give you an idea on whether it received and absorbed a thorough amount of water or not. When plants are in containers the root ball becomes like a sponge and soaks up all the water, once that water begins to deplete you will notice a change in soil color, which will become light, and it will begin to shrink from the pot.

https://mountaincrestgardens.com/blog/succulent-soil-the-ultimate-guide/
Image of moist soil vs. dry soil, notice the color difference.



https://www.researchgate.net/figure/Visible-wilting-stages-for-water-potential-measurements-Left-Stage-1-initial-wilt_fig8_318678352
Image of a well watered plant going into the stages of a crashing plant to a wilting point.

Other methods for irrigating when you have a larger area and are planting in the ground rather than a container or bed can include flood irrigation with a hose, soaker hose, sprinklers or rainwater, irrigation lines can be used for making sure your plants get adequate water on a consistent basis. Some irrigation materials that are commonly used are, drip tape, poly, and spaghetti lines which are run by a timer.

Drip Irrigation

Flood irrigation/Ak-chin farming/monsoon planting are various terms similar in the practice of utilizing rainwater and dry land farming practices. When wanting to implement flood irrigation, you'll want an area that is fairly flat and is downstream from a higher elevation to capture flowing rainwater. An area can be flattened out with shovels and rakes, and a water leveler, also known as a bunyip water level that can be purchased or DIY'd.

Materials needed are:

- 30ft of vinyl tubing
- 4 pieces of wire or string
- water source
- taper measure
- black marker
- two stakes
- yard stick.

Here is a video that shows how to assemble and use the tool. https://youtu.be/pRjNA0DZZb4?si=9lN9LZqJk8tMeQjD

chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.harvestingrainwater.com/wp-content/uploads/2018/03/Appendix-1-Bunyip-Water-Levels-and-A-Frame-Levels-revised-3-2018.pdf

For more technical assistance a laser leveler would be most helpful and precise but not everyone has the access, however the Tohono O'odham Community College Agriculture Dept. could provide these resources.

Making berms are necessary when capturing water, they can be made with a shovel, a rock rake or a tractor and they are also useful in creating a walking space when entering your garden because you do not want to compact the soil from continuous foot traffic so make sure you have designated walking paths between your rows and planting beds/area.


Flood water irrigation on a dry land farm in Cowlic, the first image is of a pipe attached to a pump to generate water into the fields and the second is of a field that was flood irrigated, notice how the ground is leveled so that water can flow efficiently throughout the field and how the berms hold water in each row.

Caring your garden (maintenance and troubleshooting)

Once your garden has been established and your plants are starting to pop up, you will want to observe them daily and look out for any damages, abnormalities, growth, and overall condition of the plant and your garden. One of the biggest maintenance challenges and ongoing work is weeding. Weeding your garden is necessary because it prevents weeds from taking up the nutrients and water that are needed for your plants. You will especially want to take out weeds before they flower to prevent spreading of seeds. Weeding can be done by hand pulling, a flat head shovel or some kind of garden hoe/hand hoe. Practices such as mulching with cardboard, plastic, and/or wood chips are helpful in preventing weeds and keeping soil moisture in.

Image of cheese weed (little mallow)

Some wild plants we consider as “weeds' ' can be edible like cheese weed for example, the leaves, stem and flower of this weed can be eaten raw or cooked. Some weeds also have medicinal properties, however, proper research will need to be done before experimenting.
This site will take you to the University of Arizona Pest Management Center and show common weeds in our region.
https://acis.cals.arizona.edu/pest-identification/weeds/weed-photo-gallery/-in-tags/tags/little-mallow

Other factors to consider when caring for your garden is, picking off yellow or damaged leaves, especially if they are close to the soil, you will want to remove any lower leaves that are touching the soil on your plants to keep in good air flow and prevent pests, harmful molds/mildew or diseases from interfering with your plants.

Common diseases: powdery mildew, rust, fungal, etc.
Common pests: aphids, mealy bugs, grubs, caterpillars, thrips, etc.

Analyzing and observing your garden every morning or on a consistent basis will help you identify certain things that might be going on in your garden like catching diseases or pests from overcoming in your garden. Look out for leaves that have holes or a discoloration, some bugs like to hide under the leaves and in the small crevices of the nodes or in the flower buds. It is also a good practice to take note of when plants sprout from planting date, when first blooms arrive, and when fruit begins. Keeping a good record will be a great guide for future planning and planting.

Some of the common challenges farmers/growers face on the nation are with wild animals interfering in their fields which are cattle, gophers, prairie dogs, ground squirrels, field rats, javelina, rabbits, coyotes, ants and birds all have a tendency to want to get to your crops. A secure fence or barrier should be implemented before planting to prevent certain wildlife from eating your crops, chicken wire is recommended to prevent ground animals from burrowing, chainlink, cattle fencing or even pallets can help provide protection for your crops.

If you have irrigation lines above or underground, look out for any larger puddles of water or an excess of moisture in an area, this could indicate you have a hole in your line which can be fixed with the necessary tools.

Harvesting

Harvesting has always been a big part of O’odham Himdag (People's Way of Life) as we came together to grow and collect our share of the crop. It is the reason why we came together to celebrate our harvest from the field to the village or community and to our families. We danced together in celebration as we gave thanks for a bountiful season, from planting, to calling for the rain and finally to our loved ones. One of the noticeable things in O’odham culture now is that we have a pilgrimage to a small church in Magdalena, Sonora Mexico. The O’odham go down into Mexico towards the end of September to ask for blessing from the Saint which is called St. Francis Francisco. Nowadays the younger generations call this the Fourth Celebrations. The Catholics saw a way to unite O’odham culture with colonialism as a way to

celebrate two religions together, as most people don't know that Spanish Missionaries were Farmers. Wherever there was a church, they would bring seeds with them to grow crops that feed their congregations. This Celebration brought both O'odham and Catholics together which still goes on to this day, to share the harvest season.

The O'odham have used different techniques to harvest their crops when it came time. For each type of crop there was a way that could make things easier to process for seed saving and cooking. Some of these practices are still being used to this day by farmers. With the practices, some of the O'odham Kaij do not have any mechanical machines that will help with the harvest. Sometimes harvesting can be done all by hand from start to finish with no machines but use what mother nature gives you.

Threshing is one of the techniques that is still being used today by small farmers as a way to harvest their crops. What is Threshing? And which crops can you use it for? Threshing is using some type of pressure, like your feet, to stomp or trample your crops seed pods. Traditionally this method was done by horses or mules. Usually threshing would take place on smooth flat surfaces like a concrete slab or in a tarp so that the seeds are kept in place and not lost. The pods would be laid on top of the surface and by using your feet and your weight to break loose any of the seeds from their shells. You can also use your hands by using blunt objects like a shovel, pitch fork, wood stick, to thresh your crops to collect seeds. If you don't have a concrete slab, the next best thing is to use a hard surface. After you selected a space, lay a big tarp open and flatten out and put your harvest on top of the tarp. Then use the winnowing technique to collect seeds from your harvest. It's good practice to have another tarp to put any debris to go through another process of threshing.

O'odham youth helping thresh and winnow bawi.

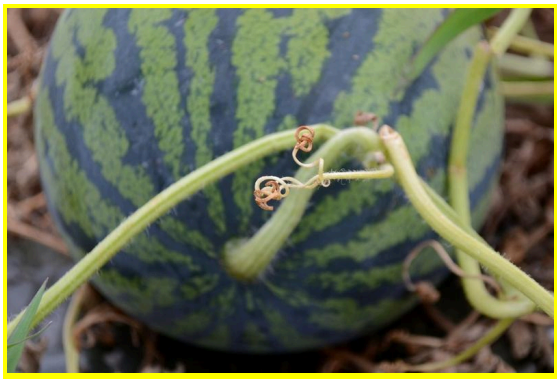
After the threshing process, the O'odham would use hand woven baskets to collect seeds and remove debris through the winnowing process. Winnowing is a method that uses the wind to help remove the shaft and debris from the seed. O'odham would wait for a breeze of wind to come through with their basket full of seeds in their broken pods, and the action of gently tossing the seeds into the air helped clean them. With the help of the wind the debris are light enough to fly away into the air and the seeds are dense enough to fall back into the basket. This technique is used on beans and wheat.

Hand shelling is another technique that is used for a variety of crops like Bawi, Mu:n, Howal, Kanya, Pilkan, and Hu:n. Instead of harvesting the whole plant like the threshing process, you harvest just the pods/cobs of the plant. When hand opening the pods you can separate the seeds into a container or basket. With other crops like Kanya and Hu:n, using your hands can help separate seeds when you are harvesting. For kanya, once the seeds turn into a darker color from red to almost black you can harvest them by snipping off the top of the plant where the seeds form with a pruners. For Hu:n, take a piece of corn using your hands, squeeze tightly with both hands over the corn and twist your hands in different directions to release the cob from its husk and a similar process for releasing the kernels from the cob.

There are several ways to harvest the bawi, whether it is by hand picking which can be time consuming or through a full chop and roll method which is when the plant is dried as well as the pods, they can be chopped from the stem and rolled together like a big rug. After the beans are rolled up, place them on a tarp and begin to thresh the seeds from the pods, a shovel or another heavy tool can be used so that it allows the separation of the seed from the shaft. After the seeds have been threshed, a winnowing method can be utilized to remove the debris.

Separating seeds through various screens can also be used to remove fine pieces of debris.

When harvesting melon, you will want to look at the major stem and notice whether the tendril that is closest to the stem of the fruit is brown and dry, this indicates when the melon is ready for harvest.



https://graduatefarmer.co.ke/2017/02/28/how-to-know-if-a-watermelon-is-ready-for-harvest/

Seed Saving

Seed saving is the next step after harvesting your crops from the garden or field. Why is this important to save seed? Is there a difference between Heirloom and Hybrid? What should you be looking out for when you are growing crops? What should you look for in seeds? How to process and preserve the seeds for storage?

The history of saving seeds can be traced in all cultures around the world. Civilizations or communities had survived in their environment for thousands of years by creating agriculture. In O'odham Himdag, seeds were created from a higher power, who gifted the seeds to the people when they needed the help to survive. It's taught to the O'odham when you save the seed of your crops, that you'll have saved them for a duration of four years. By saving seeds each year will have more seeds to plant and more seeds to cultivate. Yes, that is true, when the farmer can save their seeds after each harvest every year. The more seeds a farmer has will mean more fields the farmer can plan and share with other farmers to promote genetic diversity of that seed.

What does **Heirloom Seeds** mean? Heirloom is defined by something being passed on or handed down from one generation to the next generation. For example, if your grandfather grew squash, then your father was handed the same squash seeds for him to continue to grow, that is heirloom. If you ever wondered what heirloom meant when you see this on a seed packet at the store it just means it is an old variety that has been continually planted and preserved for its appealing characteristics and properties. Our O'odham crops are considered heirloom varieties.

What is a **hybrid seed**? If you go to a store and you see a hybrid or F1 on the packet, it means the seeds have a "controlled breeding process" with selected parent plants for specific traits and characteristics. However, when saving seeds from hybrids you will not end up with the same plant, it will vary in its traits that could have come from the grandparents or further generations. So why create hybrid seeds? Some seeds are made into hybrids so that

they grow stronger or faster and make them least susceptible to diseases as they grow. This helps the farmer have a higher yield when they grow for their season without worries.

G**enetically modified seeds** are created in a laboratory setting by removing certain genes and replacing them with other genes. Seeds that are GMOs are not accessible to the general public and are typically used in commodity crops like corn for cattle feed, and soy.

Why is it important to save seeds? Saving seed not only gives you more seed to plant, but gives you different generations of seeds to plant, grow and cultivate. What do we mean by generations? Every time you plant and harvest seeds from a crop, it's a new generation of seeds. One generation is equivalent to one year of growth. It's recommended to plant 2 generations of seeds together when you are seed saving. To have 2 generations growing together, you would need seeds from previous years. Here is an example of a community member and their experience, "I grew watermelons in 2021, and I wanted to grow the same watermelon again in 2022, then it would need watermelons from 2020 or older. Or I can get the same seeds from another farmer." Planting two different generations of seeds is a practice for genetic diversity. "Growing out the crops each year, you will have seeds from different years to help the seeds to be stronger". Why does it matter? The seeds transfer their genetics by growing from one generation to another. If a seed grows through a hot summer season, it is more likely that the seeds will have traits in their genetics to endure the heat. If you are planting the seeds from the same generation, you will probably not have the same size, or growth, and or the same taste because they don't have genetic diversity. The seeds are amazing, for example if your plants survive an above average hot summer, it's most likely going to pass that trait to the next generation of seeds. This is what seeds have done for thousands of years as they adapted to climates and have been cultivated from civilizations.

What to look for in seeds? It differs from every crop, but you can always count on if the seed looks like the seeds you planted, then you can save them. When it comes to squash, watermelons, melons, tomatoes and chilies. They will have a lot of seeds but to choose the seeds for growing you can feel them by holding the seed in your hands, use your finger to see if the seed will bend. If the seed bends this means it is not good, but if the seed is solid it's good. Also look for any holes, half pieces, discoloration or pale color, or if the seeds feel too light and float to the top when submerged in water they are not viable.

How to process seeds? Each crop is different, but with squash, melons, and tomatoes. They all have the same process that you can use which is a wet method with water. You first want to harvest then cut open to get inside the fruit. Then use your hand(s) or using a spoon to scrape the seeds and membrane out into a bowl of water. Second, you can wash the seeds by rinsing them off in the sink or a bowl of water and stir it around to release some of the membrane from the seeds. You may also want to use some type of strainer so the membrane pieces can fall through and the seeds will stay in the container, or vice versa depending on the size of seeds and the size of the strainer/colander. Once you have cleaned the seeds from the membrane you can set them aside on a piece of paper towel or cloth to lay out and dry. You will want to move the seeds around daily so that they continue to fully dry on

both sides. Once your seeds have sat and dried for a period of time, you can store them in a sealed tight jar, container, or burlap and store it in a cool, dry place. Most people will store their seeds in a fridge or in a dark closet.

In Archeology, seeds are being traced back to their place of origins by documentations of the sociality or groups who have grown them. Archeologists are digging up ancient civilizations sites to trace any seeds that were left behind to document what was growing thousands of years ago. Another way science is helping in agriculture is by looking into the seeds genetics to help define what the seeds are so that they can be matched, mapped and organized. By doing this, they can show if the seeds have traveled to different countries not just in the US but the whole world with each seed. It was discovered by sources that Tepary Beans have been in ancient villages to be more than 5,000 years old, 4,000 years old Tohono O'odham 60 Day Corn and 2500 years old the Tohono O'odham Squash.

Wild Harvested Foods:

Ciolim (cholla buds): The ciolim is a wild food that comes into season during spring time April-May. This particular food is a bud (before a flower) . It is mostly harvested from the staghorn cholla cactus, but there are many other varieties out here in the Sonoran Desert that can be harvested from as well. The process for harvesting ciolim is using tongs or a tool made from wapai which is the saguaro cactus ribs and makes the same purpose as a tongs. The cholla buds have tiny little stickers called glochids which are small hairlike clusters of spines/stickers and can easily get caught on your skin or clothes so a general rule of thumb when harvesting is to not harvest when it is windy or harvest against the wind because they will fly off and land everywhere. One common way to get the spines off of the bud when harvesting is to use sugi, otherwise known as creosote or greasewood and use it to brush off the stickers as you harvest into your bucket or basket, another plant that can be used is the desert broom, so it depends what is common in your area and whether the plant has a type of texture to it or a slight stickiness to help the spines come off the bud. Spines can be brushed on the cactus before picking and once you pick them off, several cleanings are necessary when harvesting ciolim. Next, is the cleaning and boiling process and then the drying process, a large surface away from animals and preferably sunny area to help dry them out better is needed. A large screen such as a window screen, or door screen can be used to place the cholla buds on to let them dry and to continue cleaning them can be used, they will need a few days to fully dry

The staghorn cholla plant and an upclose image of the cholla buds.

Bahidaj (saguaro fruit): This fruit is a significant symbol of renewal and the O'odham New Year the bahidaj, a saguaro fruit that comes into season during monsoon, before the rains. When this fruit comes out it is first green then slowly starts to ripen and turn a dark red and split its shell open revealing the fleshy fruit. The fruit is pulpy and has tons of little black seeds, known as kaij and can be used as chia. The O'odham get ready for this seasonal harvest by making a tool to pick known as a kuipid/kuipud. The tool is made up of saguaro ribs wapi, and can be as tall as some of the tallest saguaro cacti 10-16 feet tall. Bahidaj is used in numerous ways, most commonly used by the O'odham is sitol and wine, sitol is a syrup and the wine is made during and for a ceremony that is practiced annually for the blessings of the rains and crops and a new year of food and life.

Fresh bahidaj in the pod, sitol (saguaro fruit syrup), and a dried piece of bahidaj that is still edible and even sweeter, we call this Jun.

Wihog (mesquite bean pod): This legume comes from the velvet mesquite tree, as well as other varieties of mesquite like honey. The tree blossoms into long yellow fuzzy looking flowers and then turns into a long green bean pod which eventually dries into a tan hard shelled bean pod. The pod has a sweet flavor when chewed on in its dry stage, sometimes the green stage as well. Once the pods are brown and dry they can be harvested from the tree, but not the ground because they are more prone to molds and harsh fungi, the general rule is to never harvest from the ground or from busy road side areas. The pods are then milled into a flour, known as wihog cui (mesquite bean flour)

https://savorthesouthwest.blog/2020/07/11/mesquite-not-flour-broth/

Iwag (wild spinach): The wild amaranth and other wild greens begin popping up around monsoon season and other rainy seasons, along the irrigated fields and around the washes. The greens are typically harvested before it flowers,

otherwise the leaves become too bristly and tough with a bitterness. The seeds of the amaranth are also edible and can be used as a grain.

https://savorthesouthwest.blog/2017/08/10/blessed-monsoon-weeds/

I'ibai (prickly pear fruit): The fruit comes from the prickly pear cactus and comes into season around late summer July/August. Its color will change from a bright magenta to a dark plum/purple color. You will need a tongs or a tool similar to harvest them as well as something to brush off the little glochids, the tiny spines that cluster on the fruit. Not only is the fruit edible but the prickly pear pads are as well, which are commonly known as nopales. The Nopal is harvested at a young stage when it is most tender and before it gets its spines.

https://arizonadailyindependent.com/2015/09/20/prickly-pear-cacti-many-varieties-many-uses/

Kuk Ceidag (Palo Verde pods): The pods on the palo verde come into season around early to mid summer time, they can be harvested at the green pod stage or dried. However, when harvested during the dry stage, the beans are hard and cannot be eaten raw, some may grind the seeds into flour, similar to mesquite beans. The green pods can be

eaten whole like a green bean or opened up and just the seeds are eaten. The seeds have a sweet taste, similar to a pea.



https://tucsoncleanandbeautiful.org/product/foothills-palo-verde/https://savorthesouthwest.blog/2020/05/31/the-palo-verde-window/

https://savorthesouthwest.blog/2020/05/31/the-palo-verde-window/

RESOURCES AND CITATIONS:

https://www.iitc.org/wp-content/uploads/tepary-handout_20200904-1310.pdf

https://statemuseum.arizona.edu/sites/default/files/tohono_o-odham_foodways.pdf

Activities & Videos:

Weather vs Climate: https://youtu.be/YbAWny7FV3w

Climate Change Impacts: https://youtu.be/SDRxfuEvqGg?si=VLkNwJWhdkW7Eqky
Causes & Effects of Climate Change: https://youtu.be/G4H1N_yXBiA?si=4rsKxx6PiO6e8AZY
Climate Change Infographic Video: https://youtu.be/-D_Np-3dVBQ?si=mAz8__QcFSMo_K4x

Podcast on Farming and Climate Change:
https://climate.mit.edu/til-about-farming-warmer-planet-educator-guide

Climate Smart Ag: https://youtu.be/q7JnJ0oBa94?si=4VWl0sIN70wbFgQ6

Understanding Climate Smart Ag: https://youtu.be/WjzW00OfATM?si=DN3tB3wBOlYI1v9h

https://youtu.be/z3ewl7MhRXY?si=DWfTRmlzhirh20lD

https://youtu.be/z3ewl7MhRXY?si=oUxgnk1h7w2iHCgB

Crop Rotation: https://youtu.be/wqRh6pNBObw

No Till: https://youtu.be/DBYeb66dN80

Cover Crops: https://youtu.be/NLoEkcbsJLo

USDA NRCS:
https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/climate/climate-smart-mitigation-activities

Resource:
https://www.climatehubs.usda.gov/hubs/northwest/topic/agriculture-and-climate-change-alaska-curriculum-grades-6-12

Seed Saving- how to save seeds, why is it important? (seed saving handout?)

Planting- planting traditional O'odham crops in the school garden each season (planting calendar with O'odham crops)

- Label the garden with what is planted using the O'odham names
- Corn planting handout

Ajo CSA Planting Videos:

- Tepary Beans- https://youtu.be/Ax8egVanikI?si=H9Em1W_WpTq_RQvQ , https://youtu.be/EPVaNM8mZV0?si=1Bw628ybqEw_Z82o
- Corn- https://youtu.be/d47KTpeh7dI?si=Gq0dA614BQJQucyV
- Squash- https://youtu.be/PcB_er-aBS4?si=RRANU7L2Vn0c1ODt
- Watermelon- https://youtu.be/7OChZ0Jvqrs?si=5-Z61ud4LOUZd_6q
- Monsoon Planting- https://youtu.be/mMzpzf037tg?si=WIyWvJknfmB2TRhs
-

Harvesting- harvesting crops from the garden, wild harvesting

- Threshing Tepary beans, TO squash rope
- Ajo CSA Cholla Workshop: https://youtu.be/7QQo4htz_U4?si=KzETBSTyHphu_9yb
- Saguaro Fruit Harvest Video by Terrol Johnson https://youtu.be/UEaa3mh7DcU?si=5i7-qF0tVka_83bJ
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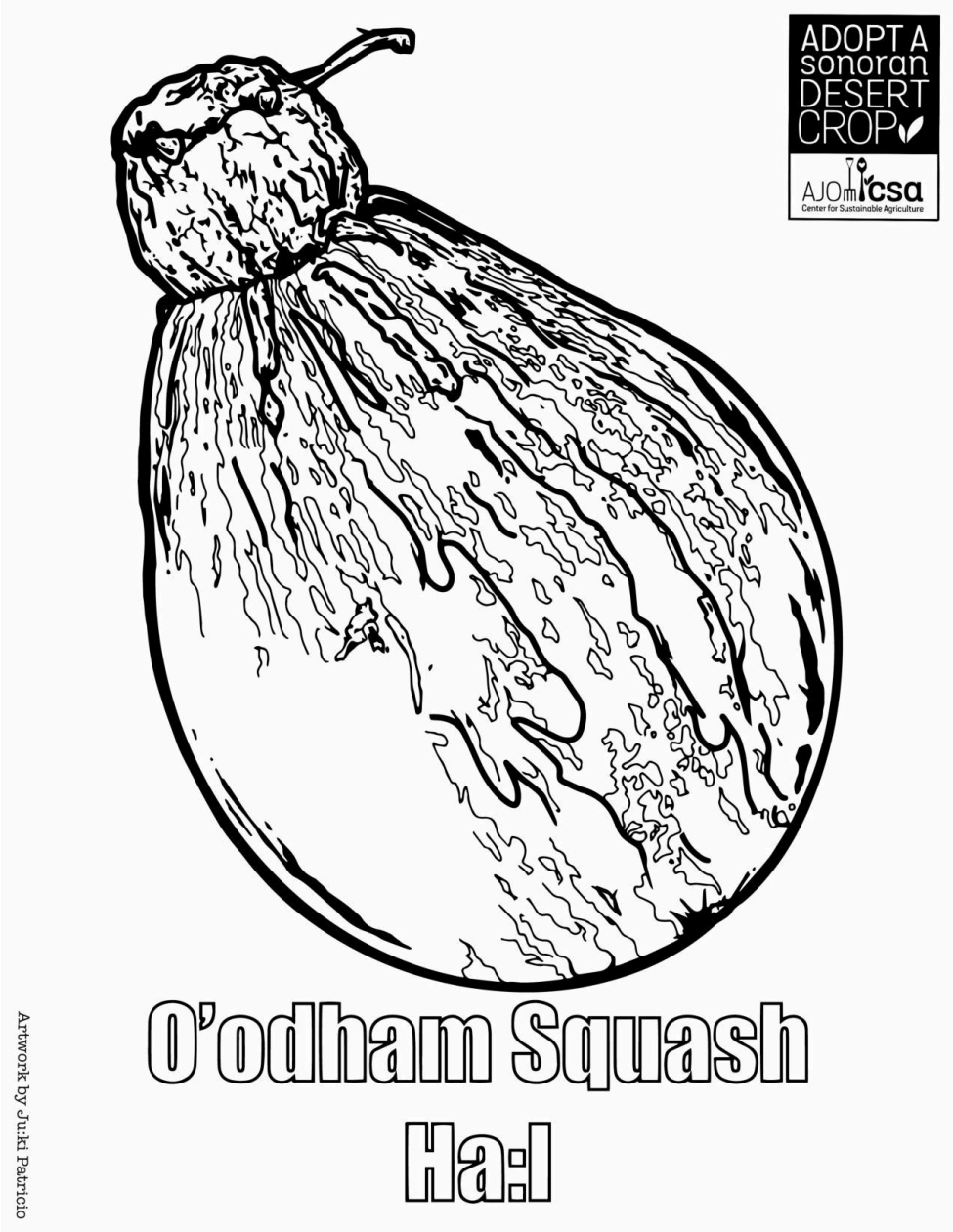
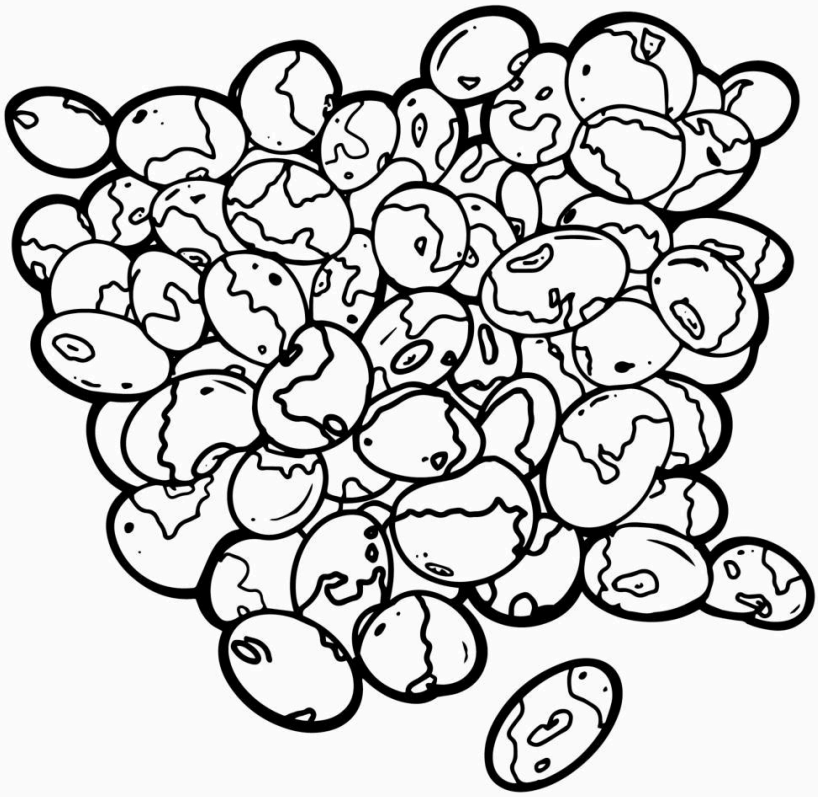
AAC Coloring Pages- individual pages:



ADOPT A sonoran DESERT CROP

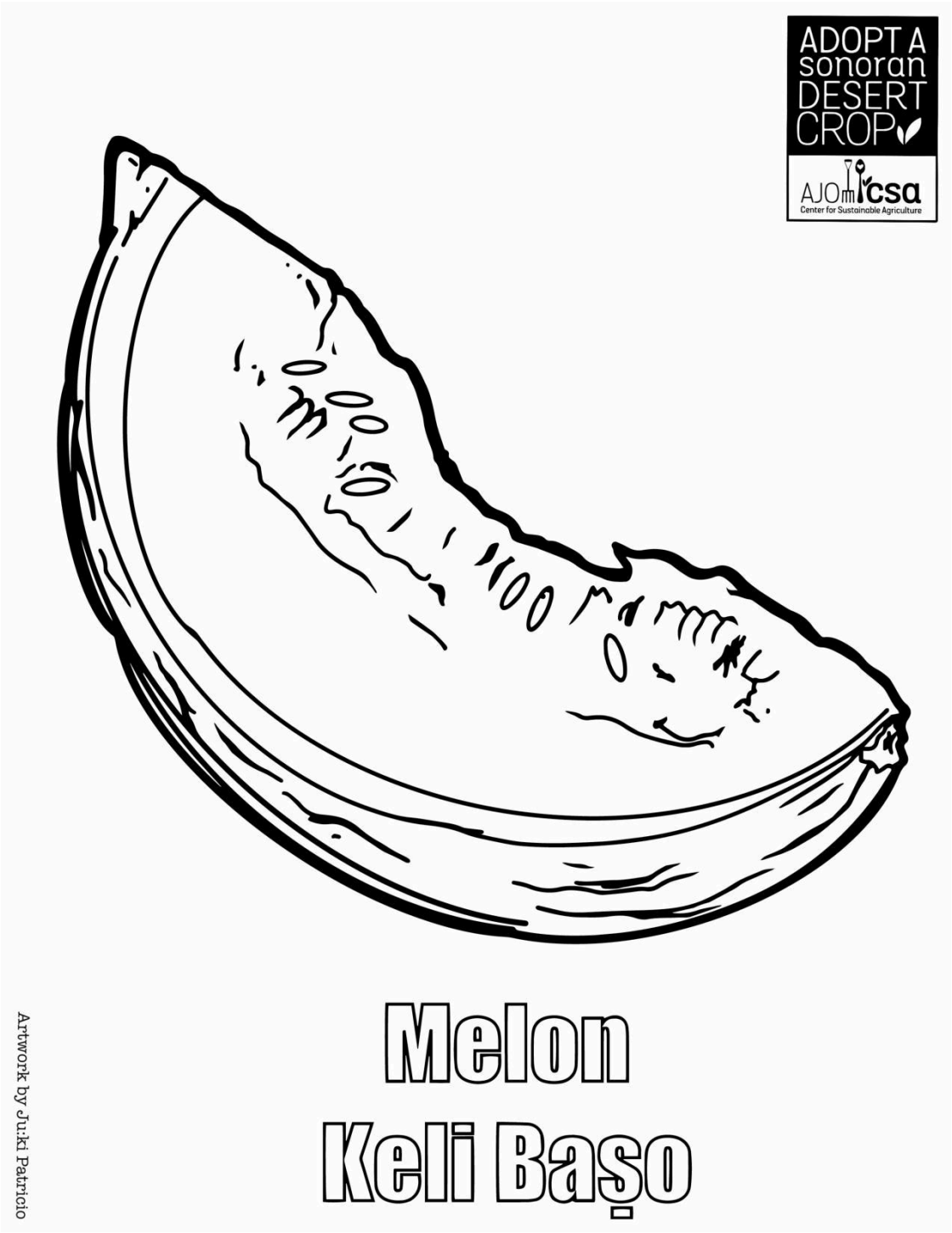
AJO csa Center for Sustainable Agriculture



Black & White Cowpeas

U'us Mu:ñ

Artwork by Juki Patricio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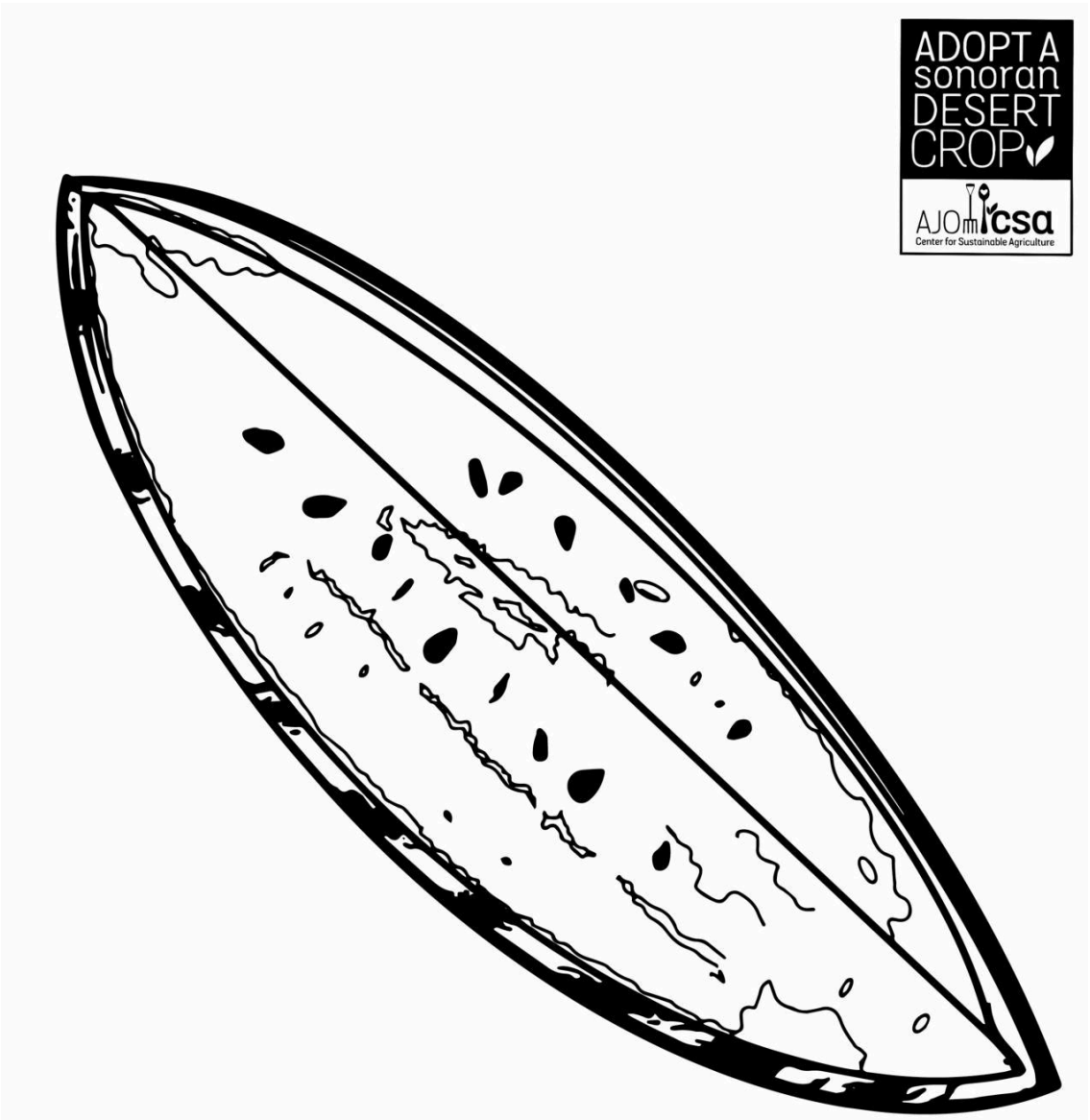
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Yellow Watermelon
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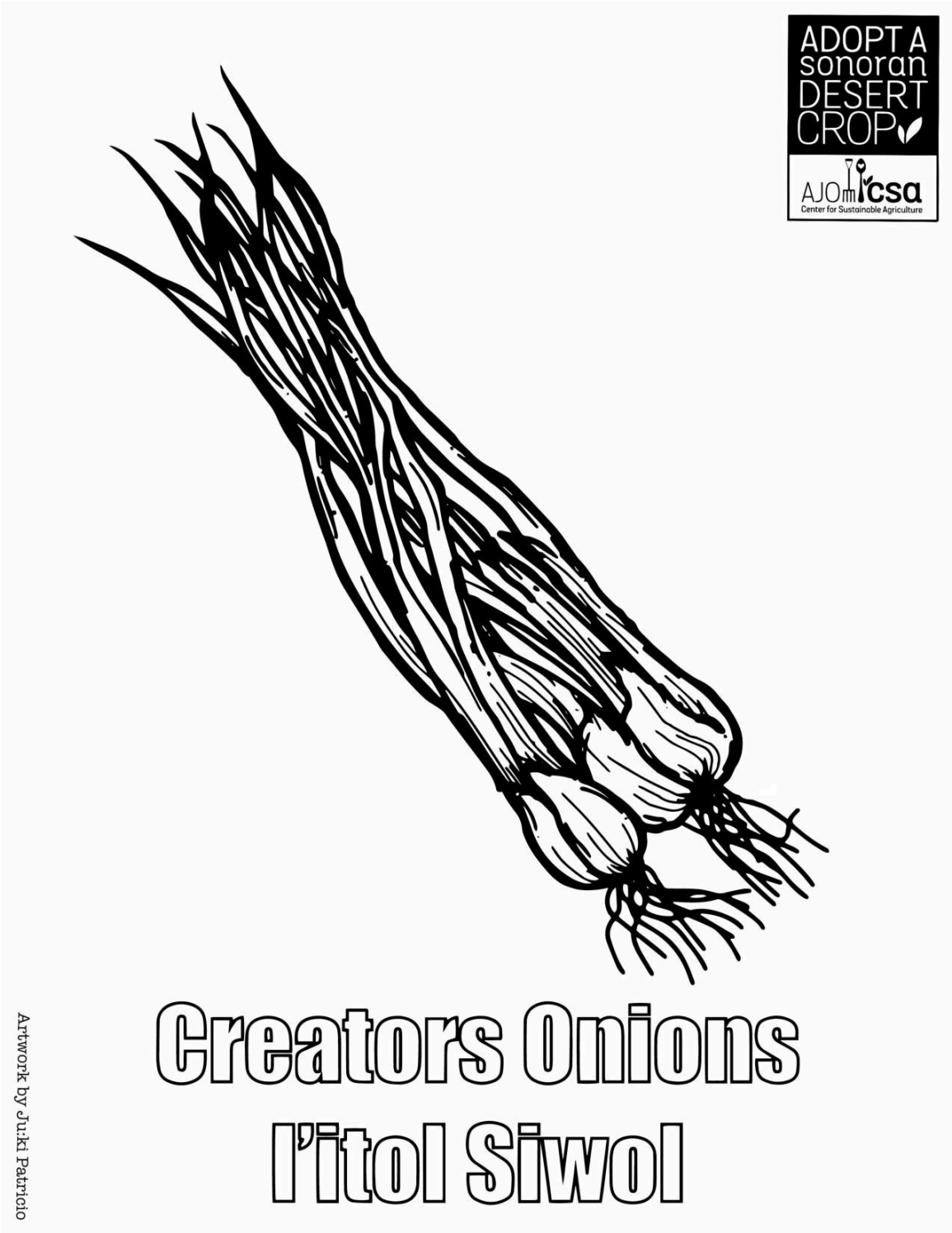
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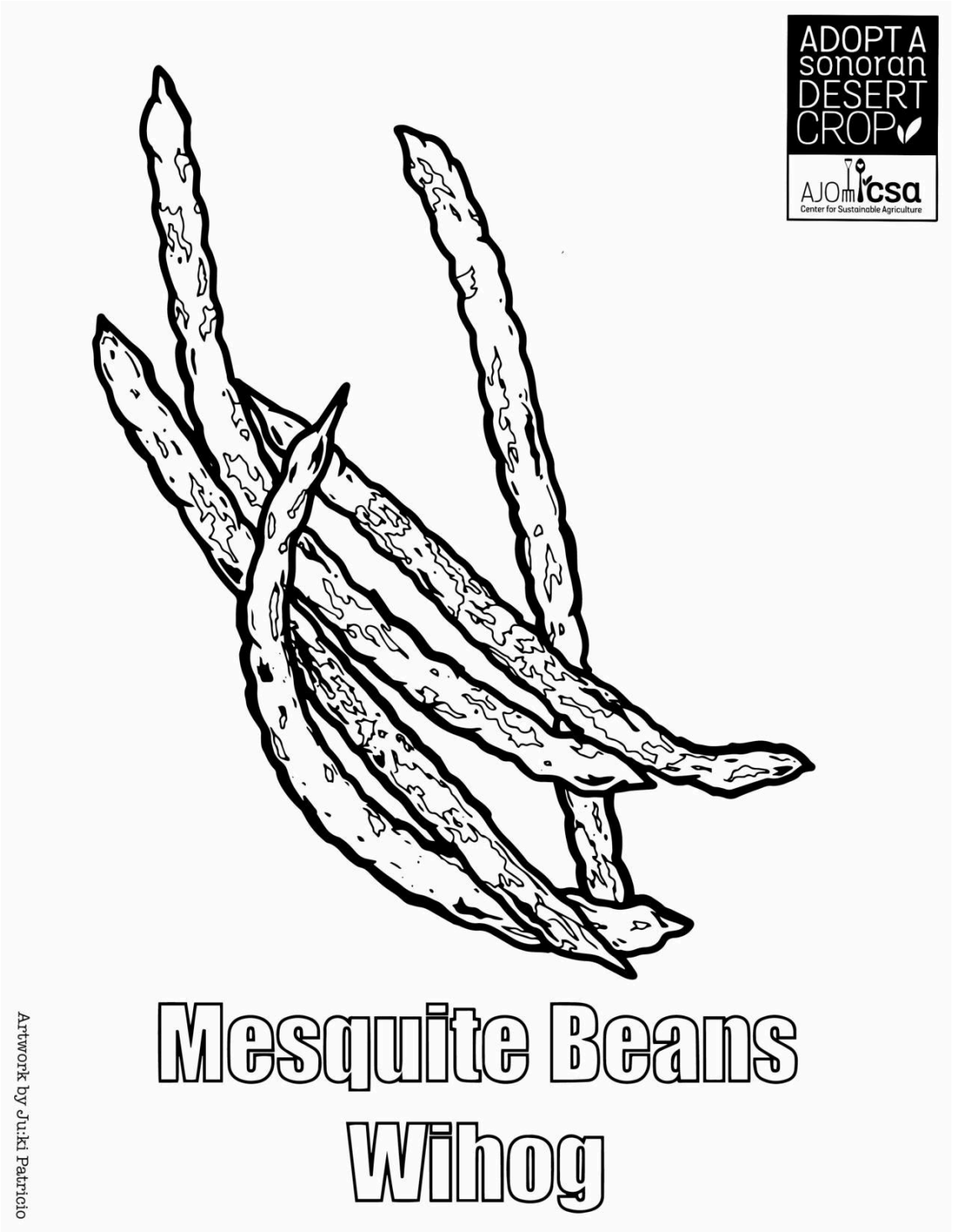
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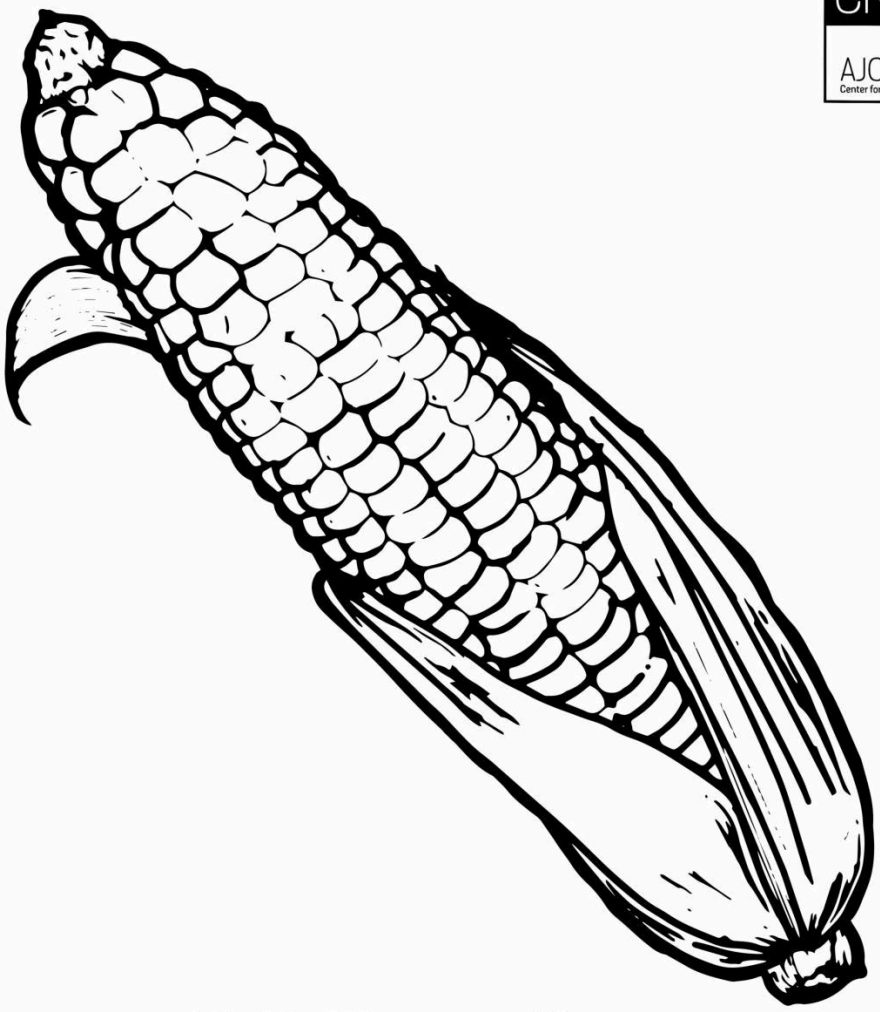
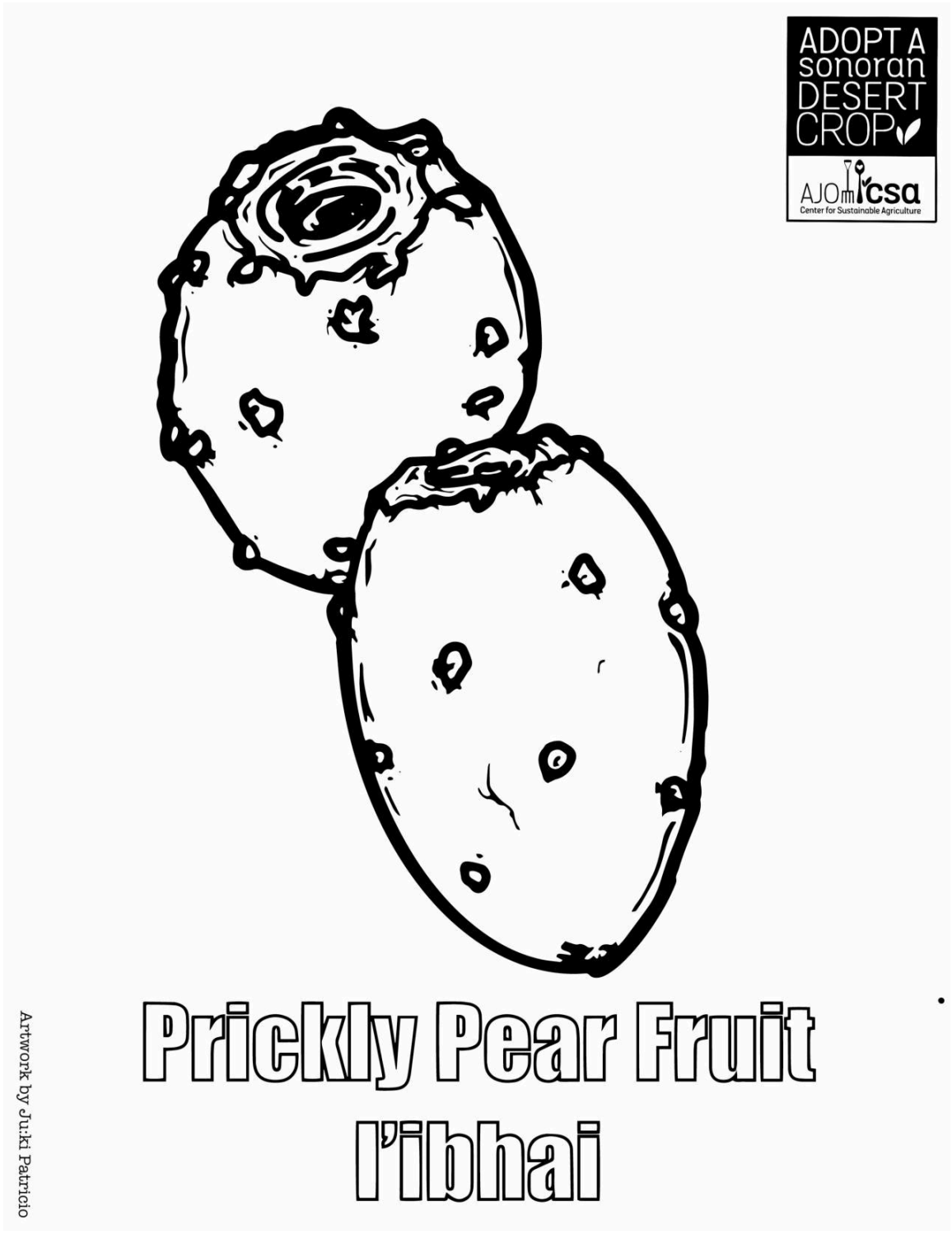


60 Day Corn

Hu:ñ

Artwork by Ju:ki Patricio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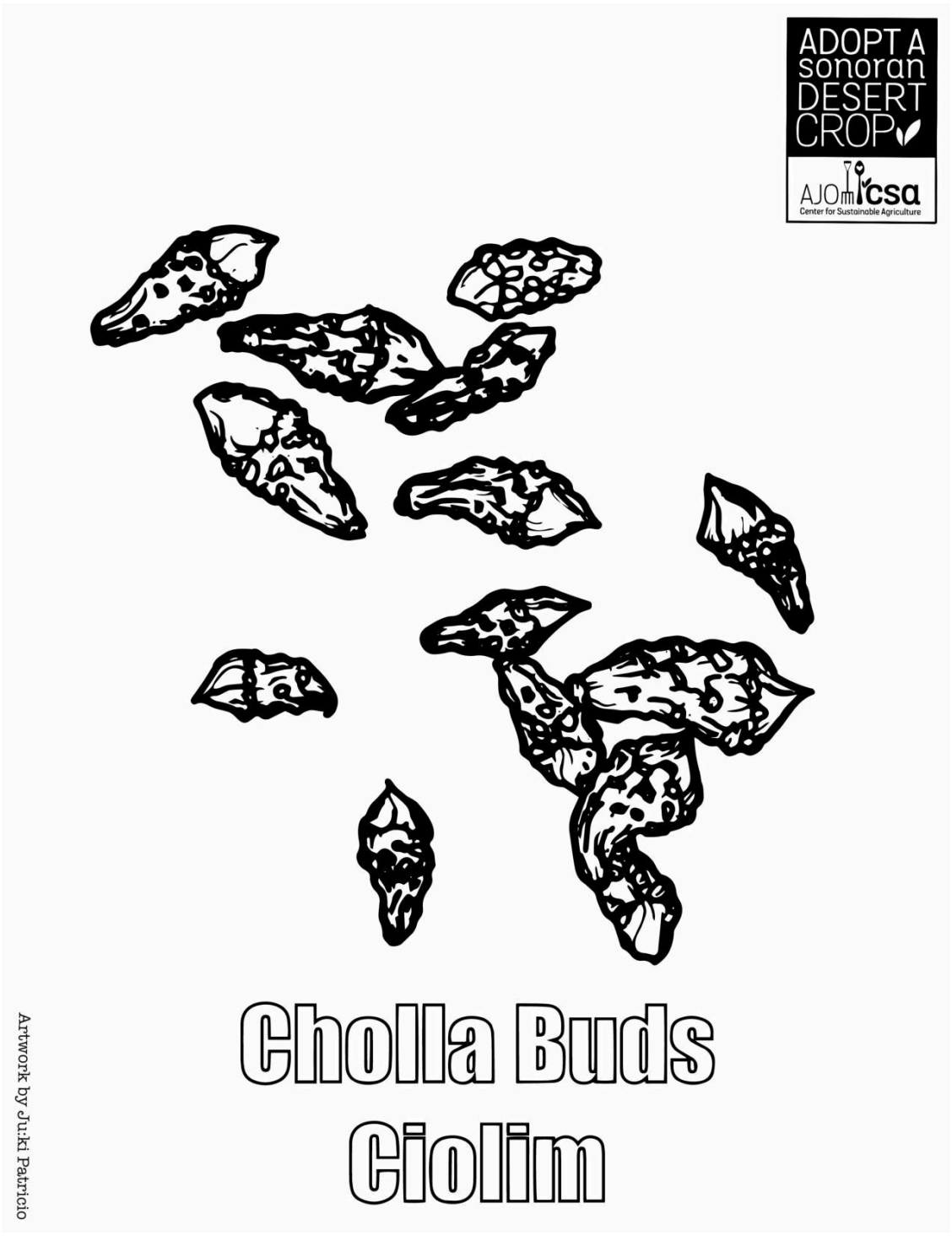
Prickly Pear Fruit
I'ibhai
Artwork by Juki Patricio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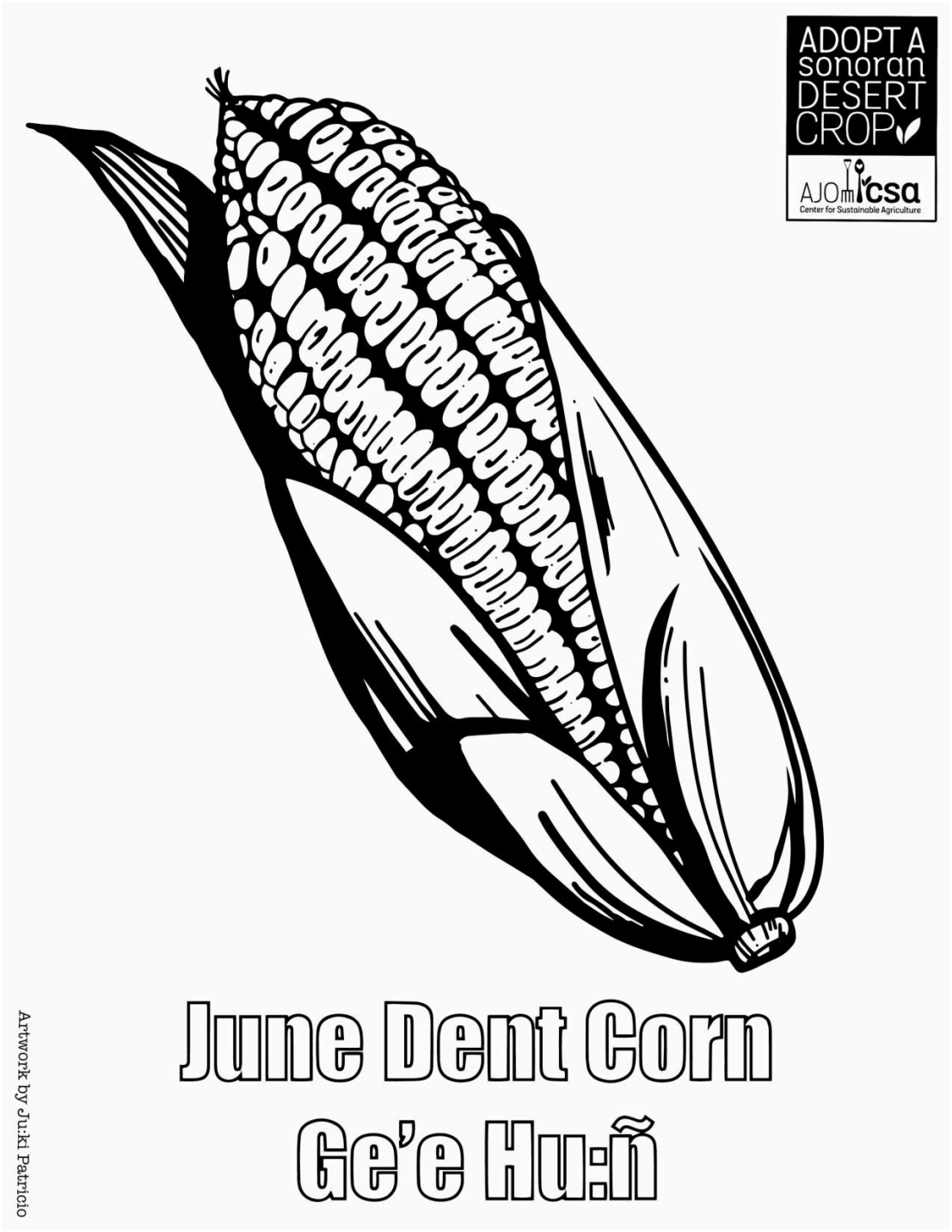
Cholla Buds
Ciolim
Artwork by Juki Patricio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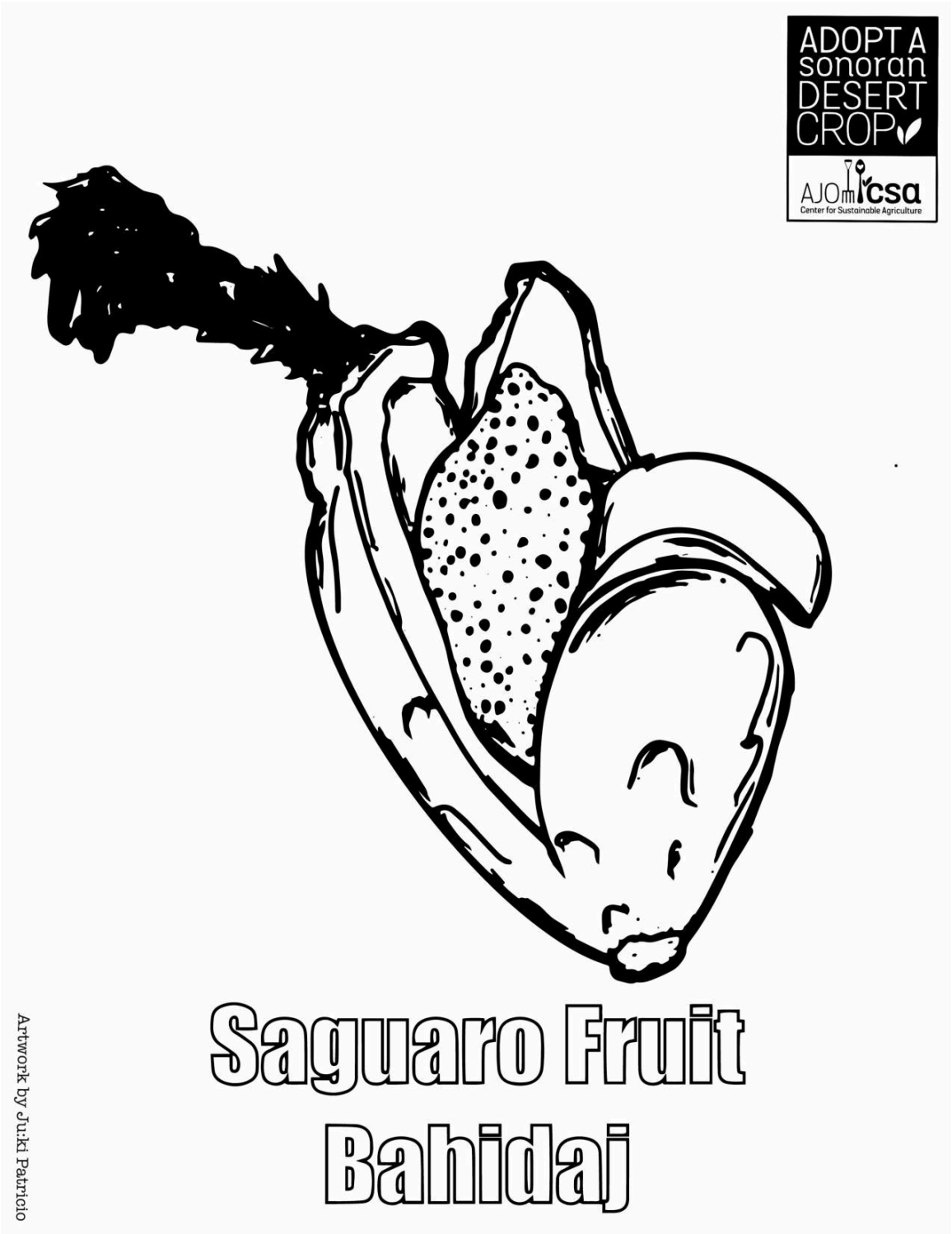
Artwork by Ju:ki Patricio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Saguaro Fruit
Bahidaj
Artwork by Ju:ki Patricio

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Wheat

Pilkcan

Artwork by Juki Patricio

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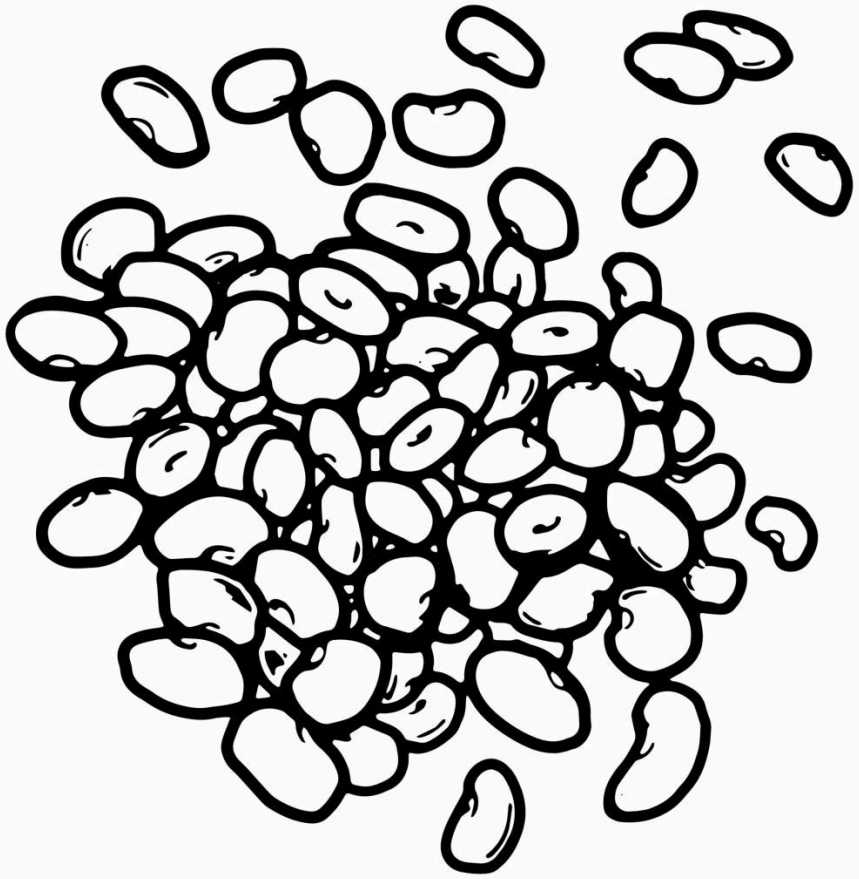


Tepary Beans

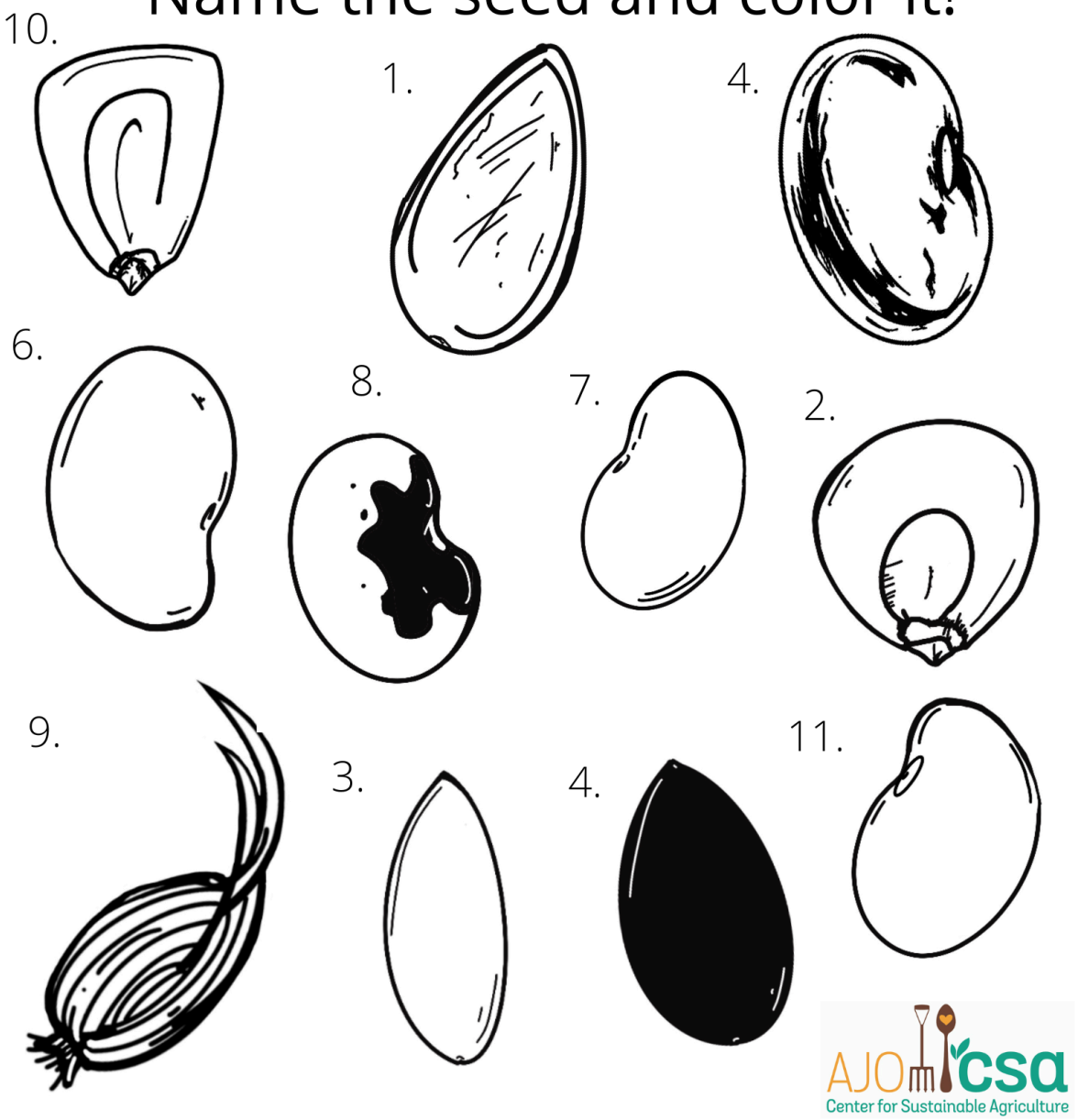
Bawi

Artwork by Ju:ki Patricio

AAC Identify the seed worksheet

Adopt-A-Sonoran-Desert-Crop Program

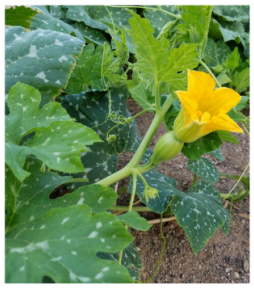
Name the seed and color it!

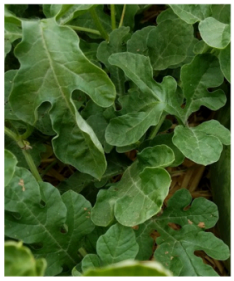


AJO csa
Center for Sustainable Agriculture

NAME THE SEEDS AND PLANTS OF THE SONORAN DESERT

Can you match the seed to the plant?





O'odham Crops:

- **Bawi**
- **Ha:l**
- **Yellow-Meated Watermelon**
- **Hu:n**

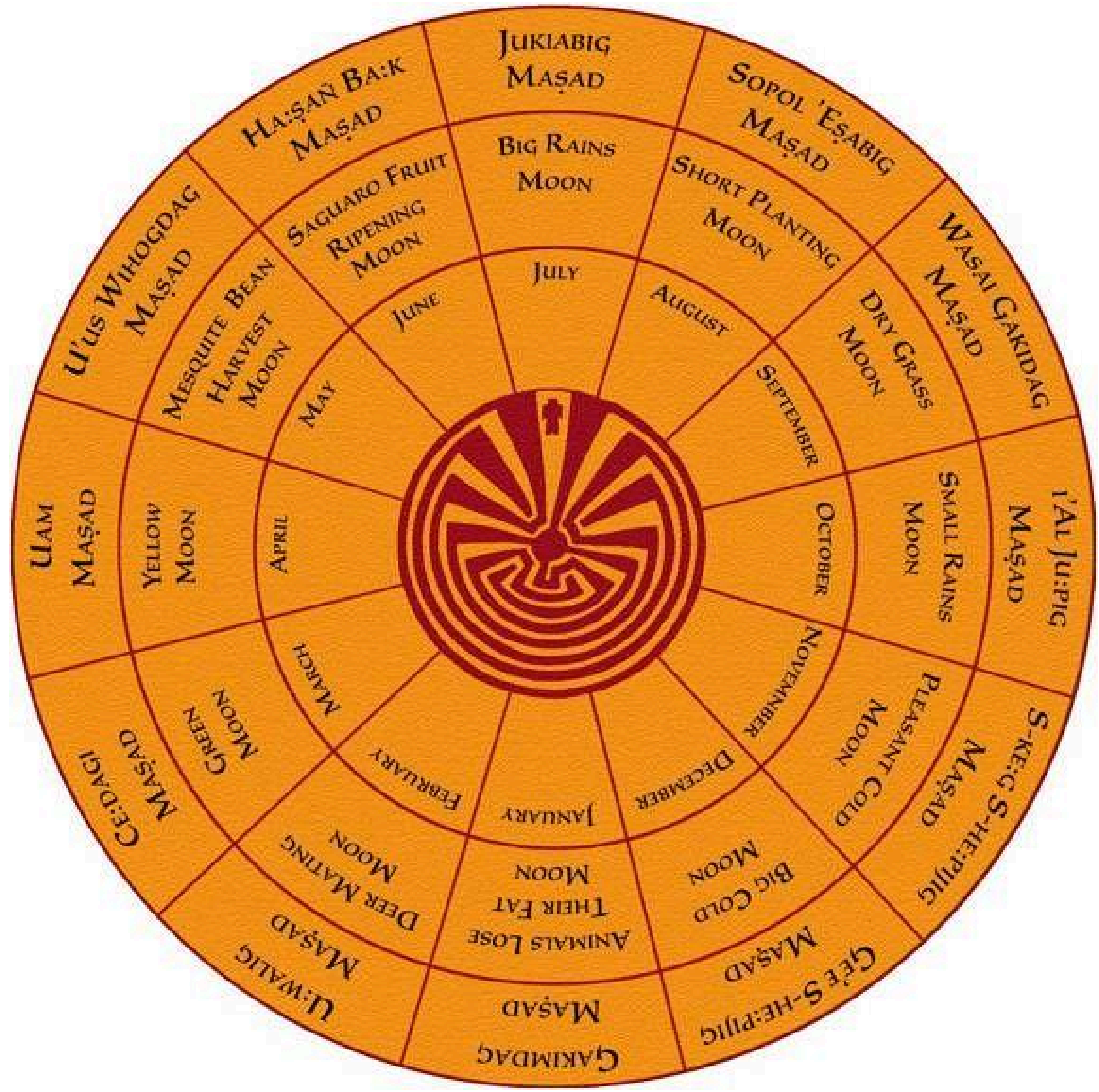
Tohono O'odham Agriculture

I I T O I S I W O L D M
U X E H N B A W I K A I
U M K O G A V F A A K L
K J A C U N I D N L T O
S A N O I K P I L K A N
M I O L N I G A D U S H
U U E A L D O C T T N T
N A E O O J E W E D E F
E O W E H R G G I N S U
N A R A I I I O E H S L
H F I C W C V O V E A U
K E L I B A S O E N E G

BAWI
HAWOL
U'UKS MUN
KANO
PILKAN
TAS
SUDAGI
JEWED
MILON
WIHOL
KELI BASO
I'ITOI SIWOL

Tohono O'odham Kaij/Seeds

1. Ha:l/Tohono O'odham Squash
2. Hu:n/Tohono O'odham 60 day Corn
3. Keli Baso/Old Man Chest Melon
4. Mel:on/Yellow Meated Watermelon
5. Mu:n/Pima Lima Beans
6. To:ta Bawi/White Tepary Beans
7. Wegi Bawi/Brown Tepary Beans
8. O'oks Mun/Black and White Cowpeas
9. I'itol Ce:walh/Elder Brother Onion
10. Ge'e Hu:n/June Dent Corn
11. S-cukma Bawi/ Dark Tepary Beans


Jukiabig Maṣad
Big Rains Moon
July
Sopol 'Eṣabig Maṣad
Short Planting Moon
August
Wașai Gakidag Maṣad
Dry Grass Moon
September
I'Al Ju:pig Maṣad
Small Rains Moon
October
S-ke:g S-he:pijig Maṣad
Pleasant Cold Moon
November
Ge'e S-he:pijig Maṣad
Big Cold Moon
December
Gakimdag Maṣad
Animals Lose Their Fat Moon
January
U:walig Maṣad
Deer Mating Moon
February
Ce:dagi Maṣad
Green Moon
March
Uam Maṣad
Yellow Moon
April
U'us Wihogdag Maṣad
Mesquite Bean Harvest Moon
May
Ha:ṣañ Ba:k Maṣad
Saguaro Fruit Ripening Moon
June

Climate Smart Questionnaire- 2 handouts

Activity for students on traditional crops:

- Name all the traditional Tohono O'odham crops you can
    - Do you know the O'odham names? Have them write them out
- Do you grow any of these
- How do you grow them (raised beds, dry-land field, container garden, etc)
- How did you learn to grow them
- Where have you grown them (school, home, family farm, community garden)

MATCHING THE CROPS GAME:

This activity is good for all ages and the goal is to match the crop to the picture utilizing the coloring pages and then identifying the english and O'odham name of the crop: This activity will help participants identify how the actual crop/plant can look and they learn the O'odham vocabulary to the crops and seeds.

- utilize coloring pages drawn out by Juki
- Have a specimen/display of the crop (ex, keli baso melon, tepary bean, mesquite bean pod or flour, etc)
- Cut off names of the crop from the coloring pages and leave them separate from the picture
- First lay out drawing pages of the crops
- Second have a section of displayed crops
- Third hold onto slips of crop names
- Direct participants to move the display of the crop and match it to the picture
- Once all displays are selected lay out the slips of crop names and have them match the names to the display and picture
- Finally, correct any wrongs
- A coloring book or any other incentive if available, can be given out once game is complete

TIC-TAC-TOE ACTIVITY

This is a large board game of tic-tac-toe and we can utilize the already made ciolim cholla buds and suam milon yellow meat watermelon for our "x's and o's" new shapes and pictures can be made as well whether it is a tepary bean and a lima bean or a flower and a bee.

Materials that we need to build the board are some kind of plywood or something that can be used as a large board, laminated symbols/pictures, velcro patches to connect them, and tape or paint to draw the table.

SOIL TESTING ACTIVITY:

This will help participants identify whether their soil is clay, sand or silt or a mix. We will go over vocabulary words such as sandy soil, loamy soil, silty soil and so on.

Materials that we need:

- jars or containers of each type of soil
- Water can or a water source
- Collection jars or containers
- Simple soil testing kit

Directions:

- Pick one area or two or whatever is the preferred planting area
- Gather a small handful or large pinch of soil
- Add a little bit of water to make into a dough consistency and roll into a ball
- Do a ribbon test, begin to create a flat ribbon-like structure and observe on whether it breaks or continues to create a long ribbon
- Then identify whether it is sandy or clay
    - Sandy will break and clay will continue to create a long piece of ribbon

MAKING TONGS FOR CIOLIM HARVESTING:

This will help people to prepare for the harvesting season and have a readily available and traditional tool to use.

Materials:

- Wapai saguaro cactus ribs
- Saw
- Sandpaper
- Cloth

Directions:

- Create and use a handsaw to any size tongs you prefer 8in, 1ft, 2ft
- Use sandpaper along the wapai to prevent splinters
- Strip long pieces of cloth
- Wrap one side of the tongs on one end and then wrap the other and create a figure 8 loop
- Make a knot in the center to create tension
- Finally wrap both ends of the tongs together and it should make a tong effect

SCAVENGER HUNT:

Depending on the location, we should already have cards that have a picture of a flower, a seed and a crop plant maybe even tools that are regularly around the garden/field and the goal of this hunt is to go around and identify what is on the picture along with the O'odham and english name.

Materials:

- Hole punched laminated cards that have a picture and name of the crop, seed, tool, ect
- Ring to hold all the cards together
- Or a folder with hole punched pictures in plastic slips

Directions:

MATCH SEEDS TO THE CROP ACTIVITY:

Similar to the activity 'match the crop to the picture' but with its actual seeds. For beans we can use a picture of the plant and match them in that way.

FLOWER IDENTIFICATION:

COMPOST MAKING

SEEDLING MIXTURE MAKING

FOOD DEMO

HA:L ROPE MAKING WORKSHOP

BAHIDAJ PICKING AND SITOL MAKING WORKSHOP