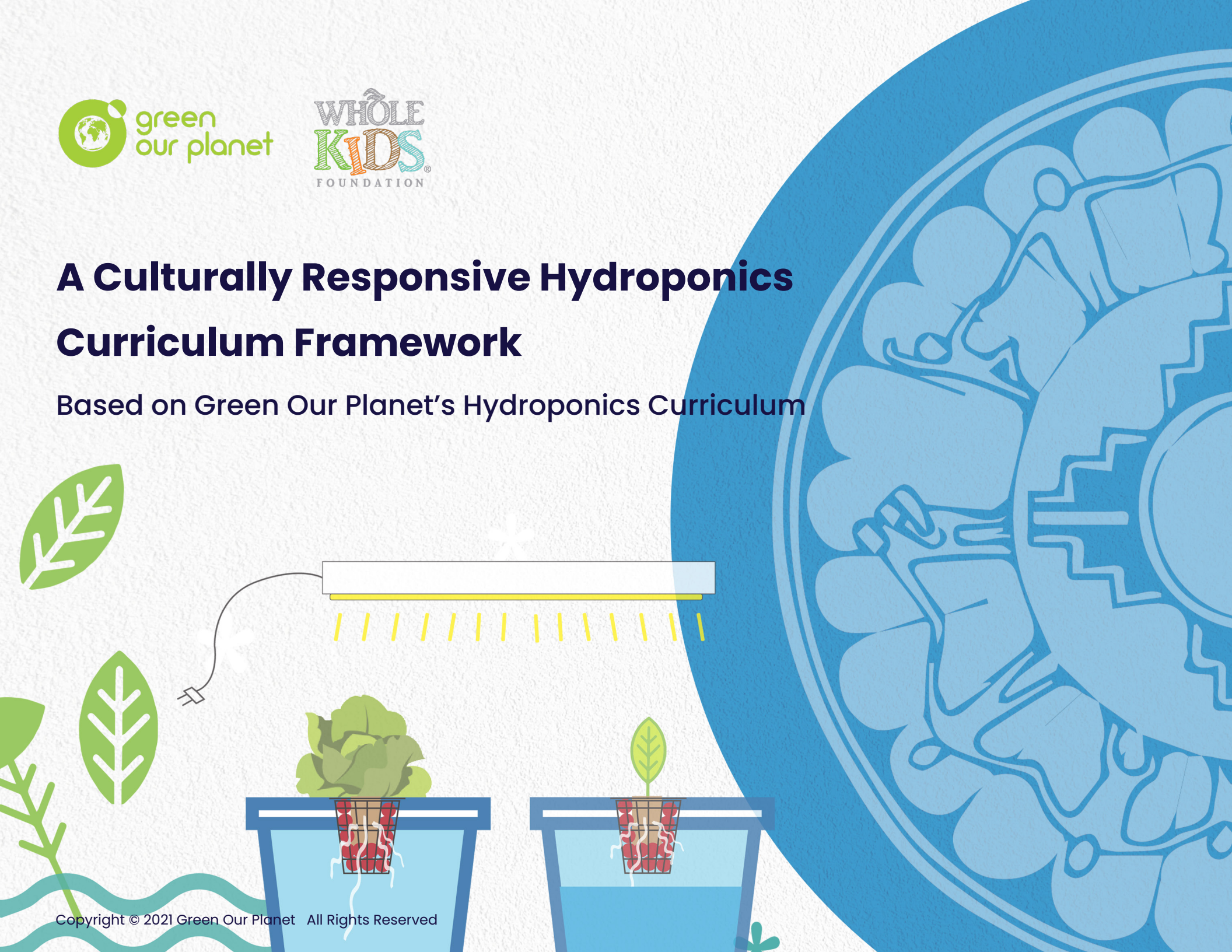
A Culturally Responsive Hydroponics Curriculum Framework

Based on Green Our Planet's Hydroponics Curriculum



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Green Our Planet is a nonprofit, 501(c)(3) conservation organization established in 2013 that runs the largest and one of the most comprehensive STEM (science, technology, engineering, and math) school garden and hydroponics programs in the United States.

The organization's mission is to increase student academic performance in STEM subjects as well as to conserve and protect the environment through project-based STEM education, which includes nutrition, financial literacy, and conservation education in PreK-12 schools. In 2018, Green Our Planet launched its K-5 STEM Hydroponics Program, which allows for hands-on STEM education using hydroponic systems. Green Our Planet published Nevada's first K-5 STEM hydroponics curriculum in 2019.

If you are in need of resources on how to teach hydroponics in the classroom, how to build and maintain a variety of systems, how to harvest, or how to prepare meals with the food you grow, visit our Virtual Academy at greenourplanet.org/virtual-academy/

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TEACHER FEEDBACK—LET US HEAR FROM YOU!
Teacher feedback is welcome—we want to hear from you about your experiences using this curriculum framework so that it can be continually improved! Please send your feedback to: feedback@greenourplanet.org

Introduction

The Culturally Responsive Hydroponics Curriculum Framework was created to ensure that our programming enables all students to learn about hydroponics through their own culture, heritage, and local geographical conditions.

Between 2020 - 2021, Green Our Planet worked with schools and community organizations in New Mexico to implement the hydroponics program and write a Culturally Responsive Hydroponics Curriculum Framework. This framework compliments the current curriculum by considering how a hydroponics lesson can be created in a way that represents and celebrates the diversity of students. It gives suggestions on how to create lessons that are student-centered, affirm cultural identities, allow students to connect with one another, and elevate cultural beliefs as well as ways of knowing and doing. The framework covers scientific information, the different ways in which students learn, and makes cross-curricular connections - interweaving various subjects, including science, math, social studies, language arts, and art.

Each page of the framework acts as a guide for teachers to create their own cross-curricular hydroponic lessons through the lens of their students' diverse cultural backgrounds. Developing this framework came from a two part process. First, the contributors reviewed the GoP K-Grade 5 Hydroponics STEM curriculum and drew out major themes or Big Ideas.

How to Use the Framework

The Big Ideas are: 1) Understanding Hydroponics, 2) How Hydroponics Relates to Your Life, 3) Water, 4) Seeds, 5) Plants, 6) Nutrition, 7) Environmental Sustainability, and 8) Designing Hydroponic Systems. The order of the Big Ideas can be adapted based on teaching needs.

Second, the contributors met for a series of writing workshops to identify the essential questions and subsequent content. The 7 categories covered in each Big Idea are: Cultural Significance, Regional Considerations, Suggested Topics, Suggested Activities, Cross-Curricular Ties, and Teacher Resources.

Essential Questions are questions to stimulate thought, discussion, and learning activities with the hydroponic systems. Each theme covers 7-8 questions. We recognize that the list is not exhaustive and encourage teachers and students to create questions that resonate and reflect their learning context and create personalized content.

Cultural Significance covers information to consider and be sensitive to when teaching a diverse group of students. When teaching with the framework, keep in mind that cultures around the world are diverse and unique. No two tribes, cultures, or denominations practice ceremony, tradition, or culture the same way. However, similarities in cultures can be discovered with an open mind and non dismissive attitude toward the variances in cultural practices. Cultural knowledge is foundational to all academic pursuits. Showing concern for the past of a people indicates that you care about how the information you are presenting will influence their future.

All people, especially teachers, are in a unique place to teach new content that will inevitably challenge a person to grow and think about new information. It is important that we embrace cultural diversity and leverage the beliefs, interests, and preferred learning modalities of our students. This means taking the time to find out what those things are and how they can improve a classroom community. All children come from truly different perspectives of the world

that may affect how they interact with it and one another. They are all capable of learning new content and be open minded towards their own and others thoughts and beliefs.

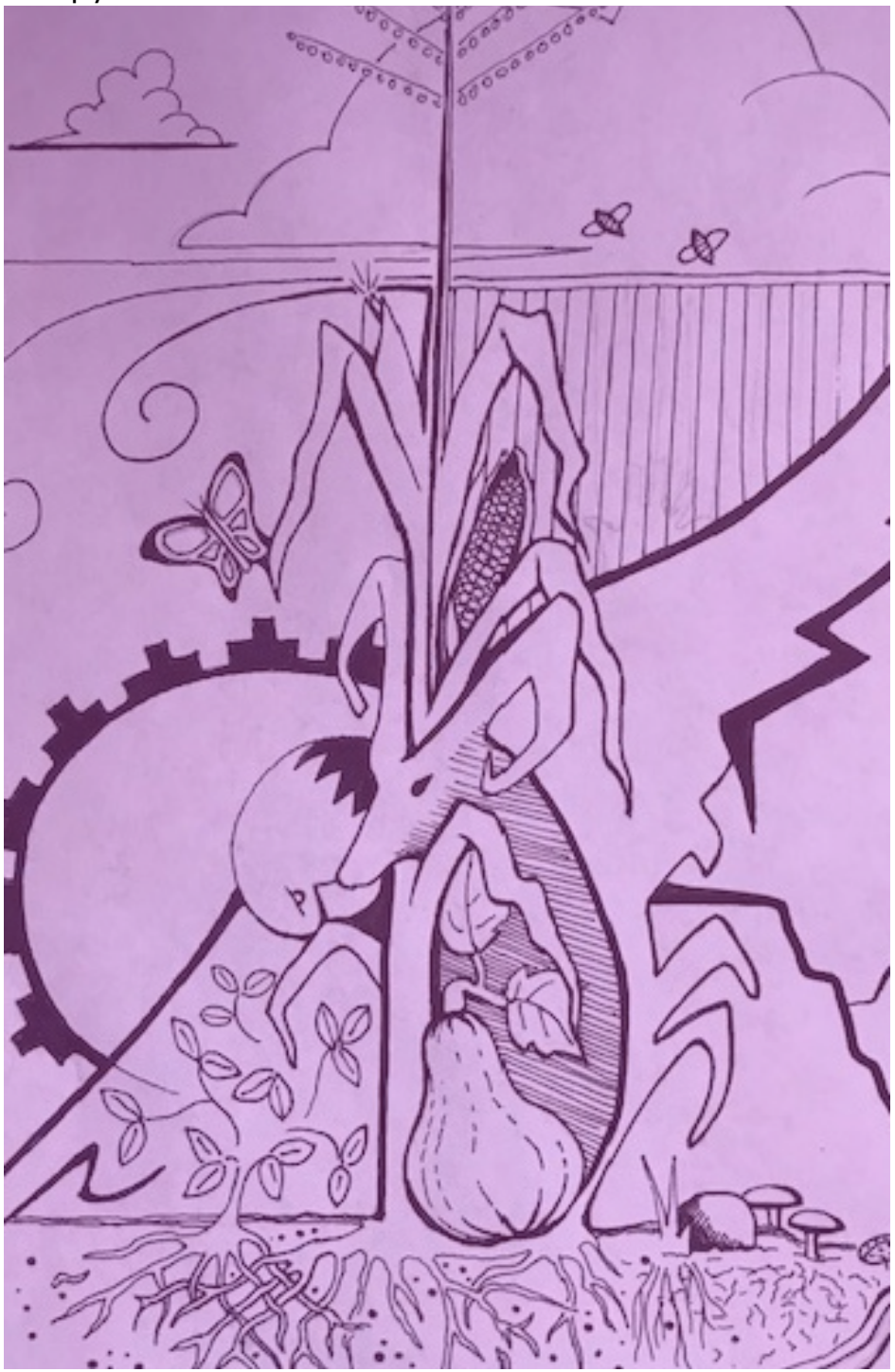
When creating lessons, engage in learning that allows you to discover the culture and perspective of your students. Practice empathy, compassion, humility, non-judgement, and relate course content to your students' cultures. This approach involves a lot of listening, time, and patience.

While teaching in a culturally responsive way, be aware and respectful of the traditional land on which you are living and working. Use resources that originate within the culture. For example, use resources regarding Indigenous people that are written by Indigenous people.

Educators are encouraged to check their resources carefully before communicating to students about matters of culture. This can help guard against spreading incorrect or insensitive information.

"People who come from 'cultural' backgrounds may identify as Black, Indigenous, and People of Color (BIPOC). People who are BIPOC have often suffered from historical trauma and it is imperative to learn how to be sensitive and compassionate when communicating with those individuals. It is a privilege to teach using a culturally responsive curriculum, as there are cultures in this world that are fighting every day to keep their heritage alive."

- **Talavai Denipah-Cook**



Drawings by Roxanne Swentzell showing connections between all things...water being central

Here are a few resources for further information on Culturally Responsive Teaching:

- School Garden Support Organization Network: Promising Practices
- NYSED Culturally Responsive-Sustaining Education Framework
- Ann Fox ApS Culturally Responsive Teaching: A framework
- What is culturally responsive teaching?
- Cultural relationships for responsive pedagogy: A bicultural mana ōrite perspective
- University of Hawai'i Culturally Responsive Teaching: Certificate of Competence

Plant Choices and Planting Times

Culture is, in part, created by our environment and our relationship to that particular environment. People have coexisted with plants since time immemorial, observed their natural growth cycles each season and developed relationships with the native plants in their geographical regions. Cultures have their own varieties of cultivated plants which are place-based and are part of what makes cultures unique around the world. Location on Earth affects the traditional plants used for ceremonies, prayers, offerings, food and medicine. Planting times are dependent upon the crops to be planted as well as the climate and weather of the area.

Culture may also affect the plants that students choose to grow. Their relationship to certain plants may be because of where they are from, crops that are familiar to them, or because of their belief system. For example, some Native American tribes feel it is important to honor corn, beans and squash by growing them together because they are sisters and need each other. Some tribes believe some plants belong to females and others to males and should be handled only by their gender. Since we live in a diverse global society, we must learn from and honor the wisdom of the cultures around us. We can do this through asking students about their traditional plant-based foods and the significant seasonal rhythms at play in the growth cycle(s).

Creating a Culture of Gratitude with Your Students

Teachers can create a culture of gratitude with their students by allowing students to experience learning through various modalities and by connecting the learning to real life events, happenings, and everyday being. This will help students discover first-hand the significance of what is being taught and why. It will show students the everyday miracles that create and support life, helping them to see that we are all connected.

Beginning the class with meditation, mindfulness, even just a moment of silence to align everyone in the class with their intentions, can help create a culture of gratitude. The teacher can ask each student what they are grateful for and what they hope to accomplish from the hydroponic class. Giving students an opportunity to speak and be heard can help them feel connected and invested in the learning.

Students often mirror what they see and hear. First, a teacher must be grateful. Then they can model it. The more teachers appreciate and praise their efforts, the more likely they are to notice ways to thank other people for their work. It is important to know how gratitude is expressed and received by the people with whom they are interacting.

Ex. *"The Mohawk People have a tradition of reciting "Ohenton Kariwatekwen" (words before all else) at every meeting,*

event, or ceremony. In those words we give thanks to all of the things we have been given, beginning with our own bodies, and then from our Mother Earth, land, water, plants, animals, trees, birds, all things in the Sky World, and the Creator himself. It is good to be grateful for those things."

-Lorraine Kahneratokwas Gray

Explore ways to build these habits of gratitude with your students.

Asking Permission While Harvesting

Asking permission is an act of respect. It is the first step to building a reciprocal bridge of communication and cooperation. The value of asking permission is to offer thanks and show our respect and gratitude before taking or using something that has come from the earth. It demonstrates good will and good intention with what one is asking permission for, i.e. harvesting an ear of corn or planting a corn seed.

Asking permission starts with engaging and building trust with a person, place, or thing. A common belief is: whatever you put into the world is going to come back to you. Teachers could consider including a way to ask permission before harvesting from the hydroponic system because it will help students get in the rhythm of having respect at a young age that will continue to develop as they mature.

Teachers should help students understand that asking permission to take, use, or give, creates good energy between them and whatever or whomever they are interacting. When we see and value the importance of all living things and acknowledge them as our equals, we treat them with respect. Asking permission from Mother Earth is a way to practice a reciprocal relationship. Creating a practice of asking permission to harvest from the hydroponic system allows teachers to model this for their students and invite them to do the same.

Regional Considerations covers information to consider about each unique geographic area. It is included to aid teachers in considering the type of information that influence and frames their students perspectives. For example, some regions have a high precipitation rate, while others do not; some regions have very cold winters, while others have mild ones; some regions are focused on community building, while others prefer to act independently; etc. This type of information relates to hydroponic systems because they can be placed inside or outside, rely on a consistent water supply, may require access to a reliable energy source to power the system, and although they are an ancient way of growing food, incorporate many technological advancements.

Regional languages and subject vocabulary should also be considered when writing lessons. These can either be a barrier to learning or be seen as an opportunity to epand the lesson.

Whether inside or outside, growing food can nurture a connection to the land we inhabit. While writing the framework, the following perspectives of connection to the land were shared by the cadre members. They are shared here as ideas to consider when creating lessons that reflect your unique region and your and your students' relationship to the land.

"As a traditional person, the land is our Mother. All life is Her children. Whenever we walk, farm, build, sit on Her, we ask for permission and thank Her for loving us in the ways she does. If the land is our Mother, we treat her very differently than if she is seen as just 'dirt'."

- Roxanne Swentzell

"Land is sacred. It is not meant to be altered by humans. Land is a place to build shelter, to get food, to get water, to survive."

- **Jaclyn Tregle**

"Land is not something to own, but rather to take responsibility for. People are the caretakers of land. We must care for and nurture, and in return, the land gives to us. We should appreciate its beauty everyday. It sustains us on all levels, physical, emotional, spiritual, mental. We must respect the land that provides us with so many gifts."

- **Marcela Casaus**

"Land is a partner with water and light. It works with those partners to support interconnected webs of life that change from season to season and generation to generation. Land is a foundation that changes most when there are seismic forces or abuse."

- **Nathan Thompson**

"The land is a sacred gift from the Creator of it and should be gently and graciously nurtured as a response of wise appreciative stewardship. If we do it right, we grow soil as we grow plants."

- **Daniel Loper**

"In the Mohawk language Earth is Ientinihsten Owentsia, our Mother Earth. The land gives us all we need. In traditional ways of thinking, the earth doesn't belong to us, we belong to her."

- **Lorraine Kahneratokwas Gray**

"Land means earth, and the earth is Mother. The land provides everything humans need from food to medicine to shelter to beautiful landscapes which offer feelings of love and gratitude. We understand this when we are present and assisting in taking care of our Mother, as we all should as children of the earth."

- **Bruce Bermudez**

"Land is precious. When we came into the 4th world, we were granted permission to live on this land from our Fire God, if we were to keep up with our traditional ceremonies. It is believed that we do not own the land, but we do have to take care of it as a part of the agreement. I care for the land wherever I go. Whenever I visit another place, I acknowledge the people who were the first stewards of the land and who try to keep that relationship active to this day."

- **Talavai Denipah-Cook**

Suggested Topics provides content ideas that teachers can pull out from the essential questions to teach their students. Hydroponic systems are a beneficial alternative for schools who do not have outdoor garden access. They provide a hands-on learning tool for many subjects, in particular STEM, and can be utilized to stimulate critical thinking concerning the importance of our personal actions on the planet. For example, 3 of the suggested topics that appear throughout the framework are: components of a hydroponic system, life cycles, and nutrition.

Components of a hydroponic system: It's easy to see all of the parts of hydroponic systems, and thus it is easy to use them as a model in a classroom. Students experience hands-on how quickly and efficiently plants are grown hydroponically. It introduces a unique farming method, which shifts perspective of how plants are grown. By learning about, engineering, and iterating hydroponic systems, students learn the essential parts or components of hydroponic systems. Getting to know all of the factors of the systems will help students to think of new and improved ways to grow plants. Hydroponics is a continually evolving field of agriculture, giving teachers and students an opportunity to experiment with trial and error.

Life cycles: Everything on Earth and in our galaxy happens in cycles. Even reciprocal relationships amongst people, plants, animals, and water form a circular pattern of give and take. Through growing plants hydroponically, students experience plant life cycles first-hand. By growing food, students can learn about where energy comes from and how it supports life.

Nutrition: They also experience the rewards of growing plants. Hydroponic systems show students that caring for plants will provide them with nutritious food and medicinal plants in return for their care. Growing food means independence, sovereignty, survival, abundance, power, the ability to choose for ourselves and participate in community. It helps students understand where food really comes from and what it takes to produce it; therefore, encouraging them to appreciate life. Participating in growing plants inspires creativity, ingenuity, patience, hope, and maturity of character. It promotes health in the physical, mental, emotional, and spiritual aspects of life.

Teachers can use the suggested topics that appear in the framework or come up with their own.

Suggested Activities is as a list of activity ideas that teachers can do with their students to engage them in the topic. The list is not all inclusive, but acts as a starting point for teachers creating hydroponic lessons. The section varies in activity ideas for PreK-Grade 12 students.

One of the intentions behind designing the framework this way is that teachers have an opprotunity to co-create a lesson with their students. Student voice and choice is paramount to being a culturally responsive teacher. Some suggestions on how to integrate students' voices are:

- students envision the application of the tools made available
- students share personal stories about their experiences, feelings, and/or relationships with plants
- students choose the plants grown in the systems
- students' curiosity guides the lesson (ideas, suggestions, imaginative possibilities)
- students are engaged through storytelling
- students choose between activities
- students free-write on a future lesson by writing or drawing it out
- students express their likes and dislikes (what they did in class, what they enjoyed and why)
- students explain their current knowledge and interests in a topic
- students connect learning to real life experiences
- students report on what they learned, how they feel, and how a lesson affects their personal lives, their community, and the world (KWL chart)
- students are free to be creative and are supported through the learning process

Another intention of the design is to give space for teachers to incorporate diverse learning styles into lesson plans. Teachers can unlock students' minds and help them progress through incorporating diverse learning styles or modalities into their lesson plans. Consider how lessons can incorporate Verbal, Auditory, Utilitarian, Linguistic, & Tactile learning methods. Hydroponic systems offer a chance to use a combination of learning modalities. Begin by assessing students' preferred learning styles and keeping those modalities at the forefront of lesson planning. Consider the many different backgrounds and cultures in the classroom and how they can be blended to make a well rounded program. Stay open minded, versatile, and do not be afraid to try new things.

Some suggestions on how to incorporate diverse learning styles are:

- make each lesson more musical, hands-on, image rich, inter- and intra social
- visuals on the board or hanging in the classroom
- use colored paper
- watch videos
- encourage peer tutor and/or scribe
- incorporate movement
- tell stories
- invite or visit elders or special guests in the community

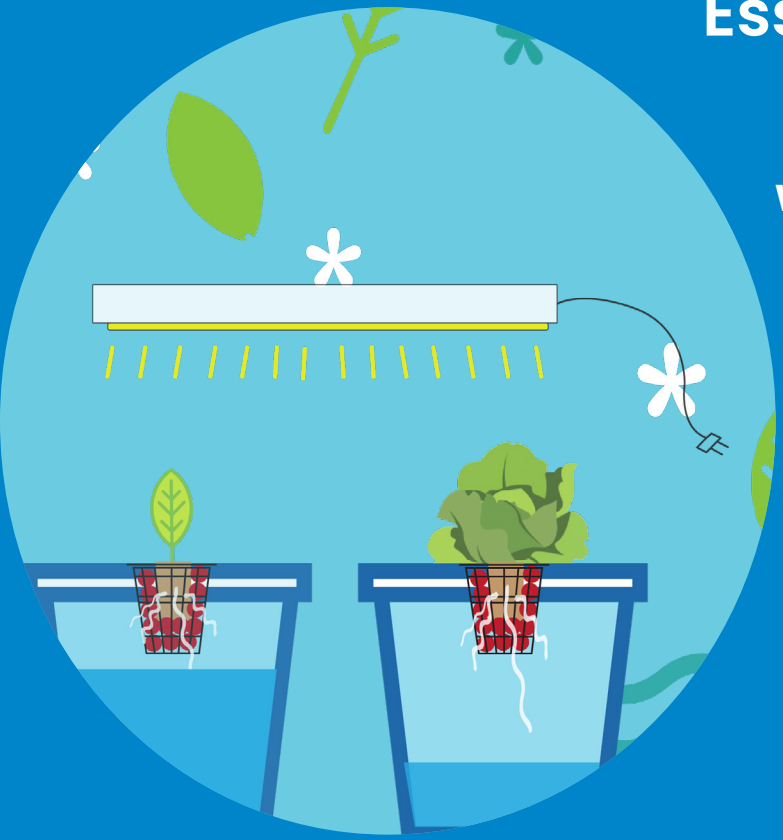
Cross-curricular Ties invites teachers to consider how teaching with a hydroponic system can incorporate various subjects. Creating interdisciplinary lessons offers ways to go deeper into a subject, identify how different subjects relate to one another, and give opportunities for applied learning and collaboration. The subjects listed are not exhaustive and will be unique to each teacher and lesson plan.

"For schools that may not have an outside garden or access to one, a hydroponic unit is very beneficial to have at the school or in the classroom. Hydroponics can provide a hands-on learning tool for most if not all subjects, particularly STEM courses, and can be utilized to stimulate critical thinking concerning the importance of our own personal actions on the planet. Hydroponics can also provide healthy nutritious food for students."

- **Marcela Casaus**

Teacher Resources are videos, books, websites, articles, etc. collected and compiled to help teachers create their lesson plans. These resources can be found at the end of the framework.

Understanding Hydroponics



Essential Questions

What is hydroponics?

How is hydroponics different than outdoor gardening?

What is the relationship between the land and the hydroponic system?

How will elders view new forms of growing that challenges tradition?

What is the best space and design for the hydroponic system?

What kinds of crops can be grown in a hydroponic system?

What is the past, present and future of hydroponics?

What is hydroponics?

Cultural Significance

Currently, the hydroponics industry is expanding, but it is not a new technology. For example, it was used in the Hanging Gardens of Babylon and the Floating Gardens of China. Indigenous agriculture has similarities to components of hydroponics (i.e. acequias, irrigation, etc). Learning about the cultural history of hydroponics and water usage in food production will help students understand its evolution. It may also offer an opportunity for people to connect to their cultural traditions of growing food, their ancestors, and themselves.

Regional Considerations

Seasonality in many areas dictate when and which plants are grown. In some areas of the country, or even in certain neighborhoods, students may have more experience growing food than in others. This will also influence whether or not students have been introduced to hydroponics and their level of knowledge.

Suggested Topics

Learn about the components of hydroponic systems (water resevoir, plants, lights, growing tray, pump or water movement/air, nutrients); how hydroponics systems provide what plants need to grow.

Suggested Activities

Build a hydroponic system. Draw digrams and label the parts of the hydroponic system. Conduct a research project. Act out how a hydroponic system works.

Cross-curricular Ties

Science, literature, history, chemistry, technology, art, language arts

Photo by Elly Johnson on Unsplash

How is hydroponics different than outdoor gardening?

Cultural Significance

Gardening can be soothing for mental health such as feeling the plants, smelling the leaves and flowers, receiving nutrition for the body, experiencing success in plant yields, and practicing a spiritual flow or prayer. It can be beneficial for the mind, body, and spirit to be outside in the garden with the plants and animals. Hydroponics, especially if inside, is a different experience, but can have the same benefits.

Regional Considerations

Access to outdoor garden or hydroponic system experiences will be dependant on the regional living conditions, whether rural or urban and the context of each.

Suggested Topics

Learn how plants can be grown in many ways. Identify plant needs (such as light, water, nutrients, space, air) and how they get each of these from either an outdoor garden and hydroponic system. The difference between growing something in water versus growing it in soil.

Suggested Activities

Visit/explore both kinds of growing scenarios. Gauge mood before and after going to the garden or hydroponic system. Compare the different tools or equipment needed when gardening outdoors and indoors. Conduct a research project by growing plants in both a hydroponic system and an outdoor garden and make comparisons (ex. chart plant development and/or do a taste test.)

Cross-curricular Ties

Biology, chemistry, technology

Photo by Elly Johnson on Unsplash

What is the relationship between the land and the hydroponic system?

Cultural Significance

Water gives life to all living things. It is used for social, physical, and emotional well being. Good water quality allows us to cleanse, and appreciating its flow has a calming effect. For the Pueblo people, water and prayer are important and culture governs interaction with water. It is the connecting force between Father Sky and Mother Earth. Controlling and using water helped people build civilizations as did the natural resources of the land. Natural resources continue to be extracted in order to produce goods such as the components of hydroponic systems.

Regional Considerations

Many important regional bodies of water are drying up (Ex. Colorado River/Lake Mead). There are important examples of water pollution by industry in many communities. Water laws and treaties affect the people who rely on the water source for survival. Drought and flooding are important aspects of many communities, either as they have learned to live with regular flooding cycles, conserve water because of drought, or because of natural disasters that cause an excess or scarcity of water. Resource extraction also varies by region. Due to this, students will have varying levels of understanding on the definition of natural resources, the processes of extraction, and the environmental impact.

Suggested Topics

Explore how water and the natural resources used to make and operate hydroponic systems are a connection between the two. Learn about the water cycle, where water or the natural resources used to make and operate it come from in their region or country, and how they are used in the hydroponic systems.

Suggested Activities

Collect the humidity that forms from a hydroponic system to demonstrate condensation and precipitation. Monitor water levels, analyze root structures and leaf growth, and measure how water absorption changes as the plants grow bigger. Research how hydroponic system materials are sourced from the land. Choose one natural resource used in the hydroponic system and have a specialist from that field visit the class to present on resource extraction and its impact on the environment.

Cross-curricular Ties

Science, literature, history, chemistry, technology, art, language arts, social studies

Top Right Picture: Cochiti pueblo pattern of plants water and clouds

How will elders view new forms of growing that challenge tradition?

Cultural Significance

Food is sacred to many cultures. Introducing a new way of growing food can have both positive and negative impacts. Take time to be sensitive to the situation. Facilitate conversations with students, teachers, community members, and elders to understand their perspective and if and how to integrate a hydroponic system into the community for food production. One question that could be considered from a spiritual perspective is: Does a plant grown in a hydroponic system have a different meaning than one grown in a garden or in the wild?

Regional Considerations

Regional systems of growing food can be entrenched. If and how the community is connected to it will vary. Change may be met with skepticism and/or fear. Others may be excited to embrace new ideas and technology.

Suggested Topics

Explore traditional ways of growing food; how people question or embrace change; how ydroponics can be a safe way to grow food.

Suggested Activities

Interview elders, farmers, and hydroponic growers. Study history of how new crops were introduced between cultures. Research the Columbia Exchange and facilitate a discussion on how introducing a new method of growing food can impact a community.

Cross-curricular Ties

Social studies, history, biology, spirituality

What kinds of crops can be grown in a hydroponic system?

Cultural Significance

Different foods resonate with different cultural groups. Each culture has its own unique plants used for food, ceremony, medicine, and commodities such as clothing. Explore growing foods suggested by your community and students.

Regional Considerations

Plant interest and selection may be affected by the regional location of the hydroponic systems.

Suggested Topics

Learn about the kinds of food that are grown successful using different types of hydroponic systems as well as the seed to harvest timeline for the crops you would like to grow.

Suggested Activities

Observe the kinds of hydroponic systems available, including how much space there is for root and vertical plant growth. Conduct an experiment by growing different kinds of plants in different systems. Research how long it takes for the plants you would like to grow to develop from seed to harvest.

Cross-curricular Ties

Biology, social studies, engineering

What is the past, present, and future of hydroponics?

Cultural Significance

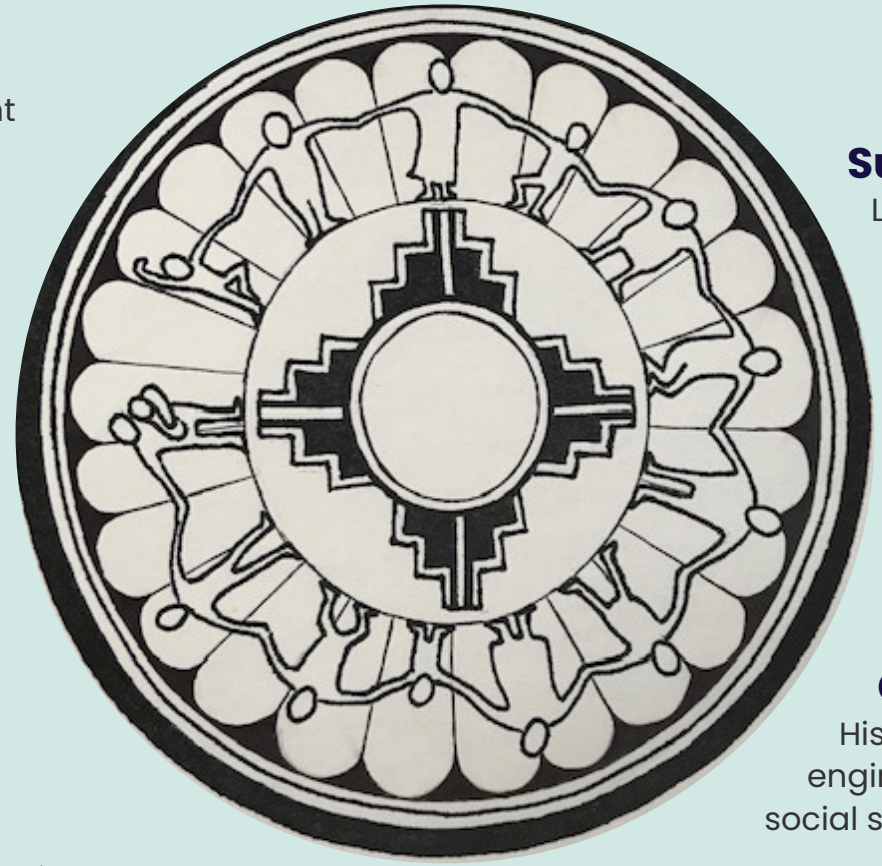
Hydroponic growing is an ancient way of growing food that is becoming more technologically advanced. This is influencing traditional knowledge and methods.

Regional Considerations

The history of the community will impact the knowledge of and interest in hydroponics. Some areas may be knowledgeable and active in hydroponic growing while others may be new to the concept.

Suggested Topics

Explore the origin of growing crops in water, modern uses of the systems, and companies who hope to expand the systems such as NASA. Learn about the effects of climate change and farming practices and how hydroponics can help the environment.



Suggested Activities

Learn about hydroponic history such as in China, Babylon, Mexico. Visit hydroponic farms either in person or virtually. Conduct a research project on hydroponic companies.

Cross Curricular Ties

History, science, technology, engineering, lianguage arts, social studies

Drawing by Roxanne Swentzell showing connections between all things...water being central

How Hydroponics Relates to Your Life

Essential Questions

What can you learn about yourself by growing food hydroponically?

How does growing food hydroponically connect you to your family and culture?

What are the social-emotional benefits of gardening?

Which plants should we grow and when should we plant them?

What plants are available to you throughout the year?

What can you do with the plants once they are full grown?

What tools are needed to start your own small business?

What can you learn about yourself by growing food hydroponically?

Cultural Significance

The kinds of plants people choose to grow are connected to their culture, traditions, location, and ancestral connections. In some cultures, it is tradition to talk to plants, pray when harvesting, build relationships with plants, tell stories about them, ask permission before harvesting, and express gratitude. Eating healthier food can affect how we feel physically and emotionally. Growing food means caring for another living being.

Regional Considerations

Food apartheid (no access to fresh food), living in food producing/farming
communities,
allergens,
seasonal foods, traditions encompassing foods, genetics, etc., contribute to food choices and attitudes about food and growing plants.

Suggested Topics

Explore the patience, perseverance, and responsibility it takes to grow plants. Celebrate the confidence that comes from success. Acknowledge the sense of taste that you and your students have developed from the food that is most readily available in your community. Investigate how we are connected to nature through growing food.

Suggested Activities

Grow plants from seed to maturity (or seed to table), making observations, tasting, smelling, and touching plants. Discuss observations and impressions with peers and others.

Cross-curricular Ties

Health, geography, psychology, language arts, history, spirituality

Drawings by Roxanne Swentzell
showing connections between all things...
water being central

How does growing food hydroponically connect you to your family and culture?

Drawings by Roxanne Swentzell showing connections between all things...water being central

Cultural Significance

By introducing hydroponics as a way of growing food into your family or community, you have the opportunity to have conversations, bringing you together. Topics that could be discussed are, but not limited to: whether or not it is a good fit for the family or community, if growing indoors is a good solution to any local environmental issues, if the type of plants you want to grow hydroponically will be beneficial.

Regional Considerations

People in some regions may be more acquainted with growing plants than in others. Living situations (ex. food apartheid or farming communities) may make people very hopeful and excited or skeptical.

Suggested Topics

Share food as well as the knowledge of how to grow it with the family or community. Practice leadership, team dynamic strategies, reciprocation, and mentorship.

Suggested Activities

Set up a hydroponic system at home, in a community center, or at school. Invite families to an open house to see the systems and learn how they operate. Share news of hydroponic systems and experiments with the community. Seek out elders and others in the community to share their opinions and knowledge.

Cross-curricular Ties

Health, geography, math, psychology, language arts, history, communications

What are the social-emotional benefits of gardening?

Cultural Significance

Gardening can be geared specifically to fit the needs of a person, family, or community. Studies show improved happiness in people who garden becuase it keeps them physically active and provides a mean to connect to other living beings.

Regional Considerations

Regional beliefs influence approaches to gardening. This will affect how people view the therapeutic activities and relationships gardening provides.

Suggested Topics

Explore the relationships and emotions that arise while gardening. Reflect on how you feel when eating fresh food. Consider how gardening impacts you externally such as developing relationships while working with others and internally such as whether or not it improves overall health.

Suggested Activities

Make a 'garden buddy'. Work together to grow plants from seed to harvest. Reflect on how the relationship evolved while caring for the plants. Keep a gardening journal and write about how you feel before and after gardening or eating fresh food. Make sure to record if the experience changes your emotions, self confidence, attitude, ect. Conduct sensory explorations with the plants. Find a group of people in your community that garden therapy can benefit (schools, correctional facilities, women's shelters, hospitals, nursing homes, etc.)

Cross Curricular Ties

Social studies, language arts, health, nutrition, geography

Which plants should we grow and when should we plant them?

Cultural Significance

Some cultures may plant by season, according to constellations that appear during certain times of the year, or moon phases. The necessity of doing a ceremony may be important and add to the experience. Students may have specific plants they would like to plant, based on their experiences, tastes, or curiosity.

Regional Considerations

In traditional growing, water supply, both quantity and quality, vary by region and can affect which plants are grown by the people of the area. This may influence which plants students are interested in growing throughout the year.

Suggested Topics

If students are not connected with their traditional, local food, it could be beneficial to take some time to learn about the traditional and modern crops and planting times of the region. Learn about plants that are reguarly grown in hydroponics systems versus ones that are more of a challenge.

Suggested Activities

Have a class discussion on which plants should be grown in the hydroponic systems. Explore the connections students have to the plants they would like to grow. Run experiments with different types of plants that students would like to try. Observe and record how much time and space each plant needs to grow to maturity (times to maturity/ harvest vary).

Cross-curricular Ties

Math, social studies, literature, astronomy, biology, spirituality, history

Photo by Alexander Andrews on Unsplash

What plants are available to you throughout the year?

Cultural Significance

Many cultures celebrate the foods that traditionally grow in specific seasons, as they are not always available. Our current food system often blurs those lines.

Regional Considerations

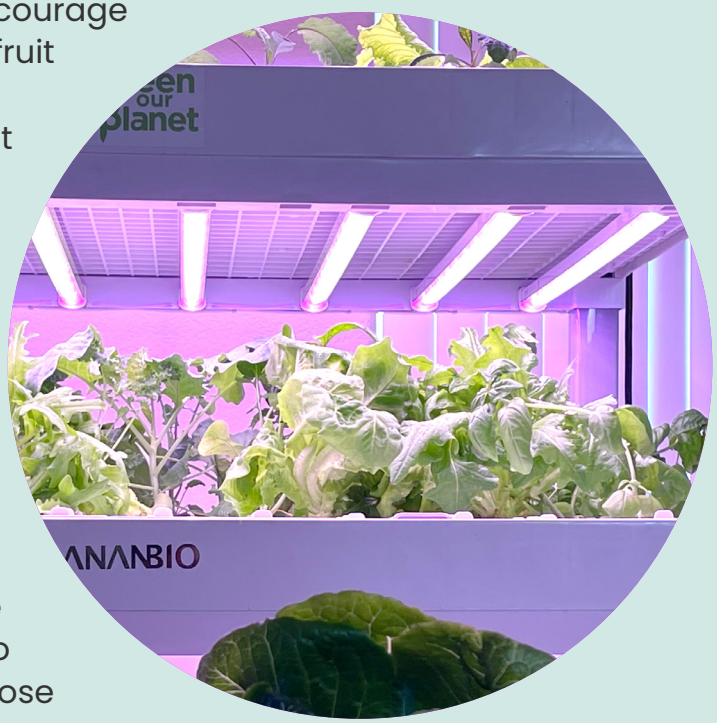
Students may or may not realize that plants grow based on the seasons and that there are cool and warm weather crops. The weather and climate of a region, especially the water supply, dictate when native and introduced plants grow and are ready for harvest or seed collection. Students can see this distinction in their local food system, however the global food system and the ability to grow plants year round, indoors through hydroponics enable most foods to be available at any time.

Suggested Topics

Learn that if the hydroponic systems are located indoors, the seasons, weather, and climate do not affect hydroponic growing like they do outdoor gardening.

Suggested Activities

Students should learn about the indoor environment the plants need in order to grow as well as how to control it. Reserach and practice adjusting the following controls for each plant variety you choose to grow: air temperature, length of time the lights are on to encourage leaf or flower and fruit production, hand pollination, nutrient and pH needs, water levels, and root space requirements in the growing raft in order to reach maturity. Record observations of the plants' growth needs and choose specific systems to best provide for those needs. Grow the same seeds inside and outside to compare and contrast.



Cross-curricular Ties

Science, geography, social studies, history, climatology, chemistry

What can you do with the plants once they are fully grown?

Cultural Significance

Many cultures have harvesting ceremonies, stories, songs and dances. Different cultures use and store foods in their own unique ways. Sharing recipes with one another and trying new methods of cooking help us to understand how foods can be used in various ways.

Regional Considerations

Where the community buys their food will vary depending on the region and culture. Farmers markets are a great place to sell produce and support local businesses. Discover when and where your community has farmers markets, what is currently being sold, and if you can add to the offering.

Suggested Topics

Learn that plants can be harvested in different stages and that there are different harvesting techniques. Different parts of plants are edible and/or medicinal. Students should learn how to harvest, process, and use the plants. If possible, sutdents could also practice seed collection.

Suggested Activities

Learn about various harvesting techniques. Have students participate in the harvesting process. Create a harvesting ceremony with the students to give thanks to the nutrition the plants provide. Prepare the food from harvest to table. Share the harvest with others.

Cross-curricular Ties

History, culinary arts, social studies

GoP Giant Student's Farmer Market

What tools are needed to start your own small business?

Cultural Significance

In some cultures, food/seeds are ancestors and should not be sold, but this is now a modern world and can be offset with community donations. Surplus of goods can be given to those in need. Business ownership can be a source of great pride and can build strong, long-lasting community relationships.

Regional Considerations

Students may or may not be familiar with entrepreneurship and local businesses. Take time to seach out local examples to share with your students and learn about the steps to starting a small business. The price of fruits and vegetables will vary depending on the region. Consider how all members of the community could afford the products.

Suggested Topics

Learn how to write a Mission Statement, Vision Statement and Business Plan. Understanding inputs vs outputs in a business is important. Learn about how the hydroponic industry is growing and changing and determine how your small business can be successful as it evolves.

Suggested Activities

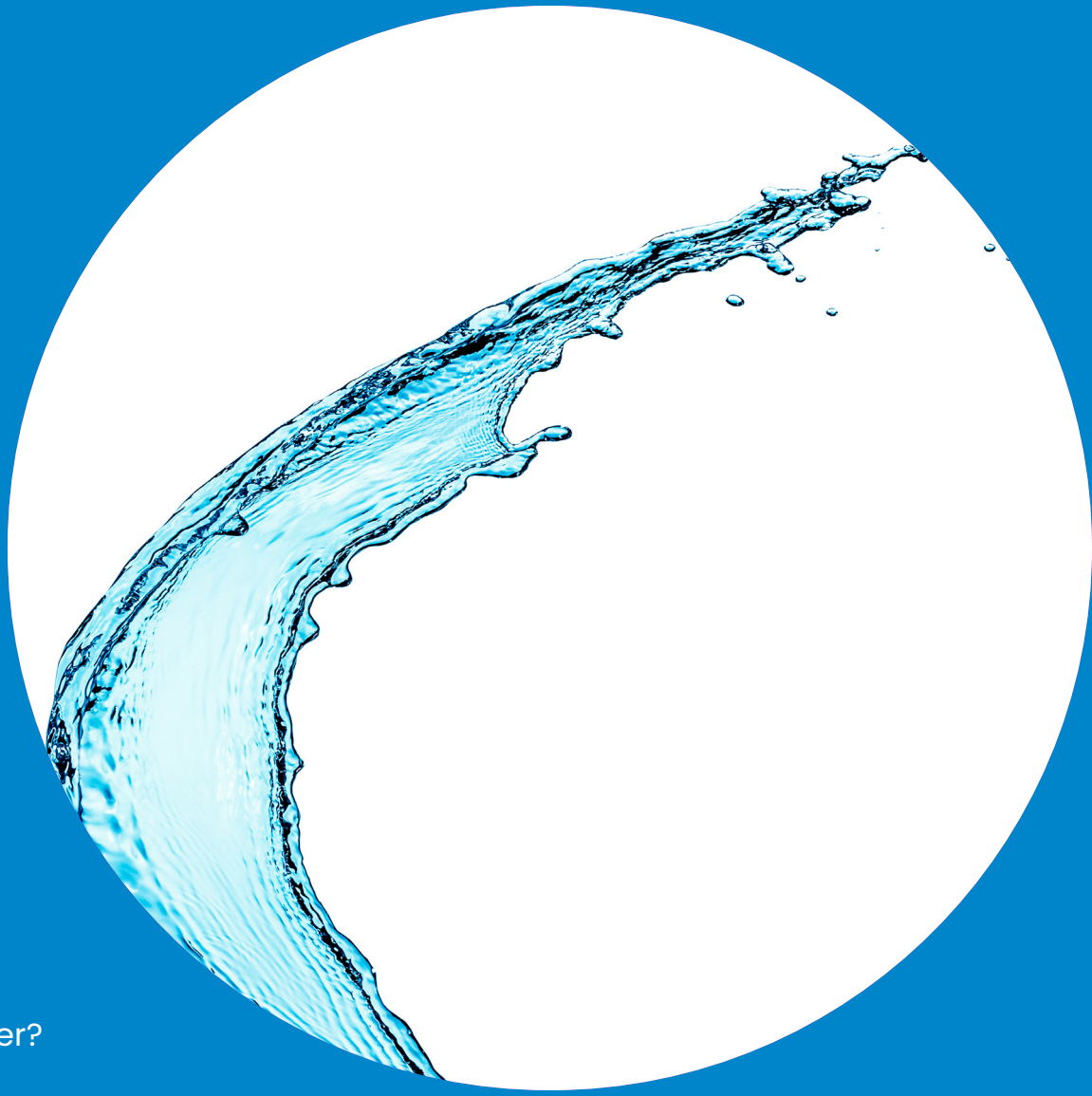
Study hydroponics businesses. Conduct a small group or whole class project to start a local business. Visit local businesses, listen to guest speakers, etc. Research how much your produce costs at local grocery stores and Farmers Markets and price it accordingly.

Cross-curricular Ties

Financial literacy, economics, history, social studies, language arts

Water

Essential Questions



Why is water important?

What is our water source and how do we use it?

How does water shape the earth?

How does water shape our cultures?

How do you give thanks to water?

How much water do I need to have a successful hydroponics system?

What if I live in an area that doesn't have much water?

Why is water important?

Cultural Significance

Water is life. Sweat, blood, tears, and nearly all of human biological functions depend on adequate water. All other animals and plants depend on water. Earth processes, such as precipitation, depend on water. Many of our systems, such as resource extraction, depend on water. Cultural groups have developed unique relationships to the water cycle and sources in their native regions. They care for and want to protect the water in their area. For example, the Hopi people practice a special relationship with water by walking to collect it and bringing it back to their homes.

Regional Considerations

The region you live in will dictate your relationship with water. Some areas have an excess of water while others have limited resources. This will determine water policy and distribution. Communities may experience water threats in the local area, such as wetlands destruction, pollution, a need to ration, etc., may celebrate water and the recreational opportunities it provides, or, possibly, a combination of both.

Suggested Topics

Learn about the water cycle, properties of water, and its different forms. Learn that clean water is essential to life processes and water is a universal solvent.

Suggested Activities

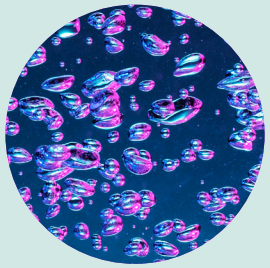
Encourage students to share their life experiences with water, such as weather, sharing it with other organisms (i.e. plants and animals), recreation, etc. Show students how different cultures collect, use, and care for water. Conduct an experiment with celery to watch the plant taking up water through capillary action. Discuss and/or research which life processes of plants require water. Observe and record observations of the different forms of water (solid, liquid, gas). Record how the amount of water in the hydroponic system reservoir changes over a week and determine why it is decreasing (observe the difference in water level changes between young plants and mature plants and/or the number of plants in the system). Conduct an experiment with various liquids, including water, to see which liquids can dissolve the most substances (nutrients for your hydroponic system). Practice using water to clean hands, the hydroponic reservoir, tools, etc.

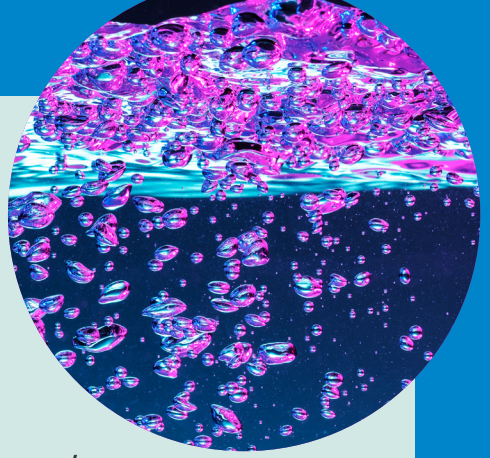
Cross-curricular Ties

Language arts, biology, history, spirituality, geography

Picture: Wetlands Park - Clark County, NV

What is our water source and how do we use it?





Cultural Significance

The body or bodies of water in a community as well as rate and type of percipitation can greatly affect people's experiences and relationships with water. If water is ingrained in a culture, the people will often share stories, ceremonies, and prayers about the local water sources.

Regional Considerations

As water is a natural resource, it is used for many different purposes besides common household activities, depending on the locality. For example, in some areas, fracking is common. There may be aquatic pollution such as in the Goldking Mine Spill. Some areas may also use water to manufacture snow for skiing. The uses and their diversity are dependant on how readily available water is in the community.

Suggested Topics

Learn about: how their water is supplied; the issues related to water supply; environmental factors affecting water supply and use; concerns for future water supply; that water isn't the same everywhere; and that not everyone has the same access to water. Students should know the process of receiving water from their local water source to their household and/or school. Digging deeper, students could explore well water systems vs municipal water systems, as well as new technologies to procure more water in drought-stricken or high population areas.

Suggested Activities

Explore students' stories/attitudes/experiences about water (perhaps ask them to create a visual representation of their relationship with water). Locate and map their local watershed. Invite a guest speaker to talk about the local water and/or take a field trip to a local waterway, well, or municipal water facility. Identify how much water the school and/or home uses. Identify and define water retaining systems such as rain barrels, swells, livestock ponds, reservoirs, etc. Compare geographic regions that have varying degrees of precipitation and discuss how that affects the water supply, environment, and growth of the area.

Cross-curricular Ties

Math, arts, language arts, social studies, science, geography

How does water shape the earth?

Cultural Significance

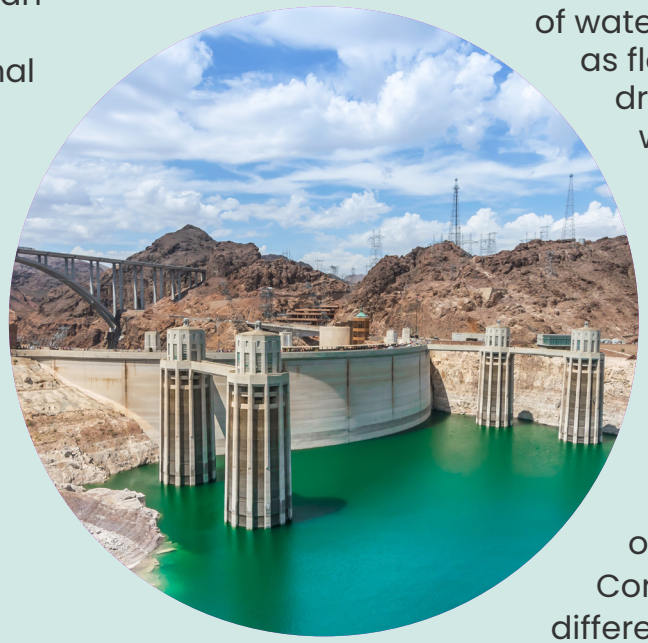
Damming of rivers can have positive impacts on water supply, however, it also can have damaging impacts on local people. Cultural sites and traditional farmland can be lost when rivers are dammed and areas are flooded. Although some people may have the perspective that ruins are abandoned, this is not true for Native American people therefore, these spaces should be preserved. Likewise, industrial use of waterways may be offensive to some.

Regional Considerations

Many areas have adapted waterways such as building fish ladders on the Columbia and Snake Rivers, Hoover Dam on the Colorado River, or mines near waterways. The land is shaped by natural forces of water as well, such as the Grand Canyon or Mississippi Delta.

Suggested Topics

Learn about the water cycle, water movement (such as glaciers, precipitation, rain, hurricanes, etc.), the different water forms (solid, liquid, gas) freshwater VS. saltwater, as well as how much of our freshwater is available for our use. Learn how to track the path of water, learn about excess water such as flooding and too little water such as drought. Learn about how to conserve water and protect it from pollution. Explore how water shapes our landscapes through climatology such as La Nina and El Nino, erosion, geomorphology, subsidence (sinkholes),etc.



Suggested Activities

Build a model of the water cycle or the local watershed. Visit a body of water and make observations. Conduct an experiment with the different water forms. Using maps, track how their regional body of water travels to the ocean and identify how it shapes their local landscape.

Cross-curricular Ties

Chemistry, geology, geography, history

Picture: Hoover Dam Las Vegas, NV

How does water shape our cultures?

Cultural Significance

Water has a sacred relevance for people around the world and is used in spiritual ceremonies. In India, the Hindu revere and wash in specific bodies of water as a spiritual practice. Holy water is used in Christian baptisms such as sprinkling it on the forehead and submerging oneself in a body of water. The waters that run through the Grand Canyon are deeply connected to the Havasupai, Navajo, Hualapai, and Hopi as they intertwine the land and the people.

Regional Considerations

Relationship with local bodies of water is important to people. Some areas have a lot of water, so their food choices and recreation center on water (ex. beach or island communities). If water is scarce, people have adapted to living with less water, for example, developing agricultural practices that conserve water.

Suggested Topics

Learn how humans move water from one place to another to carry out their daily activities and cultural traditions. Explore the reasons why different cultures care about water, how water is used in their culture, and how other cultures use water.

Suggested Activities

Show videos of people from different cultures that talk about the importance of water. Invite guest speakers such as Indigenous people or people from different cultures within your area that can tell students about their cultural connection to water. Have students share their own experiences with or stories of water. Have students create a representation of their relationship with water through art.

Cross-curricular Ties

Spirtuality, history, social studies, language arts, art, commuinty engagement, native lanuage

Picture by Roxane Swentzell. Mimbres bowl Water symbols

How do you give thanks to water?

Cultural Significance

Water is an integral part of cultural practices such as cleansing and ceremony. In spiritual ceremonies, there is gratitude for water shown through prayers, dances, and songs about water. An appreciative relationship with water can be formed through direct contact and recognizing its worth.
For example, the Hopi people have an intimate connection with water through locating it and hauling it for the people.

Regional Considerations

People who have a spiritual relationship with water show respect to it or give thanks for it whether there is an excess or lack. They practice a tradition of gratitude. This cultural practice will be dependant on your regional inhabitants. Natural processes such as tsunami, hurricanes and monsoons can affect how people view water.

Suggested Topics

Learn about their local water source and its relationship to the people. Digging deeper, students could learn different practices of appreciate water and give thanks.

Suggested Activities

Invite guest speakers such as Indigenous people or people from different cultures within your area to show students how to give thanks and respect to water. Give an opportunity for students to create their own way of showing appreciation or giving thanks to the water needed to operate the hydroponic systems.

Cross-curricular Ties

Spirituality, commuity engagement, language arts, history, native lanuage

Drawing by Roxanne Swentzell showing connections between all things...water being central

How much water do I need to have a successful hydroponics system?

Cultural Significance

Connecting to the food being grown and identifying the type and size of the plant leads one to realize how much water is necessary to have a successful crop. Identifying how much water is needed to grow food can lead to a sense of responsibility, care, and stewardship for water. Some processes need more water than others, and through stewardship, we can make sure that there is enough water for all. Traditional watering techniques and conservation can be explored to understand how to improve water availability in the local community.

Regional Considerations

Local geography will dictate how much water is available to be used in the hydroponic systems. The regional culture and conditions may also influence the types of plants grown in the system which will impact how much water is needed in order for it to operate.

Suggested Topics

Learn about how water is used in and travels through the hydroponic systems. Learn how much water is needed to run their hydroponic system which will be dependant on how many and which plants are grown. Explore the amount of water stored within plants.

Suggested Activities

Measure and track the volume of water in the reservoir and how often it needs to be refilled. Measure how much water is absorbed by the plants on a daily basis. Observe if more water is needed when the plants are mature. Show how water flows within hydroponic system. Build hydrological models and experiment with water flow.

Cross-curricular Ties

Math, biology, geography, engineering

What if I live in an area that doesn't have much water?

Cultural Significance

People have prayers, ceremonies, and dances to invite rain and end drought. When there is limited water, techniques can be created to survive. For example, the Hopi rely only on rainwater, practicing dry farming.

Regional Considerations

Local water supply is affected by regional climates or biomes (desert, tropical, wet, ice landscapes) and water laws.

Suggested Topics

Learn about the bodies of water in their geographical area as well as the amount of precipitation it receives. Learn about their local policies on collecting and reclaiming (cleaning) water. Learn how to identify when they are in drought conditions vs. non-drought conditions and/or how hydroponics conserves water.

Suggested Activities

Research the local water sources and if their levels have changed over time. Compare and contrast images from Google Earth or another resource that shows the local water sources over time. Study historical-cultural context of water in spaces that do not have much water or have lived through a drought. Collect water and make a filter to clean the water they've collected to use in the hydroponic system. Research and compare how much water is used in outdoor farming versus hydroponics.

Cross-curricular Ties

Geography, geographic information systems, weather and climate, engineering, history

Red Rock Canyon Las Vegas, NV

Seeds

Essential Questions

What are the different types of seeds?

How are seeds dispersed?

What is a seed composed of?

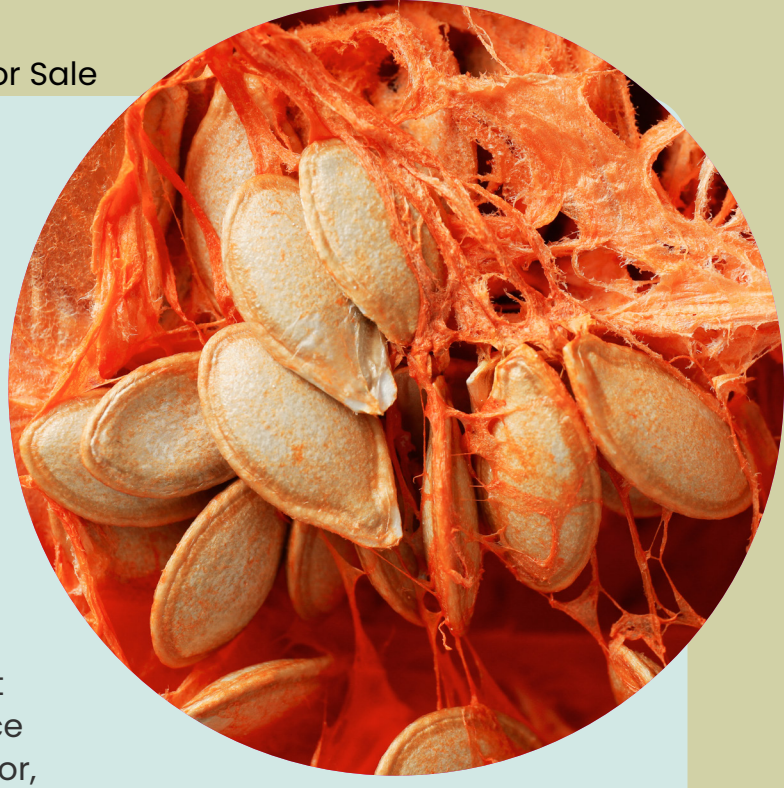
What is your relationship to seeds?

How do you care for seeds and what do they need to grow?

What is the lifespan of seeds?

Do all plants come from seeds?

What are the different types of seeds?



Cultural Significance

For some cultures, seeds carry ancestors and their intentions. Seeds carry life and spirit and are a gift of the Creator and should be nurtured like a child. There is a possibility of losing traditional seeds because of modern farming practices. Keeping native seeds within an area is important for some cultures. Seeds are passed down with their stories, specific to a region. For example, there are stories of corn seeds that will grow plants that can survive with four good waterings only.

Regional Considerations

Regional location and culture will determine what kinds of seeds are accessible and the ease of obtaining them for study.

Suggested Topics

Discover that all fruit contain seeds. Learn how to classify seeds and that they can be male or female. Explore different types of seeds such as open pollination, heirloom seeds, GMO seeds, hybrid seeds, ancient heirloom seeds, and landrace (native) seeds through seed genetics. Learn about pollination and that it is necessary in order for a seed to be produced by a flower.

Suggested Activities

Look at different seeds and notice differences (color, shape, size, feel). Practice sorting seeds. Give students a variety of seeds and have them make predictions on what plant each seed creates. Observe 15 beans stew (lentils, pinto, etc.) Learn Gregor Mendel's Theory of Seed Genetics. Teach how teosinte became corn. Play a pollination game (be a bee, butterfly, moth, bird, or bat). Demonstrate or do a skit about symbiotic relationships. Grow a fruiting plant in the hydroponic system and practice different methods of pollination. Once the plant sets fruit, collect and examine the seeds. Try to germinate the seeds and grow another plant.

Cross-curricular Ties

Biology, botany, chemistry, history, ecology

Picture: Raw Pumpkin with Seeds

How are seeds dispersed?

Cultural Significance

Besides the natural movement of seeds by animals, wind, water, etc., seeds move from place to place through trade amongst tribes and traders. People also engage in a seed exchange, so seeds can be moved to completely different regions or even continents. The stories of how this has happened can be important. There are traditional stories around the movement of seeds, such as that of Kokopelli, who moved seeds from place to place.

Regional Considerations

Each region has its own native seeds that perpetuate the local ecosystem. There are restrictions on moving seeds across borders because we now know that seeds can become invasive species and cause serious damage. The movement of animals and/or waterways can disperse unwanted seeds to far lands and other islands.

Suggested Topics

Explore the different methods of seed dispersal such as by wind, popping, water, animals, and human trade. Discover how seeds migrate naturally versus human intervention.

Suggested Activities

Research seeds/plants that traditionally grow in particular geographical regions and seasons without human intervention. Identify the seeds that will be used in the hydroponic system and research how they are dispersed in the wild. Then, identify where they were purchased and learn about how the farm distributes seeds for commercial use. Go outside and observe seed dispersal in action. Create a model of seed dispersal, including human impact. Ask students if they would be interested in collecting and creating a business from selling seeds.

Cross-curricular Ties

Science, biology, botany, sociology (traditional ways of sharing seeds)

Picture: Black Capped Chickadee Bird

What is a seed composed of?

of seeds are accessible and the ease of obtaining them for study.

Suggested Topics

Learn the parts of the seed. Identify its layers and the conditions that are necessary for germination/stages of development.

Suggested Activities

Observe the different stages of germination. Begin by dissecting and observing a dried lima bean. Then, soak another lima bean in water and let it begin to germinate. Dissect it at this stage as well and oberseve and record any differences. Finally, germinate a third lima bean and let it begin to form into a new plant. See if the students can locate the different parts of the seed emerging. Create a model of a seed. Use colored play-doh to construct a seed. Draw and label the different parts of a seed.

Cultural Significance

The Indigenous peoples have a special way of describing seeds. Some people may imagine a sleeping baby plant inside the seed, for example.

Regional Considerations

Regional location and culture will determine what kinds

Cross-curricular Ties

Science, biology, botany

What is your relationship to seeds?

Cultural Significance

Seeds are our relatives and represent belonging. Your relationship to certain seeds is special (you may be drawn to a certain type of seed). Cultural groups have different timelines and seasons for planting traditional seeds; for example, planting with the moon cycle. There are ceremonies that are carried out when planting seeds that determine the number of seeds planted and how to plant them. Seed preservation is a sacred duty.

Regional Considerations

Regional culture will determine the type of relationship students have with seeds.

Suggested Topics

Learn that there are cultural differences in relating to seeds and that different cultures use edible seeds in different ways. Explore students personal relationship with seeds.

Suggested Activities

Grow a plant from seed. Discuss the tradition of 3 Sisters planting in various cultures. Learn how various cultures use spices. Have students write a poem, paragraph, essay, etc, describing seeds, their meaning, and which ones are their favorites and why. Explore which types of seeds the students would like to germinate for the hydroponic system and why.

Cross-curricular Ties

Nutrition, language arts (mythology and folklore), astronomy, anthropology

How do you care for seeds and what do they need to grow?

Cultural Significance

The Indigenous people of your region had and have a special relationship with the seeds traditionally cultivated in the area. Explore their practices in how they cared for and stored seeds. There may also be stories of settlers who brought certain seeds (European winter wheat, for example). How and why did those people save the seeds they did? What did it mean for their survival?

Regional Considerations

The climate of the region will determine the conditions the seeds need in order to germinate - ex. in a cold climate, native seeds may need to go through a cold period before germinating. Native seeds and their needs could be compare to widely dipsersed seeds, such as lettuce and its needs.

Suggested Topics

Learn the timing and process from seed germination to fruit to harvest to storage. Through their experiments, they will learn about seed viability, how to harvest, clean, and dry seeds as well as how to store and preserve them.

Suggested Activities

Grow a plant from seed to seed (a complete growth cycle). Give students individual tasks to help them understand what seeds need in order to grow (make sure the seeds do not dry out while germinating). Maintain a detailed record of the process. Create a place to dry and store seeds. Try to germinate the saved seeds and determine if they are viable or not. Make iterations to the process for future seed saving. Examine native plants grown in your region and if the process of saving the seeds is the same or varies between the species and methods of growing.

Cross-curricular Ties

Science, biology, botany

What is the lifespan of seeds?

Cultural Significance

There are many traditions and ceremonies associated with planting, harvesting and seed saving. If stored properly, seeds can be viable for hundreds of years. The practice and art of seed saving, and creating vessels to house the seeds, is important to many cultures. Seed saving is important in order to pass along story, tradition, and spirit, as well as preserving plant biodiversity.

Regional Considerations

Regional agriculture will dictate how involved the community is in seed saving and if there are seed banks in your region. These may be managed by the government, city officials, local farmers, or spiritual leaders.

Suggested Topics

Learn the different methods of gathering, preserving and storing seeds, as well as about seed viability and seed banks.

Suggested Activities

Let some of the plants go to seed in the hydroponic systems.Practice seed saving by harvesting, drying, and storing the seeds. Create a seed library, making sure to label the bags or containers. Chart the life cycle of a seed. Try germinating “out of date” seed and chart success. Go on a field trip to a seed bank or nursery if possible.

Cross Curricular Ties

Science, language arts, social studies, history

Do all plants come from seeds?

Regional Considerations
Bioregions with native plants such as moss and ferns offer a great opportunity to explore this hands -on with students.

Suggested Topics
Learn that some plants start from seeds and others start from spores. Explore how new plants can grow from rhizomes, tubers, and vegetative propagation methods.

Suggested Activities
Create a chart comparing plants that propagate from seeds and ones from spores. Bring a moss or fern to class and observe how it is different from plants in the hydroponic system. Compare seeds and spores. Take a cutting from a few plants in the hydroponic system and propagate them.

Cross-curricular Ties
Science, biology, botany

Cultural Significance
Tribal and traditional creation stories may explain seeds or other types of plant reproduction, including where the original seeds come from or how a plant came to be on the Earth.

Plants

Essential Questions

Why are plants important?

What are the different type of plants?

What are the different parts of a plant and their functions?

Are plants culturally significant?

Can plants communicate?

What is the difference between native vs. non-native plant species?

What are cultivated plants?

How do plants adapt and evolve?

Why are plants important?

Cultural Significance

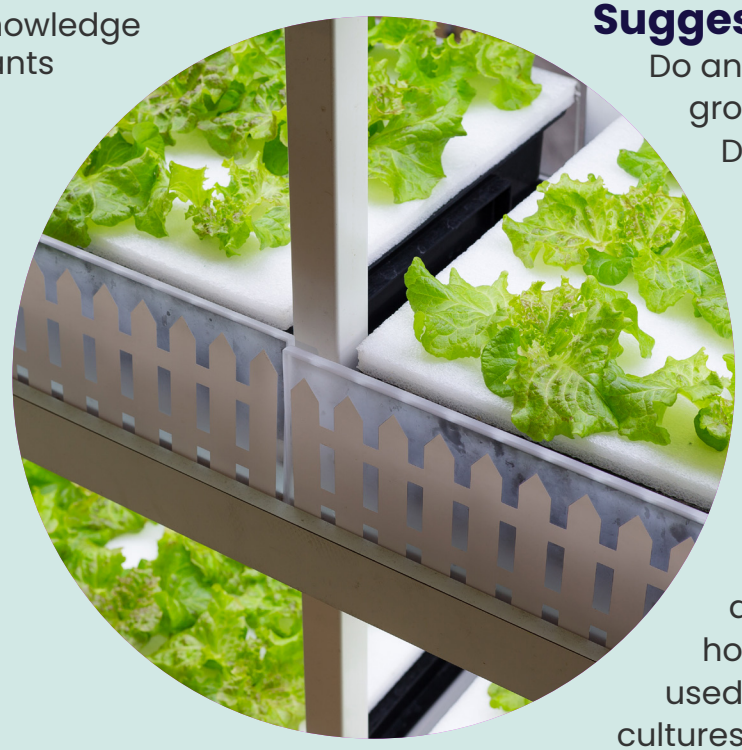
Adding to the fact that plants are the foundation of our food system, many cultures have studied plants, learned about the medicinal properties they hold, and use them for spiritual ceremonies. Scientists of all cultures have added to our knowledge of plants and it is proven that plants have a positive effect on mental health. Plants can make people feel happy by having another life to care for, adding to their sense of purpose.

Regional Considerations

Outdoor plants and the relationship that people have to them will vary by region. Hydroponic systems allow for people to grow a multitude of crops indoors, year-round.

Suggested Topics

Plants are primary producers and are the food and fuel resource for living organisms. They are able to capture sunlight and use it to create energy in photosynthesis. The process of photosynthesis keeps balance in our air because plants take in carbon dioxide and produce oxygen. Different plants hold different meanings in different cultures.



Suggested Activities

Do an experiment that shows a plant growing in light versus without light. Do an experiment that measures the uptake of carbon dioxide and/or the production of oxygen. Track the food you eat and then determine if plants are essential to your diet. Take time to observe how you and your students feel when caring for the plants growing in the hydroponic system. Interview your friends, family, or community members to determine what meanings plants hold for them. Learn which plants are used for spiritual purposes in different cultures.

Cross-curricular Ties

Biology, chemistry, spirituality, health

What are the different type of plants?

Cultural Significance

Different cultures have relationships with special plants and have created symbiotic relationships. Plants have different cultural purposes. Some are for food while others are for medicine, tools, building, clothes, baskets, or utensils. Medicinal plants are used for healing. There is a difference between wild plants and cultivated plants. Wild plants can be harvested and some are chosen to be cultivated. Many people only plant and harvest according to traditional calendars for sustainability.

Regional Considerations

Plant knowledge may be based on the biomes and/or zones where students live unless students have investigated types of plants online or on school field trips. Students may or may not know types of common edible plants found at the grocery store or in the wild.

Suggested Topics

Learn about the common types of plants that can be grown in hydroponic systems. Explore plants that are readily used in the local culture for food or medicine. Discover the difference between flowering plants and nonflowering plants. Go further by exploring the difference between angiosperms and gymnosperms.

Suggested Activities

Assess students understanding by asking them to identify the plants growing in the hydroponic systems. Talk about the difference between plants that you are growing for the leaves (lettuce, kale, basil) versus plants you are growing for the fruit (tomato, pepper, pea). Show different visuals for the different types of plants, identifying which ones are flowering and which ones are nonflowering. Have students play a game to reinforce the differences between each plant. Conduct a research project comparing flowering plants (sunflower, tomato, corn) and nonflowering plants (moss, worts, ferns) or angiosperms (sunflowers, tomato, corn) and gymnosperms (pine trees, redwoods, ginko trees, palm trees). T

Cross-curricular Ties

Botany, geography, biology

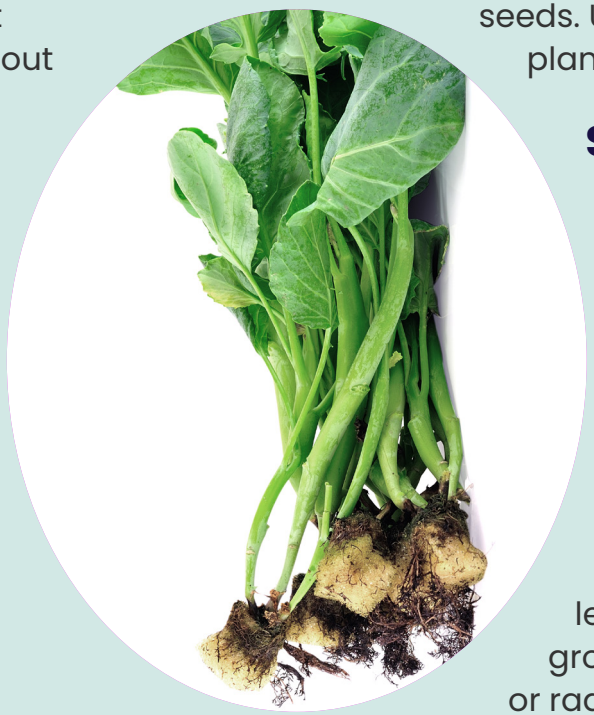
What are the different parts of a plant and their functions?

Cultural Significance

Different cultures have unique medicinal uses and meanings of plant parts. Different parts of the plants are used in different ceremonies. One way to learn about plants and another culture is to learn their names in your and others' languages. People find joy in thanking plants as well as touching, growing, and smelling them. Relationships with plants can be developed by relating human body parts and their functions to a plant's parts and functions.

Regional Considerations

Different cultures/regions use or name plants and parts of plants differently.



Suggested Topics

Learn and analyze the six parts of the plant and their functions - roots, stems, leaves, flowers, fruits, and seeds. Understand the plant life cycle and how the plant parts contribute to the cycle.

Suggested Activities

Go to the hydroponic system and observe plants from a macro (whole plant) and micro view. Use hand lenses for close observation. Notice the difference between plants at different stages of their lives. Make models out of available materials or draw a plant and its parts. Use the 5 senses to observe plant parts - smelling, touching, seeing, tasting, hearing. In addition to growing leaves, such as lettuce, and fruit, such as tomato, experiment growing root vegetables, such as carrots or radishes, stems, such as celery, and edible flowers and seeds such, as nasturtiums.

Cross-curricular Ties

Biology, language arts, art, anatomy

Are plants culturally significant?

Cultural Significance
People use plants for medical uses, paint, dye, hygiene, clothing, ceremony, and weaponry. Many people believe plants have a positive effect on mental health and emotions.

Regional Considerations
Every region has a unique cultural relationship to plants, however, some may be more pronounced and integrated into society and everyday life than others.

Suggested Topics
Learn and discuss how different cultures use and honor plants. Explore the plants that are unique to a specific culture and why. Learn which types of plants are used for cultural/spiritual purposes so there is no conflict in cultural appropriation (i.e sage).

Suggested Activities
Have students watch and discuss documentaries about how different cultures use plants. Take field trips such as visits to cultural sites or museums. Invite guest speakers to give presentations on using plants in a traditional way to represent their culture and way of life (suggestion: farmers, chefs, or elders). After the presentation, ask the presenter to do an activity with the students such as setting up the germination tray, transplanting seedlings into the system, or harvesting. While performing the activity, ask them to speak about what each part process means to them.

Cross-curricular Ties
Social studies, art, spirituality

Can plants communicate?

Cultural Significance

Many cultures know that plants communicate. Some people practice communicating and singing to them. Communicating with plants can help improve bonding. Studies show that communication such as singing to plants may improve their growth. Certain cultures believe that plants are also people and have feelings as well. In some cultures, it is known that before you harvest plants or forage, you have to ask permission before taking it.

Regional Considerations

Some regions practice communicating with plants and therefore, the language of the region will be used to communicate with plants.

Suggested Topics

Explore research and stories about how plants communicate.

Suggested Activities

Show visuals of plants competing for sunlight. Watch documentaries or read articles/books that cover current research on plant communication. Invite guest speakers to give a presentation on their relationship with plants or how they perceive plant communication (elders, scientists, or gardeners). Allow students to explore how they like to communicate with plants (i.e exchange of breath).

Cross-curricular Ties

Language arts, social studies, sprituality, science

Picture: Cochiti pueblo pattern of plants water and clouds

What is the difference between native vs. non-native plant species?

Cultural Significance

In cultural traditions, people prefer to use native plants rather than non-native plants. However, over time, people have learned to adapt to non-native plants and integrate them into their culture. Knowing the origin of plants and their properties can have a positive effect on mental health. Recognizing that there are more non-native plants than native plants can lead to feelings of loss

Regional Considerations

Plants can be genetically adapted to one area but can be transported to different areas and adapt there too. Global homogenization is something to consider. Each region will have its own invasive species.

Suggested Topics

Distinguish between a native plant and non-native plant. Know that native plants are adapted to their region in many ways, including light, water, and mineral needs.

Understand how non-native plants come to be in a new area. Explore how non-native plants affect an area for better or worse. Not all non-native plants are invasive, but some are.

Suggested Activities

Research if the plants growing in the hydroponic systems are native or non-native. If non-native, explore if they can have a negatively impact the local ecosystem if grown outdoors. Go for a nature walk and identify native plants and non-native plants. Compare environments that are populated with native plants to those populated with non-native or invasive plants. Identify ways in which non-native plants are introduced into environments. Show the damage that non-native plants or invasive species can have on the environment.

Cross-curricular Ties

Botany, geography, biology, history

Top Picture: Creosote Bush Native Plant

Bottom Picture: Bermuda Grass Invasive Weed

What are cultivated plants?

Cultural Significance

Some people know which plants were used for cultivation and making their traditional food. Eating foods that are self-cultivated is better for mental and physical health. Cultivating plants can be an emotional process especially when they die. Cultivation is a spiritual process that connects you with your ancestors who also planted for survival.

Regional Considerations

Culture and diet will determine the regularly cultivated plants in each region.

Suggested Topics

Explore how humans were able to genetically modify wild plants to cultivated plants.

Explore how hybridized plants can be used in different situations (i.e. tomato varieties that can be grown in hydroponic systems vs. those best grown outdoors)

Suggested Activities

Show visual aid on how people were able to turn grain into corn (i.e teosinte). Grow a variety of tomato plant best suited for a hydroponic system (ex. Tiny Tims, Super Sweet 100, Beefsteak) and compare their growth habits to a local, open-pollinated variety. Have students research and discuss the Columbian Exchange.

Cross-curricular Ties

Science, engineering, culinary arts, agriculture, social studies, language arts

How do plants adapt and evolve?

Cultural Significance

Many cultures have legends and traditions around plants. We have seen plants adapt to space just like humans do over generations. There are specialized endemic species only grown in one space and nowhere else in the world that cultures highly value for cultural purposes, such as plants found only on islands or Hopi Blue Corn.

Regional Considerations

Invasive plants may adapt easily to new environments, but they can also have negative effects on regions such as outcompeting native plants and using more water.

Suggested Topics

Learn how plants move from one location to another by humans, machines, animals, seed dispersal, water, and wind, as well as the adaptations and evolution of plants in new or changing environments.

Suggested Activities

Consider if plants can evolve or change in an indoor hydroponic garden. Set up an experiment to grow multiple generations of plants in the hydroponic systems. Record any observations of plants apating to life in the hydroponic systems. In between growth cycles, research if scientists have observed plants adapting to life in hydroponic systems. Outdoor field study: hypothesize and discover how the plants in an outdoor garden or space came to be growing there (ex: dandelion, lettuce, tomato, tree). Identify the plants in the outdoor space and research if they are native or non-native. Give examples of how seeds or plants can or are moved from one environment to another (ex. burr/stickers on our clothes, blowing dandelions seeds, animals eating seeds and depositing them in new places, etc). Research how the plants have adapted or evolved over time.

Cross-curricular Ties

Science, biology, botany, social studies, engineering, technology

Nutrition

Essential Questions

How does culture determine diet?

What plants make up your cultural diet?

How are western diets different than Indigenous diets?

How is the nutritional value of locally grown hydroponic or soil grown fruits and vegetables different than store bought ones?

How does water relate to your health?

How do you ask permission and give thanks before you harvest?

How do you harvest the plants?

How does culture determine diet?

Cultural Significance

Many foods are place-based and associated with local culture. Connecting to local culture helps us to understand why certain foods are chosen and how they are grown. We can also learn about how culture connects people to their land and traditions around growing and preparing the food in their diet. The available land and climate of a place will help explain why people choose to eat certain foods and how physical health is affected by their diet.

Regional Considerations

Place based foods change over time. Traditional foods could be grown in certain areas and not others. Invasive species and extinction of traditional foods (both plants and animals) greatly affect populations' health and way of life. Highly processed foods can sometimes be the only food accessible in areas.

Suggested Topics

Learn that there are different food pyramids and/or diets (ex. Indigenous Food Pyramid, My Plate, Healthy Eating Plate). Geography, climate, seasons, and demand determine fruit and vegetable production. Food advertising affects food choice. New foods have been brought to North America, and many foods were introduced to Europe from North America, through colonialism.

Suggested Activities

Explore harvesting calendars based on place and cultures. Elders can be a great source of information regarding how and when to harvest, and how to prepare local foods. Prepare foods at home or in the classroom during a culture day and explore the history of the native foods of their area. Ask students to choose which plants to grow in the hydroponic systems. Take time to reflect on the reasons behind growing the plants they selected.

Cross-curricular Ties

Health, economics, history, biology, geography

What plants make up your cultural diet?

Cultural Significance

Different cultures have different diets. People can experience self-empowerment through knowing their history, culture, connection to food, knowing how to grow and preserve food (seed saving), as well as making personal healthy eating choices. Healthy eating can lead to improvement in concentration, cognition, attention, memory, and overall well-being. When healthy foods are incorporated into the diet, the body starts to crave these healthier foods, reacting to the nutritional benefits and contributing to overall physical and emotional health.

Regional Considerations

In some areas, pervasive health issues such as high rates of hypertension, diabetes, and obesity have arisen due to highly processed Western diets and the pulling away from traditional diets.

Suggested Topics

Have students identify and learn about the plants that make up their cultural and traditional foods (cultivated vs. wild). Learn about the plants that make up the local cultural and traditional foods.

Suggested Activities

Have students reflect on the food that makes up their diet. Then, have them identify their local or personal culture and compare the foods they regularly eat to it. Finally, have students choose a food from one of the diets to grow in the hyroponic systems. Cook traditional recipes (pre-colonial). Identify if any of the plants that make up the local cultural and traditional foods grow wild, and if so, take students out to learn how to forage for them. Learn about native sourced foods and recipes. Give students an opportunity to listen to their bodies and identify which plants they like to eat most and why.

Cross-curricular Ties

Health, biology, social studies, culinary arts

Picture by Roxanne Swentzell. Mimbres water patterns

How are Western diets different than Indigenous diets?

Cultural Significance

It can be impactful to know the foods we were originally connected to and that were grown in previous generations. Interacting with our food can lead to a better perception of it and trust in it. Planting, growing, harvesting, and cooking our food can create a meaningful connection to it and the Earth. Many cultures have created stories, prayers, songs, ceremonies, instruments, and dances around their food.

Regional Considerations

There are many locally-based food producers across the country. Some continue to produce traditional foods, while others do not, sometimes to the detriment of the Indigenous people. Some organizations may seem to be producing "local" food, but are not because they use or grow plants that are not native to the region or may engage in monoculture. You local region and its culture of food production will determine which foods are available for purchase.

Suggested Topics

Learn about the characteristics of the Western diet and learn about and compare it to a variety of diets non-Western or the way traditional cultures eat. The typical Western diet is sugar-heavy and often features a high intake of red meat, processed and fried foods. Indigenous diets differ from tribe to tribe but are typically lower in sugar, salt, and processing. For example, the Pueblo diet revolves around corn, beans, squash, wild rice, deer, and pinon.

Suggested Activities

Identify if any of the foods found in a Western or non-Western diet can be or are being grown in the hydroponic systems. Research how Indigenous diets changed during colonization in the United States, Canada, Mexico, etc. For example, students could research the Columbian Exchange, the Long Walk of the Navajo, and/or commodities on reservations. Have a guest speaker come to the class and discuss how diets changed due to colonization and industrialization. Interview Elders on what they ate as kids. Compare food labels of processed food and whole food.

Cross-curricular Ties

Health, social studies, history, language arts

How is the nutritional value of locally grown hydroponic or soil grown fruits and vegetables different than store bought ones?

Cultural Significance

Many cultures have practices around growing food (stories, songs, prayers, ceremonies, companion planting strategies). There is less of a connection when buying food in the store vs growing your own. Some cultures may question using hydroponic methods instead of growing plants out of the Earth.

Regional Considerations

When eating locally, we will find place-based foods or foods that are available only during certain seasons. These foods are fresh and maintain most of their nutritional value if harvested and eaten immediately. If we buy food from large grocery stores that source food from global suppliers most food will be available all year, although its quality and nutritional value may vary or decrease. Your region will influence what kind of food is available for purchase.

Suggested Topics

Learn the nutrients we need as humans and their natural sources. Learn about nutrient values, vitamins, minerals, and amino acids. Learn that fruits and vegetables lose nutritional value the older they get. Learn about the food distribution system, and understand how long it may take certain foods to reach stores.

Suggested Activities

Set up wall charts to record the nutritional value of the different fruits and vegetables being grown in the hydroponic systems. Create games with types of fruits and vegetables and their nutrients. Research, watch a video, or read an article on how far food travels and its effect on nutrients. Interview a local food producer on their process from seed to store.

Cross-curricular Ties

Health, economics, science, social studies

How does water relate to your health?

Cultural Significance

How people in your area have traditionally treated water will vary. How people use water is different between cultures. Some traditions include the separation of water and waste (not using water in toilets, for example) so as not to pollute and disrespect it. The bodies of water near you, or the lack of such bodies, greatly affect cultures and their water use and attitudes toward water.

Regional Considerations

There are many political water issues across the country such as waste water pollution, aquifers drying, climate change, understanding water rights, and water ownership. It's important to understand these issues and how they can affect our overall health and the future of communities.

Suggested Topics

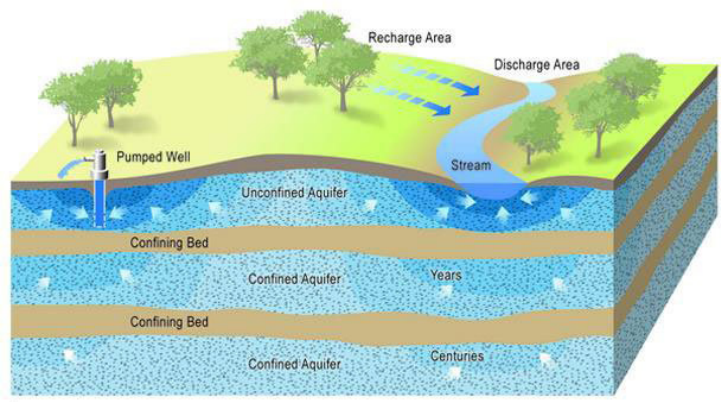
Learn the percentage of water in the human body and how long one can survive without water. Learn why your body needs water and how it can be medicine in a traditional sense. Understand the importance of clean drinking water and that it means different things to different cultures.

Suggested Activities

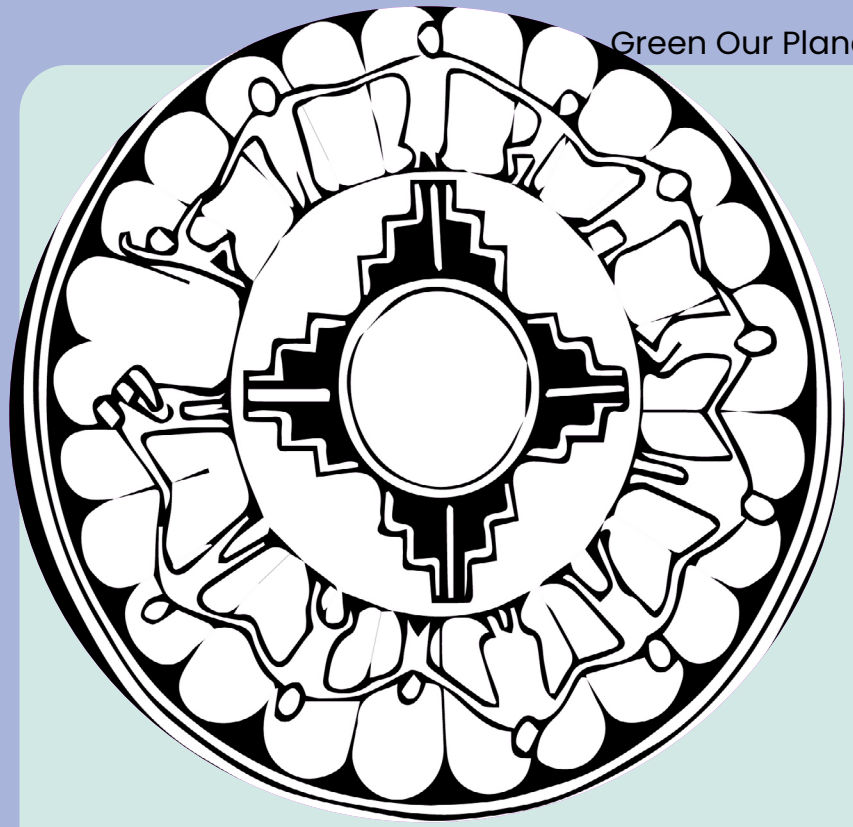
Create a shade drawing (shade in 70% of a drawing of a body) to represent how much of the body is made up of water. Research the function of water in the body. Experiment withholding water from plants and record how their structures change. Reflect on the importance of water to all living things. Compare the water content in the plants growing in the hydroponic system (ex. lettuce versus tomato). Identify how much water you receive from the plants you eat. Research the sources of clean drinking water in your community. Reflect on a time when you were very thirsty and the circumstances that caused you to be thristy and allow you to find clean drinking water.

Cross-curricular Ties

Health, geography, social studies, science



What is an Aquifer and How does it Work? DTN . 2016



How do you ask permission and give thanks before you harvest?

Cultural Significance

The traditions of the honorable harvest tell us that living things need each other and that we are all connected. Taking a moment to show gratitude for another living being supporting your life is a way to acknowledge and show respect for the circle of life. Asking permission and giving thanks for a harvest will look different from culture to culture. It can be done through song, prayer, ceremony, or whatever feels right to the person.

Regional Considerations

People in your area may practice reciprocity differently. It may be a dominant part of the culture or one that is more subtle. It may happen while the plants are being harvested or right before they are eaten. If you would like to engage in another culture's reciprocity practice, approach the topic from a humble place and be open to the fact that the group may or may not be receptive to sharing their practices of asking permission and giving thanks for harvesting.

Suggested Topics

Different cultures ask permission and give thanks before, during, and after harvest in their own ways. There are many culturally appropriate ways to think and talk about giving thanks for the harvest.

Suggested Activities

Visit Indigenous people in your area if appropriate. Ask the students how would they ask permission and give thanks. Who are we asking for permission? Who are we thanking? Have students write their own statements of permission and thanks, or share ones they know. As a class, come up with a way to give thanks before a harvest. At the next harvest, put it into practice.

Cross-curricular Ties

Spirituality, health, histoy, social studies, language arts/ reading, art

Drawings by Roxanne Swentzell

showing connections between all things...water being central

How do you harvest the plants?

Cultural Significance

Harvesting looks different from culture to culture based on that culture's relationship to plants. For example, some people harvest according to the moon phase, some use specific baskets or bins while harvesting particular plants, and make those tools especially for that purpose, and some make sure to preserve seeds native to an area or that are endangered.

Regional Considerations

Food is ready at different times in different regions and may be harvested differently. Traditional/organic farmers must be cautious of pollen dispersing during growing and harvesting, as pollen can travel to neighboring fields, causing problems with large farming operations (GMOs).

Suggested Topics

Not all plants are harvested the same way. Some plants have multiple harvests and can be harvested at different points in their life cycles. Traditionally, some plants are only harvested at certain times of the year. In some cultures, it's important to ask permission before harvesting and give thanks. Techniques in harvesting and the tools used vary by culture (ex: baskets, cutting utensils). Different parts of plants can be harvested - fruit/leaves/roots/seeds. You can harvest to eat or for seed saving to grow the next generation of plants.

Suggested Activities

Engage in hands-on harvesting. Students can create their own ways of asking permission and giving thanks in harvesting. Create a chart on ways to harvest different plants, including comparison charts and diagrams illustrating the harvest strategies. Practice the whole plant and partial plant harvesting techniques.

Cross-curricular Ties

Health, biology, language arts, math

Environmental Sustanability

Essential Questions

Can a hydroponic system mimic an ecosystem?

How does a hydroponic system effect the environment?

How do you design a hydroponic system to be environmentally friendly?

How do you know your water is safe to use in your hydroponic system?

Who owns water?

Which environment would benefit the most from having a hydroponic system?

Is hydroponics a healthy alternative to environmental contamination?

Can a hydroponic system mimic an ecosystem?

Cultural Significance

To honor and respect the Earth, it is crucial to create manmade systems that mimic a natural system as much as possible. Consider operating the hydroponic systems in a regenerative or environmentally friendly way.

Regional Considerations

Types of regional ecosystems (ex. how much water is in the area) will affect relationships to agriculture and the environment. Traditional and modern food systems may co-exist in the area. The regional culture will also influence the resources and support available to creating regenerative or environmentally friendly systems.

Suggested Topics

The components, similarities, and differences between natural and manmade ecosystems. Distinguish between natural and chemical inputs in a system (a natural system vs a manmade system). Learn about how the hydroponic systems function and the necessary inputs and outputs.

Suggested Activities

Set up an experiment to compare a hydroponic system to a natural ecosystem. Create a Venn diagram comparing a natural system and a manmade hydroponic system. Study large-scale hydroponic systems and determine how much carbon output they create. Compare pH levels of water in a natural system vs a hydroponic system. Dig deeper and compare aquaponics to hydroponics. Research biomimicry.

Cross-curricular Ties

Science, engineering, technology, social studies, economics, geography, politics, history, language arts

How does a hydroponic system affect the environment?

Cultural Significance

There are many cultures that recognize the interconnectedness and symbiotic relationships that people have with the Earth. With this knowledge, they are conscientious in how they treat and use water, land, natural resources, plants, and animals. Emotional intelligence and respect for the natural world are cultivated. One way people show interest in protecting and caring for the natural environment is by creating non-toxic regenerative systems.

Regional Considerations

How water is used and reclaimed, resources are extracted, and electricity is generated varies across the country. These practices also influence the regional attitude towards human environmental impact. Hydroponic materials may be produced in your area.

Suggested Topics

Learn about the components of a hydroponics system (energy use, nutrient supplements, water sources and uses, pH adjustments, construction materials, planting plugs, seeds, food production, location, etc.). Determine how the production and use of these materials affect the environment (whether positive or negative).

Suggested Activities

Identify local water sources and water treatment. Go for a nature walk and observe natural cycles and compare and contrast them to the hydroponic system growing cycle. Use a watt meter to determine how much energy the system uses for its lights and pump. Grow the same number of plants in the hydroponic system and in an outdoor garden. Track, calculate and compare how much water, space, and nutrients are used to grow each over a period of time. Conduct a research project to determine how the materials used to construct and maintain the hydroponic system are made. Track the amount of water used and discarded from the systems. Create a presentation explaining how the waste water could impact the local, regional, and national waterways.

Cross-curricular Ties

Science, social studies, civics, math, chemisty, language arts

How do you design a hydroponic system to be environmentally friendly?

Cultural Significance

Traditionally, many cultures follow nature's ways of reproducing and growing. Seeds are our relatives and it is acknowledged that plants have feelings and emotions. With this understanding, people sing and talk to them, positively affecting people and the plants. Deciding for or against using chemicals affects them also. Some are taught that the creator put these plants here for people. It is not our place to change their environment in adverse ways for profit or greed.

Regional Considerations

Regions have their own environmental issues, such as lack of water, frequent flooding, habitat destruction, etc. Cultural and regional perspectives also affect ideas of how to mitigate those issues. Teachers can connect students to resources and examples of environmentally friendly design in their areas.

Suggested Topics

Learn about materials that can be recycled or reused to make a hydroponic system. Learn about the inputs into the system and if they are natural/organic or synthetic (pH buffers, nutrient supplements, and planting plugs). If they are synthetic, investigate and test natural ways to adjust the pH, add nutrients and/or source materials to use in the system.

Suggested Activities

Go on a materials scavenger hunt for items that can be reused to make a hydroponic system. Observe and record a materials list of the inputs into the hydroponic system. Using the materials list, research the source and production of each input. Take the research further and identify inputs that are listed on the Organic Materials Review Institute (OMRI). Identify if any synthetic inputs could be replaced by natural ones. Create a comparison chart between natural and synthetic inputs. List the pros and cons of each.

Cross-curricular Ties

Science, engineering, technology, lanugage arts, chemistry

How do you know your water is safe to use in your hydroponic system?

Cultural Significance

It's important to understand methods of cleaning water, and how hard it can be. There are mental, emotional, and spiritual aspects to being stewards of water. Some questions to consider are: If we recognize the spiritual nature of water, why would we disrespect it? How do we prevent water from being polluted? How did people know the water was safe to drink in the first place? Rainwater collection vs bottled water - are we filtering out the good with the bad?

Regional Considerations

How water is obtained and used in an area will vary widely across the country. In addition, so will the levels of toxins. If there are chemical plants nearby, there may be higher levels of contaminants. Whether or not you are located upstream near the mountains or downstream near the ocean will also impact the water quality of the region.

Suggested Topics

Identify the water source for the hydroponic system. Learn about potable vs nonpotable water. Learn how to observe with sight and smell if water is safe to drink. Learn how to test water for chemicals, pH, dissolved solids, etc. Learn what chemicals and bacteria could possibly be in the water before it is treated. Explore how water is treated in the local water treatment facility and where it is distributed. Learn how wetlands can filter and clean contaminated water.
Determine the differences between the water humans and animals drink vs the water plants need to survive.

Suggested Activities

Have the students use their municipal resources to determine the local water source and how it is treated. Have students explore all of the water resources available to them and determine if they would drink the water or not and why. Determine the quality of water plants need to survive in the hydroponic systems. Purchase a water testing kit and conduct an experiment in class or collect a water sample together and send it to a water testing lab to be analyzed. Create a water filter (2-liter bottle, layer materials such as sand, coffee filters, charcoal, etc.) and conduct an experiment to see how much matter it can remove from water full of sediment either collected outside or prepared in class. Take a guided field trip to a water treatment plant and/or wetland (watch videos if necessary). Compare and contrast how each cleans the contaminated water.

Cross-curricular Ties

Geography, science, chemistry, science, language arts, engineering, art

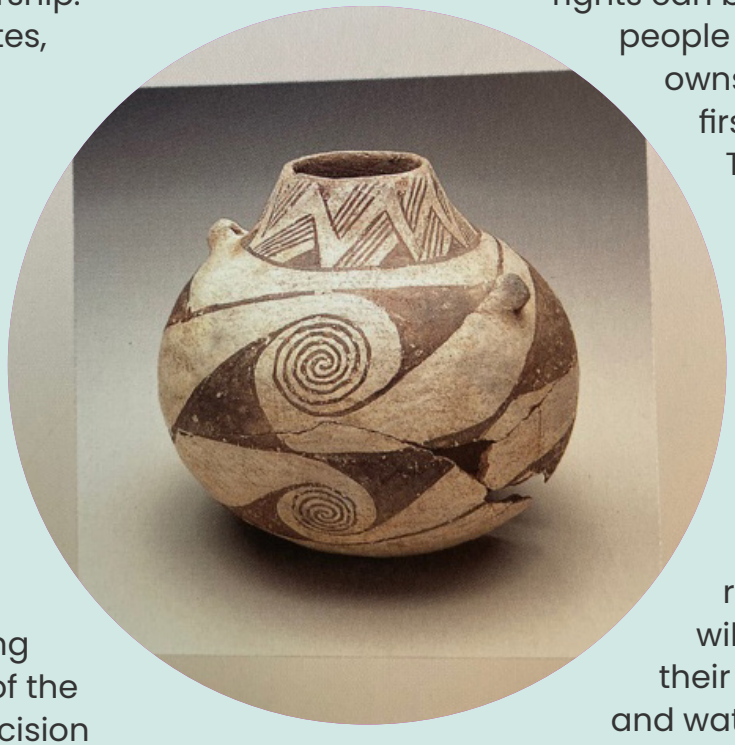
Who owns water?

Cultural Significance

In our modern world, there is a vast scale of how different cultures view water ownership. On the one hand, in the United States, there are strict laws that regulate who has the right to water. On the other, in New Zealand, waterways are considered people and given the same rights. It is beneficial to understand one's own viewpoint on this scale and decide how to best be a steward of, or responsible for, your local watershed.

Regional Considerations

All states and municipalities have water policies. In some areas, selling water rights to help the economy of the community has been a difficult decision between financial stability and cultural sustainability. Consider issues around disappearing coasts and tribal lands, private land vs public land policies, regional policies on collecting rainwater, and regional wastewater policies.



Suggested Topics

Learn how water can be a controversial topic. Water rights can be spiritual, physical, and legal, and people have different opinions on who owns water. Native Americans have the first rights, depending on the Pueblo/ Tribe.

Suggested Activities

Create a map of your local watershed. Facilitate a discussion of the question "Should we be able to own water?" Interview a water rights lawyer, irrigation companies, city council members, state representatives, farmers, local wildlife officers, etc. to understand their perspective, needs, and water policies.

Cross-curricular Ties

Social studies, geography, language arts

Picture by Roxanne Swentzell. Mimbres water patterns

Which environment would benefit the most from having a hydroponic system?

Cultural Significance

Hydroponics is an ancient method of growing food, however, it was not used in all cultures. To introduce hydroponics to a new area, it could be beneficial to talk to elders, government officials, and the people to understand if they would accept it as a method of growing food.

Regional Considerations

Whether hydroponics would benefit an area or be accepted by the people living in an area will depend on local situations, need and perspectives.

Suggested Topics

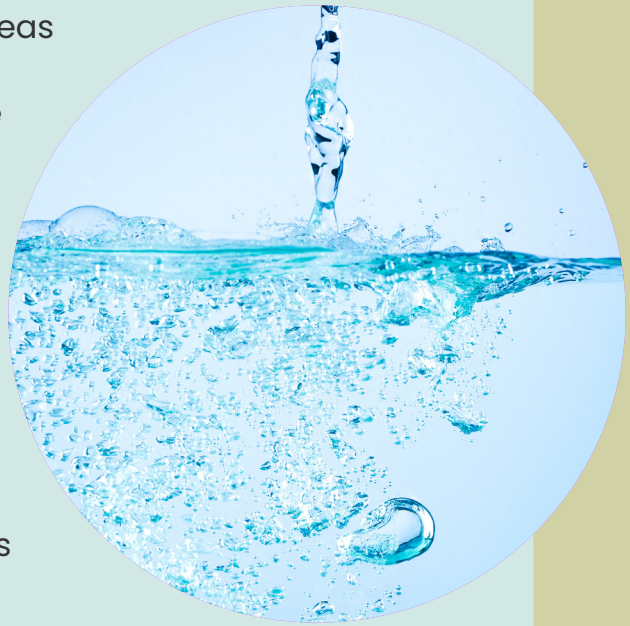
Learn about the climate and geography of local, national, and international environments. Learn how the weather can affect outdoor growing. Determine where you can place a hydroponic system to grow food.

Suggested Activities

Use Google Maps to determine where water naturally flows and decide which areas would benefit from a hydroponic system. Use GIS to look at your local watershed. Research areas that are susceptible to drought and where the water level is dropping or places that experience flooding and determine if these areas could benefit from hydroponics. Study climate change and explore how it will affect agriculture. Make a claim about whether or not it would be good to switch to hydroponics in an area. Research cultures that have used hydroponics on bodies of water.

Cross-curricular Ties

Geography, science, language arts



Is hydroponics a healthy alternative to environmental contamination?

Cultural Significance

People are intricately connected to the natural world and the spaces they grow food. In addition to a physical connection, there is also a mental, emotional, and spiritual connection as well to these places. There is a cultural need and desire to respect, care for, and help heal our natural world.

Regional Considerations

Various environmental uses and agricultural practices contribute to a region's level of environmental contamination. For example, some cities have a large number of factories that contribute to pollution, whereas some areas are mostly rural, which brings a different set of environmental risks. How communities deal with environmental contamination varies widely.

Suggested Topics

Explore the reasons for and effects of environmental contamination.
Determine whether or not food could be grown hydroponically in places that suffer from environmental contamination and protect our future generations by providing healthy food.

Suggested Activities

Go for a nature walk or a field trip and observe the landscape, identifying any environmental contamination. Test the soil and/or water to determine if it is contaminated. Read articles or watch new stories of local, national, and/or international environmental issues. Brainstorm ways that hydroponics could be used to grow food in places that suffer from environmental contamination. Set up a hydroponic system in a place that suffers from environmental contamination and track plant development.

Cross-curricular Ties

Science, engineering, history, social studies, chemistry, math

Designing Hydroponic Systems

Essential Questions

What are the necessary components of a hydroponic system?

What is the role of water in hydroponics? **How** do you transfer water in your system? And Why?

What are your goals in building a hydroponic system?

What is the best location for a hydroponic system?

What materials can be reused/recycled for building a hydroponic system?

What are the benefits of the design of my hydroponic system for me and my community?

How could you improve hydroponic system design?

What are the necessary components of a hydroponic system?

Cultural Significance

Students can practice spiritual stewardship when growing plants hydroponically. They can ask permission and offer thanks during harvest, for example. Students may be interested in replacing chemical inputs with organic alternatives or finding environmentally friendly ways to operate the system.

Regional Considerations

Materials that are available for building systems could be limited or particular to a region. Energy costs should be taken into consideration because they vary based on need and availability.

Suggested Topics

Learn that ydroponic systems should have nutrient-rich water, a controlled environment, a light source that mimics the output of the sun, a power source for the lights, a reservoir, a growing medium for the plants, plants, and perhaps a pump.

Suggested Activities

View diagrams, and videos, or build/use classroom systems and observe them. Draw and label the necessary components of the systems used in class. Assemble a hydroponic system together.

Cross-curricular Ties

Science, technology, engineering, language arts

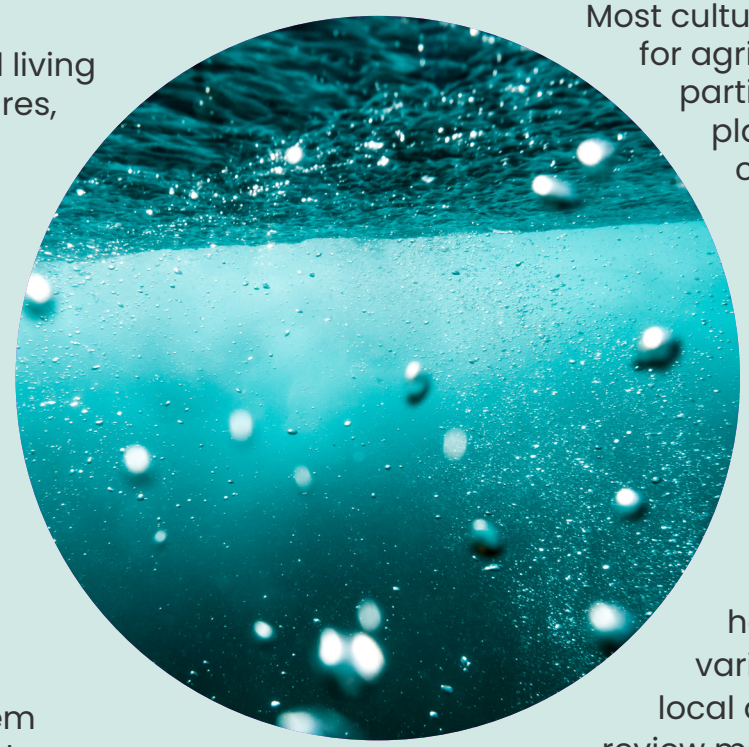
What is the role of water in hydroponics? How do you transfer water in your system? And Why?

Cultural Significance

Our bodies are 70% water and all living things need water. In many cultures, water is considered sacred and/or living.

Regional Considerations

Maintaining clean water and equity in water distribution is an important political issue worldwide. Water use can be restricted in certain areas.



Most cultures have moved water for agricultural purposes as well, particularly those who lived in places with little water. Water use/conservation is an important issue in all forms of agriculture.

Suggested Activities

Identify that hydroponics is growing plants without soil in a nutrient-rich, water solution. Watch videos, read articles, practice making nutrient solutions, and/or construct and maintain systems to understand how the water moves to the various parts. Take a field trip to local areas of moving water and review maps while there to understand water use and patterns of water movement.

Suggested Topics

The water in a hydroponics system delivers needed nutrients to plants. Students can learn about the different nutrients needed by plants and the importance of pH in nutrient uptake. People have used hydroponics for agriculture throughout history including in Mesopotamia and Mexico for example.

Cross-curricular Ties

Science, social studies—natural resources, history, language arts, engineering

What are your goals in building a hydroponic system?

Cultural Significance

When introducing new technologies into community, cultural groups consider how it can serve or will affect the people, maintain harmony between technology and the natural environment, as well as looking to the spirits (rock, water, wind, earth) for design guidance. if building new systems, it is crucial to be careful, considerate, and thoughtful.

Regional Considerations

Zoning, waste treatment, energy policy/cost, and material availability will vary by region. Many hydroponic systems can be built out of recycled materials. These materials will be available in varying capacity based on the region.

Suggested Topics

Learn that there are various plants that can be grown in hydroponic systems and that systems can be designed and built based on the crops' needs that you would like to grow. Identify that factors such as budget, space, materials, and water supply may affect system design.

Suggested Activities

Interview one another to determine what the individual and class goals are for the hydroponic systems. Research the necessary components that make up a hydroponic system and how to assemble them. Allow students hands-on experience by allowing them to design systems, using the engineering process. Research hydroponic farming operations. Visit a nearby hydroponic farm, or invite a guest speaker who works at a hydroponic farm, to present to the class. Interview an engineer about the engineering process.

Cross-curricular Ties

Language arts, math, social studies, science, engineering, art, technology

What is the best location for a hydroponic system?

Suggested Topics
Learn the differences in operating a hydroponic systems outdoors versus indoors. Determine the best place for the system and be able to explain why.

Suggested Activities
Compare the benefits and challenges of placing a hydroponic system indoors vs outdoors. Listen and observe the space. Test out placing systems in various spots and record the data from each trial. Use information sources such as mapping and GIS to conduct a site analysis of the indoor and/or outdoor space. Record the movement of the sun, air temperature, as well as consider how easy or challenging it will be to plant and harvest the crops.

Cross-curricular Ties
Science, geography, engineering, economics, astronomy, physics, chemistry, art

Cultural Significance
Observation and stillness in space are easily overlooked when designing and installing systems. Many cultures will take time to observe the space provided and ask permission from the spirits for guidance on design and placement.

Regional Considerations
School rules, health and safety, water availability, food apartheid, and the interest of the community will affect decisions regarding whether to have a hydroponic system, how it should be built, and where it should be placed.

What materials can be reused/recycled for building a hydroponic system?

Cultural Significance

There is a direct relationship between the cultural and material mindset. To care for the Earth means to reduce waste as much as possible. Learning how to reuse and recycle can have a positive impact on ourselves, our communities, and our environment.

Regional Considerations

Reusing/recycling policies and practices will vary by region. Due to this, material availability will also vary.

Suggested Topics

Learn what kinds of materials can be reused/recycled. Learn how recyclable materials can be reused to build the components of a hydroponic system (i.e. a plastic pop bottle for the reservoir and/or an old shirt for a wick in a wicking system).

Suggested Activities

Identify the components of a hydroponic system and determine what kind of reusable/recyclable materials can be used to replicate them. Draw a diagram showing a hydroponic system made out of reusable/recyclable materials. Collect reusable/recyclable materials and build hydroponic systems.

Cross-curricular Ties

Engineering, science, art, social studies

What are the benefits of the design of my hydroponic system for me and my community?

Cultural Significance

Some cultural groups are open to using new or modern technologies to grow traditional crops. The important nutrients available in traditional crops are still able to feed the community when grown hydroponically. Learning about new ways of farming can bring generations and people of different traditions together.

Regional Considerations

Growing food in hydroponic systems can benefit the individual and community in different ways. Smaller systems may be better suited to a community instead of larger ones; systems that use natural light may work better in some areas than others; or perhaps they use readily available materials that would usually go to waste. Community culture is important to consider when choosing what to grow and how to grow it.

Suggested Topics

Learn how to gather data to discover how the system type and design benefits self and community. Research other communities to find out how hydroponic design and use have affected them.

Suggested Activities

Communicate personal interest in having and maintaining a hydroponic system. Interview community members and discover their interests in having and maintaining a hydroponics system. (Examples: growing certain foods, interacting with other living beings, learning how to grow food, reducing plastic waste, etc.). Survey people who have hydroponics systems on the impact of having a system in their home, school, or community. Iterate your design based on feedback.

Cross-curricular Ties

Social studies, art, language arts, nutrition

How could you improve hydroponic system design?

Cultural Significance

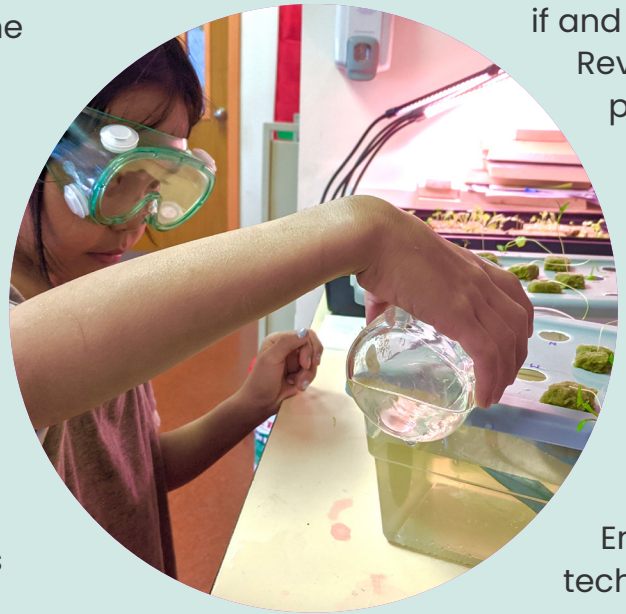
We should consider different, perhaps traditional or regional materials besides plastic to build systems. For example bamboo, beeswax, clay, buffalo bladders, gourds, barley bags, etc. Consider growing your own materials to build your systems; using solar energy to power the pump; having a mobile system that can travel outside. Explore the possibility of creating a hydroponics system in natural water sources such as creeks, aequias, rivers, etc. Can you build a floating garden like the chinampas of the Aztec?

Regional Considerations

The regional climate, available energy costs, water supply, technology (modern and traditional), and other factors could impact design and be useful to consider when assessing it.

Suggested Topics

Learn how to assess and iterate designs through the engineering process. Explore how engineers have used various strategies to improve designs.



Suggested Activities

Compare historic/traditional vs modern approaches to hydroponic system designs. Research the Hanging Gardens of Babylon and the history of moving water. Analyze the lighting, water flow, growing space, timers, and environmental factors that impact the plants growing in the hydroponic system. Determine if and how they could be improved. Review the water monitoring, cleaning, planting, and harvesting schedule and logs. Determine if and how the system or record-keeping could be improved. Explore if there is a better place/space to put the system. Interview classmates or community members for design feedback.

Cross-curricular Ties

Engineering, math, art, science, technology

Teacher Resources

Understanding Hydroponics

- Trees.com - Advantages and Disadvantages of Hydroponics
- Home Hydroponic Farm: Hundreds of Pounds of Produce in 10 Sq Ft!
- Hydroponics for beginners. All you need to know.
- Junk Pile to GARDEN OASIS in 6 Years, Natural Farming Permaculture Gardening
- Britannica Kids - Hydroponics
- San Juan Soil & Water Conservation District
- Indigenous Hydroponics System A Boon For Organic Farming

How Hydroponics Relates to Your Life

- Social & Emotional Well-being: Gardens can Help!
- Three Simple Ideas for Practicing Mindfulness in the Garden with Kids
- Food And Culture
- Planing Calendar: When to Plant Vegetables
- First Nation Growers
- In Mexico City, the Coronavirus Is Bringing Back Aztec-Era 'Floating Gardens'
- How to Grow Fresh Vegetables With Hydroponics All Year Round
- Want to Start Your Own Vertical Farming or Hydroponics Business? 4 Questions You Should Ask
- How To Start A Hydroponics Business

Water

- Crayola - Why Is Water Important?
- Charity : Water
- KidsHealth - Why Drinking Water is the Way to Go
- Harvard University - Biological Roles of Water: Why is water necessary for life?
- Importance of Water in Native American Culture
- Britannica - Water
- Watershed Management Group - River Restoration Vision
- WATERisLIFE
- Water.org
- The World Bank - Water
- CK-12
- The Hidden Messages in Water by Masaru Emoto
- Water is Life Documentary
- Black Mesa Water Coalition

Seeds

- Fantastic Fun and Learning - Seed Activities
- Native Seeds
- Native American Creation Stories
- Sciencing : The Parts of a Seed for Elementary Students
- Britannica Kids - Seed
- A Seed is Sleepy Dianna Hutts Aston
- Seeds of Kokopelli
- Native American Seed Mythology
- The Magic of Seeds and the Wonder of Growth
- ReadWorks - Seeds Need to Move
- Seed Savers
- Gardening Channel
- Fuse School - GMOs
- Real Science - The Truth About GMOs
- Are GMOs Good or Bad?
- Buying Garden Vegetable Seeds Wisely: GMO, Heirloom, Organic, Hybrids Defined
- Scholastic - Plants with Seeds
- The Man Who Planted Trees and Grew Happiness by Jean Giono

Plants

- Measuring Rate of Photosynthesis
- The Hidden Life of Trees: What They Feel, How They Communicate by Peter Wohlleben
- It's True - You Should Really Talk to your Plants
- 13 Easiest Plants that can be Hydroponically Grown
- 25 of the Best Plants for Indoor Hydroponic Gardens
- Britannica Kids - Plant
- Plants of the Southwest

Nutrition

- Pueblo Food Experience Cookbook by Roxanne Swentzell
- Healthy Eating Plate vs USDA's MyPlate
- Nourishing Traditons by Sally Fallon
- Tending the Wild
- Dr. Robin Wall Kimmerer - Honorable Harvest
- Are Hydroponic Vegetables Just as Nutritious as Those Grown in Soil?
- Britannica Kids - Food and Nutrition
- In Defense of Food by Michael Pollan
- Tesuque Farms

Environmental Sustainability

- Growing Spaces
- Organic Materials Review Institute
- LEED Rating System
- How We Got to Now - Development of Chlorine
- Colorado River District
- Land Loss in the Mississippi Delta
- Louisiana's Vanishing Island
- Home Hydroponic Systems
- Permaculture Principles
- Environmental Aspects by Dr. Dilip Ganguly
- 22 Disadvantages and Advantages of Hydroponics (What You Should Know)
- Permaculture by Bill Molison
- USDA Backyard Wetland

Designing Hydroponic Systems

- Gardening Indoors with Soil and Hydroponics by George F. Van Patten
- The Vertical Farm - Dr. Dixon Despommier
- EPCOT's Hydroponic Wonderland: The Wonderful World Of Disney Horticulture
- Navajo Water Project
- TerraCycle
- De Las Chinampas - Ancient Aztec Floating Gardens Restored!
- The Ghost of Machu Picchu - PBS
- Chinampas, The Floating Gardens of Mexico
- Uros Floating Islands: A Must See at Lake Titicaca
- Epic Gardening - Hydroponic Systems
- Gardening Tips - Hydroponic Nutrient Chart
- How to Build a Hydroponic System at Home
- Hydroponics Farming How to Build and Design Hydroponic System at Home
- Hydroponics: A Better Way to Grow Food
- Permaculture as Hope and Agency for Sustainability by Tina Lynn Evans
- The Engineering Process--Crash Course Kids Video