Ancient Agriculture

Key Topics: Agriculture, Irrigation, Climate Change, Flooding, Aqueducts, Dry Farming, Drought
Grade Levels: K, 2 - 8
Inside and Outside

Lesson Overview:

Learn about the differences and commonalities of agriculture across the world and through time since Mesopotamia to modern California, and how humans have faced the challenges of droughts, climate, and limited water supplies by focusing on the history of the Central Valley Project to bring water from the wet north to the dry south. Students will have the option to practice engineering skills to design and build mock drip irrigation systems and/or gain practical understanding of their campus through a tour to observe irrigation systems and contrast their pros and cons.

Activities:

Option 1 - The History and Geography of Irrigation - globe toss to understand the geography of water, review ancient ag. (10 min.)
Option 2 - Building a Mock Drip Irrigation System (30 min.)
Option 3 - Campus Irrigation Tour (30 min.)
Option 4 - Watering Can Engineers (30 min.)

Suggested Activities & Learning Objectives by Grade:

- K: Campus Irrigation Tour, Watering Can Engineers, The History and Geography of Irrigation
  - K-LS-1 What do all plants and animals need to survive?
  - K-ESS2-2 How do people change their environment to survive?
  - K-ESS3-3 How can we save water in agriculture?
- 2: The History and Geography of Irrigation, Watering Can Engineers
  - 2-PS1-3 Where is water found on the earth (as a solid, liquid and gas) and how can we use it?
  - 2-ESS2-3 How can a set of pieces be disassembled and made into a new object?
- 3: Watering Can Engineers
  - 3-5-ETS1-2 How can we recycle materials to create watering cans that are durable, effective and easy to use?
- 4: The History and Geography of Irrigation, Watering Can Engineers
  - 4-ESS2-2 Where is water located on the earth and how do humans transport, store and use it?
  - 4-ESS3-2 How can irrigation help reduce the impacts of a changing climate?
- 5: The History and Geography of Irrigation, Campus Irrigation Tour
  - 5-ESS2-1 Where is water located on the earth?
  - 5-ESS2-2 How do people and natural processes transport, store and use water across the earth?

- ➢ MS: The History and Geography of Irrigation, Building a Mock Drip Irrigation System, Campus Irrigation Tour
    - MS-ESS2-4 How are different types of irrigation systems beneficial in different climates (consider evaporation, rainfall, etc.)?

Essential Question(s) that Connect CCCs and SEPs:

- How could we change the structure of a campus irrigation system to benefit plants in the summertime? (Structure and Function; Planning and Carrying out Investigations)
- How does a particular irrigation method solve or cause a problem? (Systems; Asking Questions and Defining Problems)

Materials:

Option 1 - The History and Geography of Irrigation

- Inflatable globe or a classroom map; Script in 'Engage' part of lesson

Option 2 - Building a Mock Drip Irrigation System

- (6) 10' length of drip tubing
- Box of spaghetti tube cut in 0.5' lengths (have 30 on hand)
- Drip plugs (30 on hand for each student to plug one dripper in)
- Fan sprayer (30 on hand)
- Optional: extra parts to show off but not tinker with like: PVC pipes, auto timer in garden, pressure regulators, solenoids, etc it is good to show them different pieces to the puzzles
- Map of Central Valley to display
- Pencils and paper to create designs for system

Option 3 - Campus Irrigation Tour

- Journals, 3x5 cards or paper for all students (30 count)

Option 4 - Watering Can Engineers

- Enough recycled containers for each student, or one for each of a small group -- use milk cartons, water bottles, or other containers disposed of around campus
- Safety scissors (found in the classroom)
- Tape, twine or glue (should be water resistant, if needed at all)
- Sharp item to punch watering holes--could be pen, paperclip, etc.
- Pencils and paper if students will spend time designing

EG Team Support Needed:

- Make sure you have some mulch on hand (straw and/or woodchips) to spread as another activity to have on hand during or in place of irrigation system assembling (Option 2)

Prep:

All of this can take place outside. A portion of this lesson will take place in the garden--students examine and discuss the existing irrigation systems on their campus and tour not only the garden but other parts of the campus where water is used when it is not raining and where plants exist without water.

Understand where you are going to do the different parts of the lesson. Specifically, Option 1 needs to be an open space, Option 2 needs to have work stations with possibly tables to have students work at

and stand in groups, and Option 3 needs to be a campus tour that you have mapped out showing different landscapes, Option 4 needs materials and a water source as well as plants to water.

Teachers can preview these videos to get the students excited about the upcoming lesson:

- Egyptian Ag. https://www.youtube.com/watch?v=oE2YZZgZWdE
- Floating Gardens https://www.youtube.com/watch?v=_JatsIs73RA
- CA's Water Supply, Drought and Ag. https://www.youtube.com/watch?v=dWzEQxD_zGs
- Hopi Corn https://www.youtube.com/watch?v=maH0sr_Mm2A
- Grapes https://www.youtube.com/watch?v=zooa1QOgvE8
- Hopi Ag. Resiliency https://www.youtube.com/watch?v=28gAFESNGMU
- Aztec Ag. https://www.youtube.com/watch?v=dZnZJ6XlHRg
- Mexico's Floating Farms https://www.youtube.com/watch?v=HJiTRh4EeTs

Activity Procedure:

Engage:

Option 1. The Geography and History of Water

What do you need for farming and growing food? Think-pair-share. Water is vital! Without it, we would not be able to grow any crops. Over time, different civilizations have used different methods to acquire, transport, and apply water to crops.

Activity: Globe Toss

Pass the inflatable globe around a group of students. If no globe is available, have someone point blindly at a classroom map. Remind students we are not playing volleyball with it. The person holding the globe answers your questions.

First person: Do you think the world is made up of mostly water or land? Water! How can you tell? 75% of the world's surface is water. What forms does water take? Ocean water: 97.2 percent Glaciers and other ice: 2.15 percent; Groundwater: 0.61 percent; Fresh water lakes: 0.009 percent; Inland seas: 0.008 percent; Soil Moisture: 0.005 percent; Atmosphere: 0.001 percent; Rivers: 0.0001 percent.

Second person: How much of the water can humans use to consume and use? To go to the bathroom, wash clothes and food, grow food, and drink from?

Third person: Can you find the Middle East? That is one of the first places that we started growing food as humans!

Fourth person: Can you find Africa? It is the largest continent. Can you find Egypt? That is another place where we started growing food as humans!

Ask for the globe back and put it away somewhere not distracting.

Finish story about the peoples around the globe:

In what is now called the Middle East, there is a strip of fertile land that lies between two great rivers. This land was once known as Mesopotamia. The Tigris and Euphrates rivers flowed through the land, forming the shape of a crescent moon. When the rivers flooded in the spring, they brought rich nutrients to the soil. For this reason, the land was also known as the Fertile Crescent. Thousands of years ago, it gave birth to a new civilization. Many things that human beings still do and use were first invented in

Mesopotamia. People farmed there for the first time, invented writing, and used the wheel for transportation.

Ancient people paid attention to the natural processes and cycles of their world. They used clues from the environment to become successful farmers. An example of this was the way they watched the flight of the ibis, a long legged bird that migrated from the mountains to the delta each year. When the ibises flew over their farms, the people knew that the annual floods would soon follow. The first people to arrive in ancient Egypt and Kush moved from central Africa to the Mediterranean Sea along the Nile River. The Egyptians settled in the north, and the Kushites in the south. They built their towns along the banks of the river. The Nile flooded each year, just like the Tigris and Euphrates rivers. The people called it "the black land" because the floods deposited a strip of dark, rich, fertile silt on the banks of the river. The yearly flood was called the "gift of the Nile."

Agriculture developed independently in many regions in the world, but the oldest known agricultural civilization was in Mesopotamia. Tell students Mesopotamia was located between the Tigris and Euphrates rivers. Take it a step further by breaking down the Latin translation: meso = middle; potamia = river-- in other words, between two rivers.

Explore:
Ask students why a civilization would settle by a river [because there's water]. 'And what did they need water for besides drinking?' [Growing food].

Ask students how they think farmers were able to divert water from the river. Tell them there's a word for it that starts with the letter I and they may have heard their parents say it when they're landscaping their yard/gardening [Irrigation].

<u>Option 2. Drip Irrigation Models</u>

Ask students if they've ever heard of irrigation. Ask students to name a couple examples [Hose, drip line, aqueduct]. (If they're unable to think of any examples, prompt them: 'What do you water a garden with?'

Define the term irrigation for them: ways of artificially watering land to grow plants. Ask a student to define/explain the term artificial.

Tell students they'll be building their own irrigation models in class.

Preparation: Before designing and building the system. Divide the class into six groups, ideally with access to tables or space to work on assembling the drip irrigation system. Distribute irrigation parts to the students while defining their names, explaining their purpose and how to assemble them. Discuss Gallons or Liters Per Minute (GPM/LPM) as a flow rate that can be used to calculate water use. Demonstrate proper assembly in front of the class Create an objective to guide the design and building of the model systems: maximize the amount of space covered by water, water x number of plants of

different types and water needs, grow a certain crop or landscape. Consider giving different objectives to different groups, or the same objective to the whole class.

Designing: Allow students 5 to 10 minutes to plan and design on paper, drawing the system before they assemble it. Encourage questions about how parts work or how to assemble them. Review and discuss student designs before they start building--don't force them to have a perfect design, don't judge the designs as right or wrong, but do ask them to justify their reasons for a given design.

Building: Students work in teams for 10 to 15 minutes assembling their systems. Ensure that they compare their assembly to the design, and follow the design they created.

Testing: Once the systems are complete, you can connect them together using couplers and connect the entire series to an outdoor hose. Ask groups to observe how their system functions. Did it operate as expected? What happened that was unexpected? Would it meet the needs of their design objective? What would they change if they had time to rebuild or redesign?

Explain:
We can't just wait for rain to come in order to grow our food. Do you know where one of the biggest gardens is that supplies 350 different crops? The Great Central Valley! (Show a map of California where Central Valley stretches)

In 1900 there were 73,000 farms. By the time the big Central Valley Project was built, creating lots of levees and dams around 1935, around 150,000 farms existed! 55% of our food grown from California is grown in this 430 mile stretch of fertile farmland. The southern tip of the valley did not always have enough water for its crops. The north had a lot of flooding problems. Once levees and dams were installed, farming boomed! Then, some other problems arose. Drought came and some levees and dams broke causing flooding once more. Today, the Central Valley Project is one of the world's largest water control and delivery systems. Twenty dams and lakes are connected by five hundred miles of canals that deliver water from the northern part of the state to the southern part of the Central Valley. Eighty percent of this water is used for agriculture. With the new water system, farmland in the Central Valley tripled. Before the dams and canals of the CVP were completed, one million acres in the Central Valley were farmed. Afterwards, three million acres were used to grow crops and raise animals!

Elaborate:

What are ways we transport, use and store water? [Capturing and storing it, mulching and lessening evaporation rates, sprinklers, wells, water treatment plants, etc.]

<u>Option 3. Campus Irrigation Tour</u>

Tour the campus looking at irrigation methods (sprinkler, drip, dry farming). Set up a template of how students should track the pros and cons of each method before departing.

Tour 2-4 different areas of campus. Students observe and write in their journals pros and cons (e.g. sprinklers use a lot of water, but they are able to water a wide area evenly, drip uses a small amount of water to a specific location, but can only water a small area) of each method of irrigation. Choose areas

such as: school garden/food crops, lawns, landscaping, trees and drought tolerant plants that use no irrigation, etc.

Option 4. Watering Can Engineers

Humans have changed their environment to make life possible and comfortable. Irrigation is one way we change our environment. From canals, to piping systems, to sprinklers and drip irrigation, engineers create methods of moving water to where it is needed.

Preparation: We'll become engineers as we transform waste into watering cans. Begin by giving students an objective--they need to design and build a watering can to transport and apply water from the hose or sink to a given number of plants or a garden area. Other specifications can be given, such as: watering cans should carry a set volume of water (to track water use--students can calibrate their devices with measuring cups and make marks to show how much water is in the can), water must drain out at a fixed rate, there must be control over when the watering can is watering and when it is storing (i.e., so a hole in the bottom of a milk carton would not be acceptable since the carton would leak all the time). Pick 2 or 3 constraints, or make up additional ones, or let the students make them up.

Design: Once students have their constraints, provide a list of supplies and examples of each item. Before building begins, students should either create a design on paper, or spend time talking in their group and thinking about how they will use the given materials to meet the design objectives. Allow 5 minutes or so to designing. Before providing materials to each group, have them justify their design, either presenting to the class, or individually to the educator. Don't tell them whether it will work or not, just ask questions and make sure they have a reason for what they want to do. Allowing them to experiment and make mistakes is okay!

Building: Provide materials to each student or to small groups. Allow a fixed amount of time to build before testing.

Testing: Allow students to fill their watering cans and water. Ask whether the constraints were met. What could they do to improve the watering can? If there is time, allow for another design-build iteration.

Evaluation:

When building models, use the success or failures of the model as an assessment--how would the model be improved, or why did it or didn't it work?
Facilitate a class wrap up discussion or individual writing assignment using a prompt:
How could climate change affect the availability of water and the methods of irrigation used?
How would you improve your drip irrigation model or watering can?
What kinds of irrigation are used in my town and surrounding agriculture, and why?
If my family has irrigation systems for gardens, farms, landscapes, or lawns, what kind and why?
What are some ways that you learned how to conserve water?
How could our school campus improve our irrigation systems?

Also, refer back to the Learning Objectives for your grade level and ensure that they have been met by asking the given learning objective question.

Extension Activities:

- Look for John Lahargou - local watermelon dry farmer - at Farmers Markets
- Mulching with different types of mulch

Tips and Caveats:

Adaptations for K/1

- ❑ It will be very challenging for your youngest grade levels to comprehend the parts and assemble irrigation systems.
- ❑ Have pre-assembled irrigation parts (for example, the spray fan hooked to a drip tube versus a drip tube and emitter) and pass them around. Talk about which one you might use for which. The students can explore and relay to each other where they would want to use each. (for example, drought tolerant plants or fruit trees get drip emitters, radish seed bed gets spray fan)
- ❑ Focus on mulching with the little ones! It's important to note to them why the beds will get straw and when versus why the paths get wood chips. Create a task for everyone by having piles, gloves and/or buckets ready for every student to grab handfuls/bucketfuls and place in area needing mulching.

Cited Curriculum:

- EEI's 6th Grade Unit on Agricultural Advances in Ancient Civilizations
- Survey of Irrigation techniques, 2010