



Water, Water Everywhere (At Home)

Middle School / High School

Introduction

Kansas has a diverse climate from the east to west ends of the state. In many parts of the state, corn farms are rain-fed, known as dryland or non-irrigated farms. These farmers normally receive enough rainfall to raise a crop. As you move toward the western part of the state, the climate is more arid and more farmers supplement their crops with irrigation, with the water sources coming mainly from underground aquifers. Farmers also can irrigate their crops from surface water sources, such as rivers and ponds. Many areas of the high plains region of western Kansas benefit from the Ogallala Aquifer, which supplies a water source for irrigation. Yet, the aquifer is a limited resource, and farmers are working hard to extend its life by finding ways to use less water to produce their crops. When considering the irrigation needs of commercial crops, farmers must consider several variables. Is there groundwater or surface water available to irrigate the crops? Are the costs associated with irrigating justified economically? What is the best way to ensure that the water reaches the plant roots for the most benefit with the least amount of waste? Wind, evaporation, and runoff are all working against the farmer's goal of getting the water into the soil and, ultimately, into the roots of the plant itself. With multiple types of systems available to help meet the demands of water delivery, it is critical to understand some basics of irrigation. In this lesson, students will construct and evaluate some of the multitude of irrigation possibilities based on the amount of water that reaches deep enough in the soil to be taken up by the plant.

Learning Objectives

- Understand the importance of conservation of natural resources for the continued growth of crops.
- Understand the water cycle and the ways water moves in different forms.
- Understand how much water is needed for a corn plant to produce adequate yield.

Materials

- Kansas Corn: Water, Water Everywhere PowerPoint (available at kansascornstem.com)
- How Much Water Do We Usually Get Per Year? Worksheets
- Irrigation Worksheet
- Computer access
- Gardena.com Website: <https://my-garden.gardena.com/int>
- Paper
- Pencil
- 3 different colored writing utensils

Activity 1: Water Cycle

1. Draw the water cycle on a blank sheet of paper in one color.
 - a. Feel free to use the following website, Precipitation Education provided by NASA, to check your work:
<https://gpm.nasa.gov/education/videos/water-cycle-animation>

2. In another color of writing utensil, label the forms water can take during the cycle (liquid, vapor (or gas), and solid).
 - a. The website from step one can help you if you are stuck.
3. In a third color of writing utensil, describe how water moves from place to place in the water cycle. Use the following to help:
 - a. Draw arrows to show water movement.
 - b. Label the arrows with the names of the processes causing the water to move (evaporation from a lake, percolation from rainwater soaking into the soil, etc.)
4. Focusing on the plants in our cycle, answer the following questions:
 - a. Which processes are directly involved with water movement and plants?
 - b. Would the plant survive if that process did not take place?
 - c. How can we control that process to ensure the plant is getting enough water?

Activity 2: Completing a Practice Calculation

1. Most corn needs 20-25 inches of water during the vegetative stage which is the emergence to maturity stages of the growing season. This will help to produce over 250 bushels of corn per acre of land. How much water is that?
 - a. Here is the conversion you will need: 1 in. of rain per acre is about 27,154 gallons. How many gallons of water would be needed total?
 - The average high school competition pool in Kansas holds about 162,000 gallons of water. So, the amount of water we would need would fill up 3.68 or about 3 $\frac{3}{4}$ pools.
2. Suppose that at harvest time, your data shows that you have an average of 200 bushels per acre of corn. How many gallons of water were used to produce one bushel?
 - a. Take your total gallons of water from 1i, and divide by 200 bushels (round your answer to the nearest whole number). This is the amount of water in gallons, it would take per bushel of corn.

Activity 3: How Much Water Does Mother Nature Provide?

1. Print How Much Water Do We Usually Get Per Year? worksheets. Then select a particular geographic area to focus on for your precipitation data. Use the following website from Kansas State University to select your area: <http://climate.k-state.edu/precip/county/>.
2. While you collect your research and fill in the chart and graph, consider the following questions:
 - a. What are some of the issues I might face getting water to my crops?
 - a. How can I make sure the water gets to the crops themselves instead of ditches or other waterways?
 - a. How can the processes from the water cycle as discussed in the first activity be altered by normal climate changes?
 - You can find more climate data at the link below which includes wind speed data, relative humidity data and various other climate and soil data points.
 - Use website provided by Kansas State University <http://mesonet.k-state.edu/weather/historical/>

Activity 4: How Do I Get Water to My Crops?

1. Take time to review the two resources below while considering the pros and cons of each type of irrigation addressed.
 - a. Past and Present: <https://water.usgs.gov/edu/wuir.html> Irrigation Water Use (Water ScienceSchool) provided by USGS.
 - b. Short video: Irrigation for Agriculture provided by History Channel - <https://www.youtube.com/watch?v=24LJSjqpYuY>
 - Please note that this video is from 2009 and technology has improved since then.
2. Complete the Irrigation Worksheet.

Activity 5: Sprinkler Plan

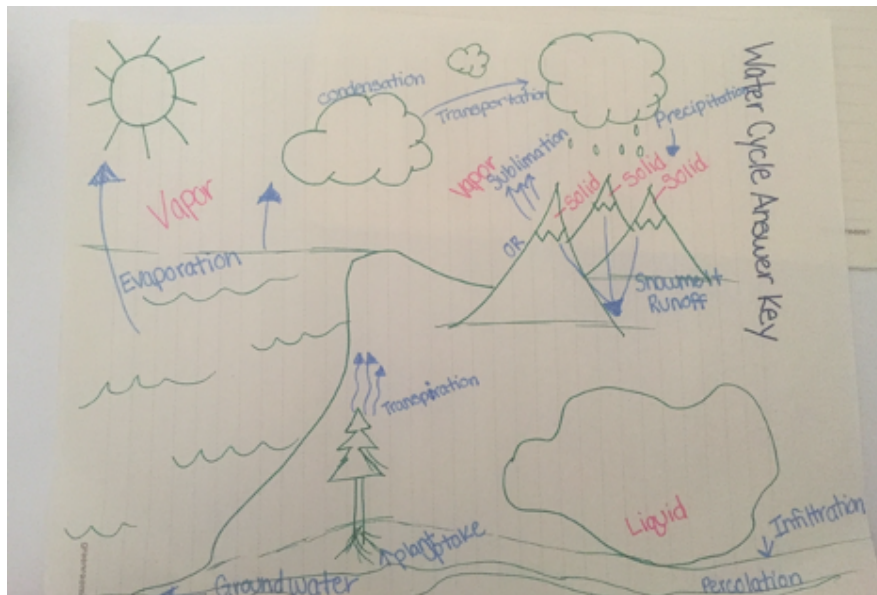
1. Visit, <https://my-garden.gardena.com/int>
2. Scroll down and choose “create a new sprinkler plan.”
3. Use the vertical toolbar on the left-hand side to plot your land. You can add pond, houses, and more.
4. When you have finished creating your land plot, scroll all the way to the bottom of the toolbar to “Sprinkler Plan”. You will be given the chance to have the sprinklers set automatically. Just X out of this option.
5. You will notice in the toolbar, you now have five different options relating to your irrigation system including: positioning sprinklers, placing water connection, lay pipeline, water control, and planning a sketch with a shopping list.
6. Build your ideal irrigation system. Feel free to print or save it if you choose.



Answer Keys

Activity 1

Potential Water Cycle Drawing



1. Which processes are directly involved with water movement and plants?
 - Infiltration, Percolation, and Groundwater Flow
2. Would the plant survive if that process did not take place?
 - The plant and immediate area surrounding the plant would have to have direct contact with precipitation from rain or be directly in the path of snowmelt or surface runoff.
3. How can we control that process to ensure the plant is getting enough water?
 - Student answers will vary.

Activity 2

1. Most corn needs 20-25 inches of water during the vegetative stage which is the emergence to maturity stages of the growing season. This will help to produce over 250 bushels of corn per acre of land. How much water is that?
 - Formula: 1 in. of rain per acre is about 27,154 gallons
 - Between 543,808-678,850 gallons
2. The average high school competition pool in Kansas holds about 162,000 gallons of water. So, the amount of water we would need would fill up 3.68 or about $3\frac{3}{4}$ pools.
 - $162,000 \times 3.68 = 596,160$ gallons
3. Suppose that at harvest time, your data shows that you have an average of 200 bushels per acre of your corn. How many gallons of water were used to produce one bushel?
 - Take your total gallons of water from 1i, and divide by 200 bushels (round your answer to the nearest whole number). This is the amount of water in gallons, it would take per bushel of corn.
 - $596,160/200 = 2,980.8$ gallons

How Much Water Do We Usually Get Per Year?

Visit: <http://climate.k-state.edu/precip/county/>

1. Select a county to complete your study: _____

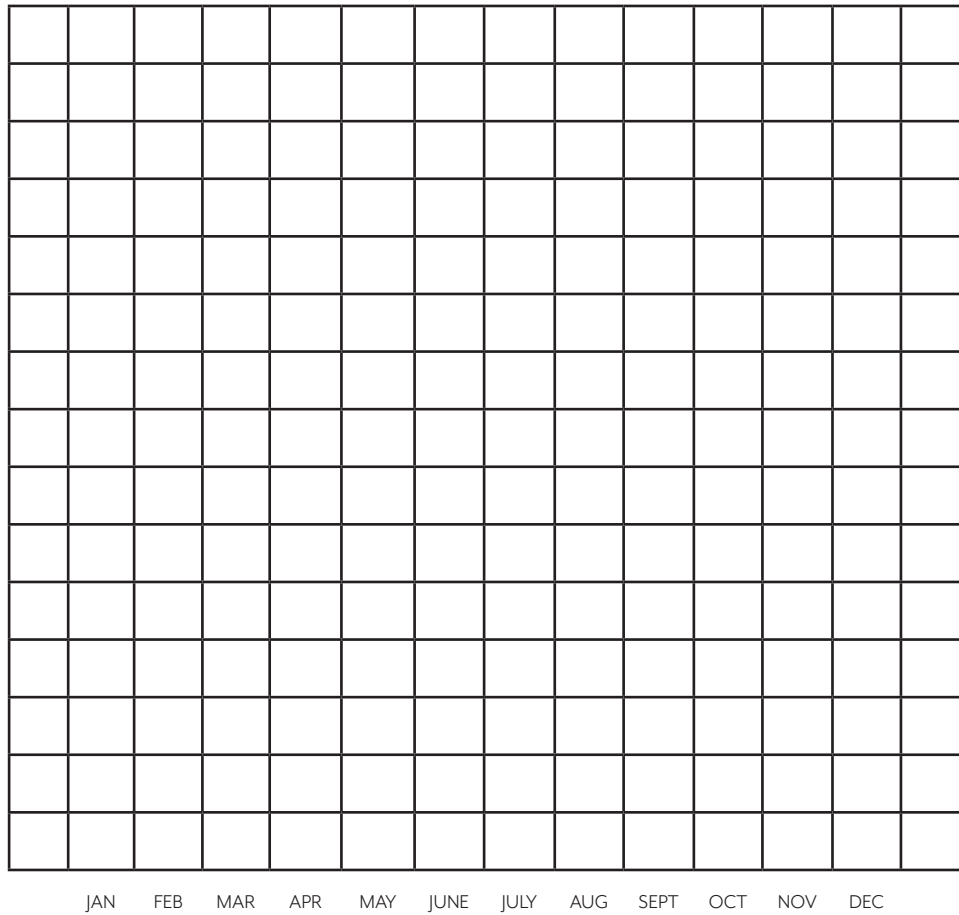
How much rain did that county get in the last 5 years?

Year	In. of Rain.
2017	
2016	
2015	
2014	
2013	
Average: (total in. of rain / 5)	

2. When did the rain come? Precipitation that we receive as snow in December helps but doesn't have as much direct impact as rain during the growing season.

	2017	2016	2015	2014	2013	Monthly
Average						
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						
Yearly Average						

3. Graph your data. Create a graph showing your average monthly precipitation over the year, January to December.



4. The planting season for corn is from May through September. Add up the total amount of average precipitation you would get in those months. It will take approximately 22 in. Do you have enough?

Irrigation Worksheet

What other factors are at play? Brainstorm potential factors that can affect water in your area.
Hint: Think about what might affect water moving through the water cycle.

Type of Irrigation: <https://water.usgs.gov/edu/wuir.html>

Use the resources on the site above to help you determine the pros and cons of each type of irrigation.

Flood Irrigation		Drip Irrigation		Spray Irrigation	
Pro	Con	Pro	Con	Pro	Con