ANSWER KEY

Climate Change and

Farmland Soil Quality

As the climate changes, the frequency and intensity of extreme precipitation is likely to increase. While crops need adequate precipitation throughout their growing cycle, extreme precipitation can erode soil and degrade soil quality.

To determine soil quality, agriculture producers test the pH of soil and the level of nutrients such as nitrogen, phosphorous, and potash. These nutrients are necessary for crop health and production.

In this activity, you will examine the soil quality in an area of an imaginary farm before and after an extreme precipitation event has resulted in erosion of the topsoil.

PREDICTION

I predict that the:

- pH of the topsoil will be **HIGHER / LOWER** than th…ver layer.
- Nitrogen of the topsoil will be **HIGHER** …han the lower layer.
- Phosphorous of the topso… **…HER / LOWER** than the lower layer.
- Potash of the topsoil will b… **HIGHER / LOWER** than the lower layer.

student answers will vary

MATERIALS

- 4 tubes and caps
- 4 soil-testing capsules
- Tube rack
- 3 squeeze-bulb pipettes
- Paper towels
- Beaker of water
- Beaker of soil
- Soil solution
- Soil color chart
- Spoon

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SOIL TESTING

1. Follow the instructions provided by your instructor to test your soil.
   a. Place a paper towel under your test tube while conducting the test.
2. Wait the specified time for the soil test to develop.

COMPARING SOIL ON AGRICULTURAL LANDS WITH SOILWEB

In this activity, you will investigate soil characteristics of agricultural land in three areas and at your location. These soil characteristics can help predict how agricultural producers in these areas may be affected by extreme precipitation events. Use a computer or tablet with internet access and follow the instructions below.

a. Go to the California Soil Resource Lab SoilWeb Apps: casoilresource.lawr.ucdavis.edu/soilweb-apps/
b. Click on the "SoilWeb" link.
c. If a pop-up message appears, Click "OK"
d. Click in the upper left corner on "Menu."
e. On the dropdown menu, click Zoom to Location.
f. In the "Enter a location" box, enter the latitude and longitude for the first location in the Soil Variables table on your worksheet and press Enter.
g. Locate the location pin in the soil area lines (in yellow) immediately surrounding it. Click within that area. There will be a pop up that appears in the left corner.
h. In that pop-up, find percent slopes in black letters at the top. Record its slope in the Soil Variables table on your worksheet.
i. Click on the "Map Unit Composition" section in blue for a dropdown to appear. Select the soil composition name with the highest percentage next to it. A soil profile will pop up.
j. Click on the "Org. Matter" (organic matter) button.
k. Below the graph, click on "View Source Data" link. A new tab with data will pop up.
l. Find "Organic Matter (%)" and "pH (1:1 H20)" on the data table and record the numbers at the 0 "Depth Range (cm)" in the Soil Variables table on your worksheet.
m. Return to the SoilWeb tab in your browser. Click on "Hydraulic and Erosion Ratings" section in blue and find "Runoff." Record it in the Soil Variables table on your worksheet.
n. In the left-hand corner, click the "Close" button until you get back to the "Menu" button. Repeat steps d-m for the next location until you have completed the first three columns of the Soil Variables table on your worksheet.
o. For "My Location," enter your school address instead of longitude and latitude. Zoom out or in if needed to help you to see the soil area lines (in yellow). Click within that area.
p. If it doesn't have a % slope you can skip this section.

SOIL VARIABLES				
LATITUDE, LONGITUDE	**21.5236, -158.0436**	**34.3823, -103.3695**	**36.4554, -120.1225**	**MY LOCATION**
CITY, STATE	Wahiawa, Hawaii	Clovis, New Mexico	Five Points, California	
% SLOPE	*8-15%*	*1-3%*	*0-1%*	
ORGANIC MATTER AT 0CM	*3.5%*	*2.5%*	*1.3%*	
PH BY WATER EXTRACTION AT 0CM	*5.6*	*8.2*	*8.2*	
RUNOFF	*Medium*	*Low*	*High*	

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SOILWEB CONCLUSIONS

1. Organic matter comes from the tissues of plants, animals, or microorganisms that are currently or were once living. In the soil, organic matter can be a source of nutrients for crops. In general, areas with higher organic matter tend to have soils with higher levels of nutrients.

   Which location or locations likely have the highest nutrient levels for crops? How do you know?

   Wahiawa, HI (This answer assumes that your local site is not higher.)

2. Which location or locations have the highest potential for runoff, which could result in the erosion of soil by water?

   Five Points, CA (This answer assumes that your local site is not higher.)

3. Would the soil in your location likely have favorable nutrient content and pH for crop growth? Why or why not?

   Student answers will vary depending on local soil organic matter and pH values.

4. How could an agricultural producer use SoilWeb to help in the decision to purchase a piece of land as a potential crop field?

   The producer could examine the organic matter content, pH, and runoff values to determine whether the land likely has high soil quality and low runoff potential. This could save her or him some initial investment funds if the land was in need of little or no fertilizing or groundwork, for example.

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Return to Soil Testing
1. Examine the tubes and compare to the corresponding charts to determine pH and nutrient levels.
2. Complete your group's data table and the whole class data tables.

DATA & ANALYSIS

Your Group's Data Table

GROUP NUMBER _____				
SOIL LOCATION (topsoil or lower layer)	**PH** (number)	**NITROGEN** (high, medium, low, or very low)	**PHOSPHOROUS** (high, medium, low, or very low)	**POTASH** (high, medium, low, or very low)

student answers will vary

CLASS DATA TABLES

pH: record the pH level of each group as a number.

TOPSOIL		LOWER LAYER	
GROUP NUMBER	**PH**	**GROUP NUMBER**	**PH**
MEAN		**MEAN**	

student answers will vary

student answers will vary

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NUTRIENTS: record nutrient levels of each group as **high, medium, low, or very low**.

TOPSOIL				LOWER LAYER			
GROUP	NITROGEN	PHOSPHOROUS	POTASH	GROUP	NITROGEN	PHOSPHOROUS	POTASH
MOST COMMON LEVEL				MOST COMMON LEVEL			

student answers will vary

student answers will vary

RESULTS

1. pH was higher in the:

student answers will vary

A. TOPSOIL **B. LOWER LAYER** **C. NEITHER (SAME)**

2. Nitrogen tended to be higher in the:

A. TOPSOIL **B. LOWER LAYER** **C. NEITHER (SAME)**

3. Phosphorus tended to be higher in the:

These will usually be the case.

A. TOPSOIL **B. LOWER LAYER** **C. NEITHER (SAME)**

4. Potash tended to be higher in the:

A. TOPSOIL **B. LOWER LAYER** **C. NEITHER (SAME)**

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SOIL TESTING CONCLUSIONS

1. How do you think the affected area of our imaginary farm changed physically? In other words, what changes in the way the area looked would we have seen before and after the extreme precipitation event?

   We would have likely seen evidence of soil erosion and topsoil removal. This could involve formation of channels, removal of crop plants, a change in soil color, and/or a change in soil texture.

2. Think about the nutrient levels in the lower layer of soil in the affected area of our imaginary farm after the extreme precipitation event. How were the resources, especially the nutrients, available for the crops affected by the precipitation event?

   If the nutrient-rich topsoil is eroded, we will have fewer nutrients available for crops.

3. How would the crops in the affected area of our imaginary farm be impacted by the changes in nutrients after the extreme precipitation event?

   With lower nutrient levels, crop plants would not be able to efficiently conduct the necessary processes for life functions, such as photosynthesis, production of energy molecules, production of genetic material, etc.

4. How will the increasing frequency of extreme precipitation events affect agricultural producers? List any effects that you can imagine producers will experience as a result of extreme precipitation events.

   - *Flooding*
   - *Soil erosion*
   - *Reduction in soil quality/nutrient levels*
   - *Damage to crops*

5. Using your knowledge of climate change, list at least two other ways that our changing climate will impact agricultural producers.

   Reduced productivity because of higher temperatures, drought, and extreme events

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