READY-MADE RESOURCES

Smart Farming: Using Data to See Variability

name: _____

date: _____

class: _____

Welcome, teachers, to your guide for successful student completion of the Smart Farming Student-Led Assignment, an activity designed to help students see the use of soil data in making farming decisions. Your students will want to save a copy of this assignment to a cloud storage platform, flash drive or computer. They will follow your directions for submission of their assignment.

Before students begin this activity, they will need a computer with internet access and a writing utensil. Students will complete the assignment by graphing box and whisker plots and answering the following questions.

How is pH related to nutrient uptake?

Precision agriculture describes a set of technologies that allow farmers to be more efficient in their farming practices. It includes, but is not limited to:

- soil testing across ½ acre to 2½ acre grid squares on the field
- auto steering on tractors to allow for optimum use of field area
- planters that can plant different varieties of a crop in different parts of the field, depending on productivity of the soil
- sprayers that can adjust fertilizer and pesticide levels to areas that need targeted
- harvesters that collect yield data that can be mapped in relation to a particular area in the field
- and more

Soil tests show the pH, and nutrient amounts in a field. Soil chemistry determines the amount of root growth, the amount of nutrients that can be held in the soil and the ability of plants to take in and use those nutrients. But why is pH important and what are the consequences of different levels of pH?

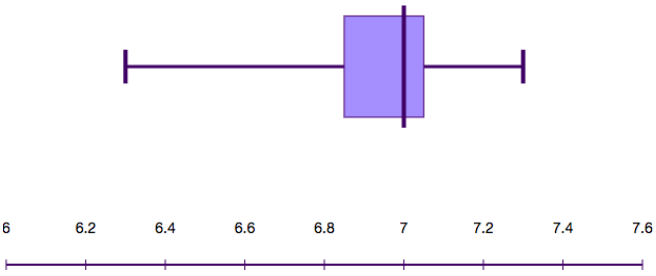
The measurement of pH is measured on a scale of 1–14, where the lower numbers represent acids (have more hydrogen ions H+) and the higher numbers represent bases (have more hydroxide ions OH–). A measure of 7 is neutral. The scale is logarithmic, meaning that the difference between a pH of 5 is 10 times more acidic than a measure of 6, a measure of 9 is 10 times more basic than a measure of 8.

Most plants need a pH between 6.5 and 7.5 to grow and thrive, or yield seed. In Ohio, the top seeds that are grown by farmers are soybeans, corn and wheat. If a field has a wide variability of pH, a farmer may have to apply a product to adjust pH. This product most commonly applied is lime (crushed limestone) that helps to adjust the pH to more basic or higher pH.

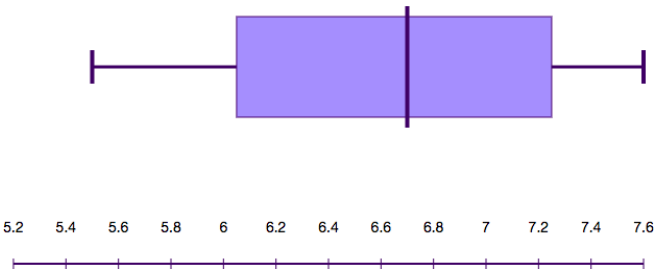
Activity 1: Graph the pH data

In box and whisker plots, graph the pH data to the right from the four farm fields below to determine the differences between the fields. Box and whisker plots can give an idea about the amount of variability in a data set. These plots use the **median** and **quartiles** along with the maximum and minimum values in a data set to show the spread of the amounts.

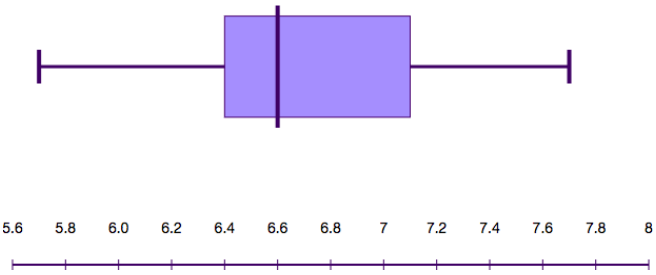
Field 6



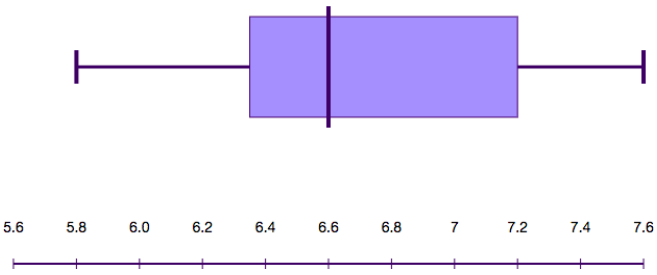
Field 8a



Field 11



Field 12b



Activity 2: Analyze the data in the graphs

Compare the plots and answer the questions below.

1. Which of these fields has the greatest variability in pH?

   Field 8A: total difference from low to high pH = 1.2

2. Which of these fields has the most consistent pH across the data points?

   Field 6: 12 data points at 7pH

3. Rank the predicted yield from each field if pH is not adjusted (Use the pH for Ohio crops to make your ranking)?

Field 11:	Field 8A:	Field 12B:	Field 6:
4th	***3rd***	***2nd***	***1st***
9 data points	***13 data points***	***15 data points***	***24 data points***
with ideal pH	***with ideal pH***	***with ideal pH***	***with ideal pH***

Activity 3: Compare the graphs to soil maps

Compare these graphs to the map of each field.
Which of these representations, the soil map or the box and whisker plot, show the variability better? Justify your answer.

Answers will vary.

Soil maps show color variation to indicate pH levels. A map of colors does not always give a true picture of the amount of variation without closely looking at the key. The key shows groupings of .4 pH levels. Folks who are colorblind will see little variation. However, the soil map shows that there are differences across the field and that the pH levels will not necessarily be grouped together. The box and whisker plot shows the variation and the grouping of the ranges in a different way.

Both methods are visual representations.