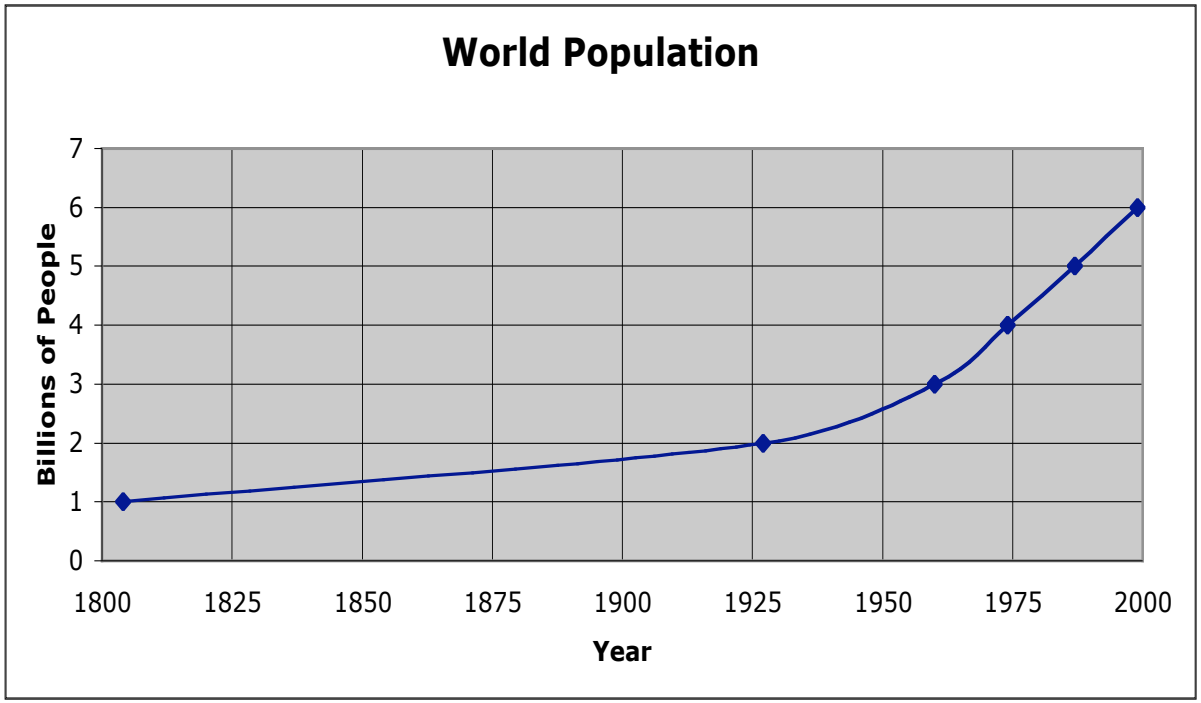


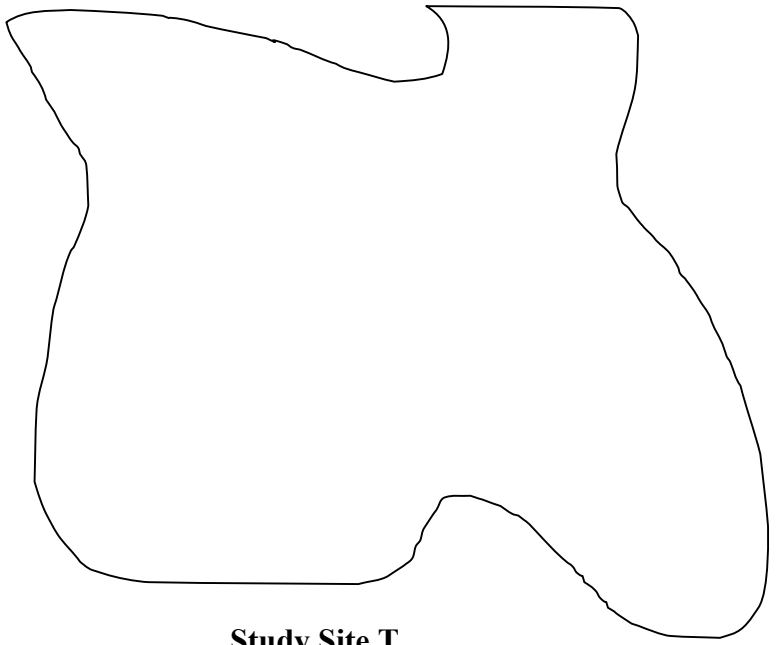
Growing world population and inadequate food supply have become concerns in recent years. In an effort to increase the food supply, scientists and farmers have proposed cultivating land areas that are currently covered with native grasses. A variety of factors must be studied to determine the soil best suited to growing crops as well as what type of crops to plant.

In this activity, you will examine some of the complex variables t interact to influence the selection of cropland and the appropriate crop

EARTH SYSTEMS INVESTIGATION AREA – MAKING CONNECTIONS
GLOBE SAMPLE STUDENT ASSESSMENT TOOL – HIGH SCHOOL (2)

1) **(Plan Investigations: Specify measurement/variables to investigate) & (Interpret GLOBE Data: Explain data & relationships)** Identify two quantitative observations about a study site that will give information about the growing season at that site. Describe how each of these factors influence seed germination or affect the growth of food crops. For example: How long is the growing season? Even if the soil is full of nutrients and there is adequate precipitation, if the maximum and minimum air temperatures create a short growing season, the crops will not mature.

2) **(Take GLOBE Measurements: Use quality assurance procedures)** A map of Study Site T is shown below. Identify how you would collect samples from 8 locations (A – H) within Study Site T. Explain why you created your sampling grid in this way.



Study Site T

Table 1 shows soil measurements taken from Study Site T.
Soil salinity is a measure of how much dissolved solids are present in a sample. It is measured using a conductivity meter which records how much electric current will pass through the sample. It is measured in units called mmho's (milli mho's).
Soil pH is a measure of the acidity/alkalinity of the soil. pH values range from 1 – 14. A pH of 7 is neutral. pH < 6.5 is acidic, while pH > 7.5 is alkaline.
The precipitation during the growing season has been measured for the past three years at Study Site T.

3) **(Interpret GLOBE Data: Create multiple formats to represent data)** Calculate the average precipitation during these three years. Add this value as another column in Table 1. Be sure to label the column and include the units used to measure precipitation.

Table 1: pH, salinity and annual precipitation for Study Site T

Soil Sample	Salinity	pH	Growing season precipitation for past three years			*ave. ppt.*
A	6mmho	5.0	10cm	10cm	13cm	
B	10mmho	4.5	9cm	9cm	11cm	
C	9mmho	5.5	19cm	20cm	21cm	
D	9mmho	5.5	18cm	20cm	19cm	
E	4mmho	5.5	24cm	24cm	24cm	
F	5mmho	4.5	9cm	9cm	12cm	
G	6mmho	5.5	21cm	24cm	25cm	
H	9mmho	5.5	18cm	19cm	20cm	

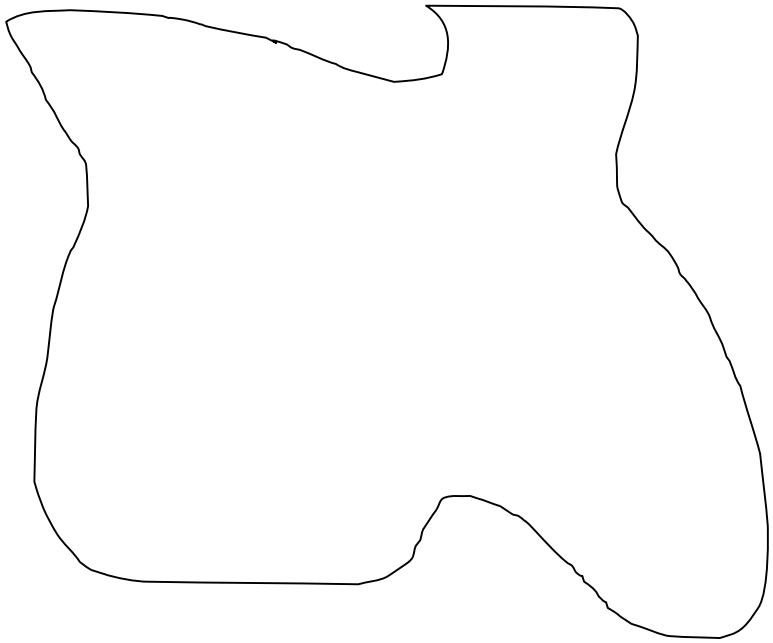
Table 2 shows the pH, salinity and minimum moisture needed for several food crops that grow in the general area of Study Site T.

Table 2: pH and salinity tolerance

Plants	pH*	salinity*	Minimum moisture needed to produce a crop yield
Crop W	6.0	12	16.8 cm
Crop X	5.5	9	17.3 cm
Crop Y	5.5	6	23.4 cm
Crop Z	4.5	9	8.9 cm

* these values indicate the lower limit of pH and the upper limit of salinity at which plants grow and produce without damage to crop yields

4) **(Interpret GLOBE Data: Explain data & relationships)** Use the information in Table 2 to identify where it might be possible to grow a Crop X in Study Site T. Describe the evidence that supports your conclusions in the table on the following page.



Possible Growing Areas for Crop X within Study Site T

Site	*Crop Growth*	*Evidence*
A	*crop Z*	*pH too for other crops; other factors support growth of Z*
B		
C		
D		
E		
F		
G		
H		

The amount of water that is used by a crop is equal to the amount of precipitation the area receives plus the amount of water in the soil. This amount of moisture is referred to as evapotranspiration or ET.

ET consists of two parts, evaporation and transpiration. Evaporation is the amount of water that evaporates from wet soil and plant surfaces after a rain. Transpiration is the amount of water that moves through the soil, into the roots, up the stem and moves out the leaves to the air. The water that is involved in transpiration is part of the photosynthesis process.

5) **(Interpret GLOBE Data: Create multiple formats to represent data)** In the space below draw and label a diagram that shows the interactions between radiant energy, the water cycle of the atmosphere and the carbon-oxygen cycle of photosynthesis.

6) **(Interpret GLOBE Data: Create multiple formats to represent data)** Write a description of how energy is used in these cycles. Include a description of the photosynthesis process in plants (chemical reactants, products, energy input and energy storage). Include a description of the energy release and energy uptake during the different stages of the water cycle.

Table 3 shows the average subsurface moisture levels available to plants during variable conditions of drought.

Table 3: Available subsurface moisture in Study Site T.

Description of Year	Available subsurface moisture
Year with average annual rainfall	10.2 cm
Year with below average annual rainfall (dry season = average – 30%)	9.0 cm
Year with above average annual rainfall (wet season = average + 30%)	11.0 cm

7) **(Interpret GLOBE Data: Create multiple formats to represent data)** Combine the data from Tables 1 and 3 to calculate the EvapoTranspiration levels for a wheat crop planted in your recommended areas. Include additional rows in the Table 4 as needed.

(ET = seasonal precipitation + soil moisture available to plant)

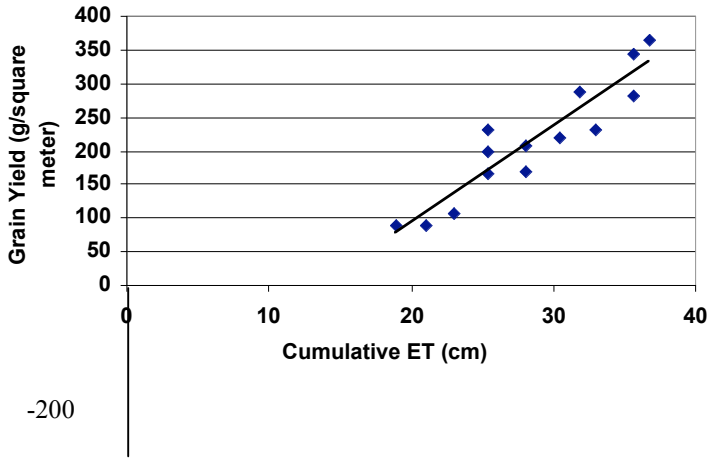
Table 4: EvapoTranspiration levels for proposed wheat-growing areas of Study Site T.

Recommended region for growing Crop X	ET during season of average rainfall		
C	20cm + 10.2cm = **30.2cm**		
D			
E			
G			
H			

8) **(Interpret GLOBE Data: Explain data & relationships)** Describe a procedure to calculate the average EvapoTranspiration for the entire region that you proposed as an area for growing Crop X. Explain why this is the best method to calculate the ET for the region.

Figure 1 shows a graph of the relationship between Cumulative EvapoTranspiration and grain yield for Crop X.

Figure 1: Production of Crop B as a Function of Water Use



Crop scientists use information like this to develop mathematical models. Using a model derived from the experiment shown above, they can predict a crop yield based on the amount of water available during the growing season.

The equation that describes the graph takes the classic form (y = mx + b) where:

y = crop yield (g/m^2)
m = slope of the line
x = cumulative EvapoTranspiration
b = where the line intercepts the y axis.

Crop scientists and farmers can use this data to estimate the yield for a crop when soil nutrients are not limiting and weed / insect pests are controlled.

9) **(Take GLOBE Measurements: Measurements are accurate and appropriate)** Calculate the slope of the line shown in Figure 1.

10) **(Take GLOBE Measurements: Measurements are accurate and appropriate)** Extrapolate the line in Figure 1 to determine the y-intercept.

11) **(Take GLOBE Measurements: Measurements are accurate and appropriate)** Write a mathematical model for predicting the yield of Crop X using cumulative ET as the variable.

12) **(Take GLOBE Measurements: Measurements are accurate and appropriate)** Calculate the predicted yield of Crop X in Study Site T. Include calculations for:
    an average moisture year
    a predicted dry year
    a predicted wet year

Use the space below to show all your calculations.

13) **(Communicate: Create reports to explain or persuade)** Write a 2 - 3 page summary report to the farmers who work the land of Study Site T. Describe your recommendations for land use and the predicted range of Crop X. Explain how you made your decisions, why you made these recommendations, how you calculated the predicted yields, as well as any limitations or special considerations of your study and conclusions.