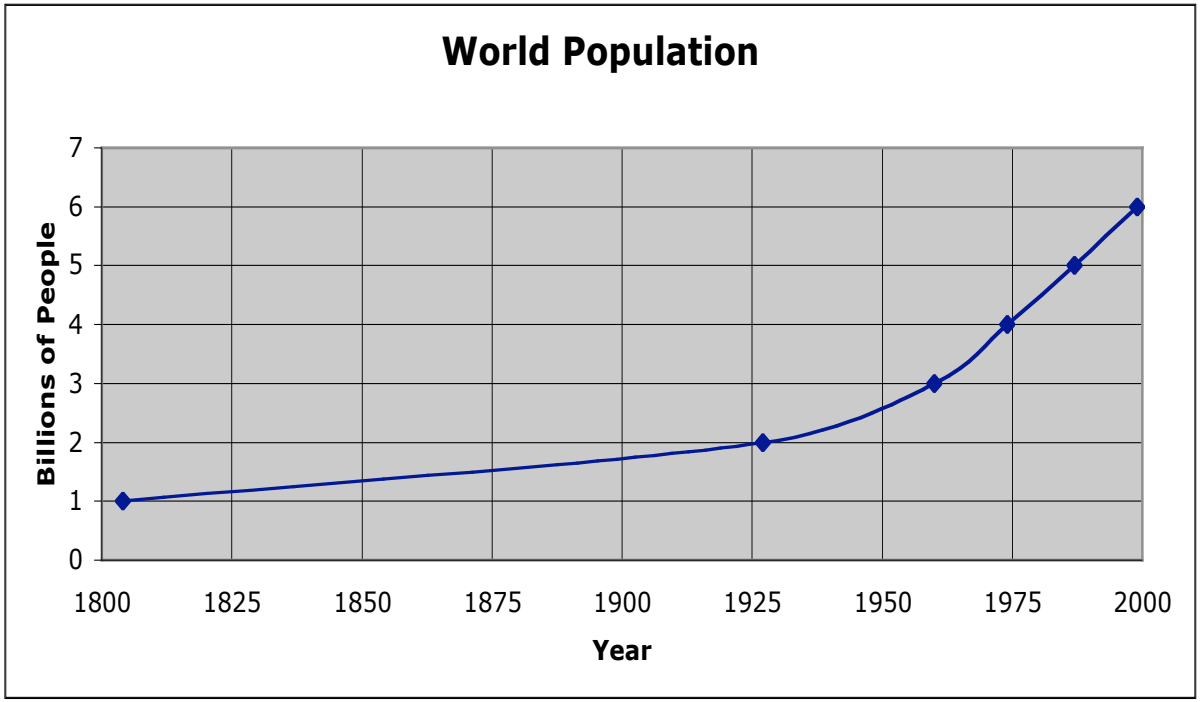
EARTH SYSTEMS INVESTIGATION AREA – MAKING CONNECTIONS
GLOBE SAMPLE STUDENT ASSESSMENT TOOL – MIDDLE SCHOOL (2)



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

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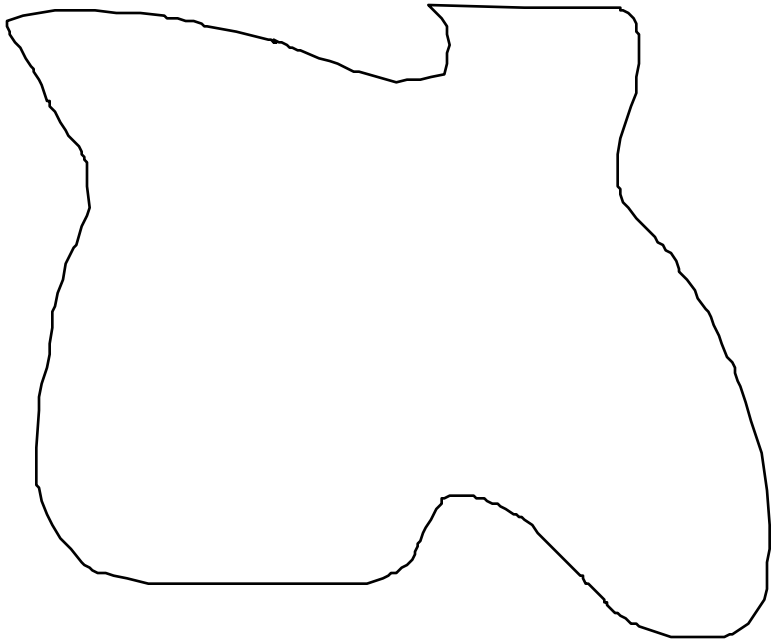
(Taking GLOBE Measurements: Use quality assurance procedures)

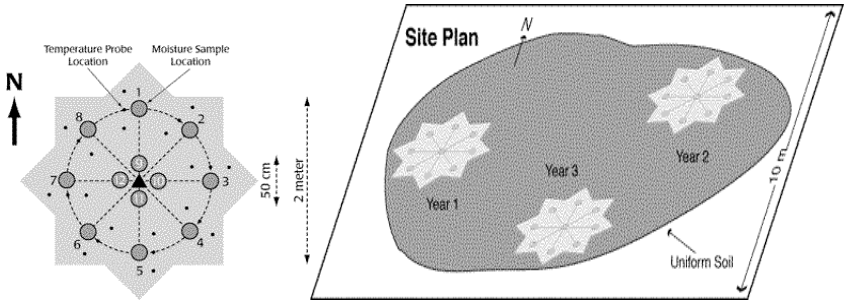
1) A map of Study Site T is shown below. Identify how you would collect samples from 8 locations (A – H) within Study Site T. Explain why you created your sampling grid in this way.



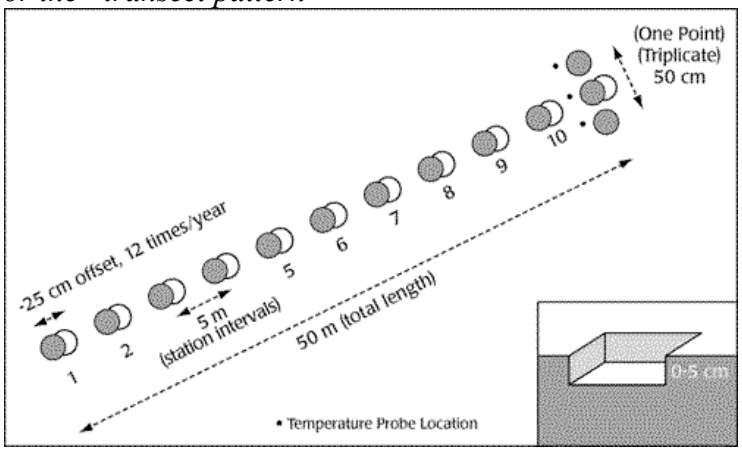
Study Site T

Answers will vary.

Some students may attempt to replicate the two patterns for collecting GLOBE soil data, i.e. "the star pattern"



or the "transect pattern"



Alternatively, the student may create a pattern that is a combination of these collection patterns OR create a new pattern. Whatever data collection pattern is used, the sites should be spread throughout Study Site T so that all areas are represented.

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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.

(Interpret GLOBE Data : Create multiple formats to represent data)

2) 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 the precipitation.

Table 1: pH, salinity and annual precipitation for

Soil Sample	Growing season precipitation for past three years			*ave. ppt.*
A	13cm	14cm	15cm	*14cm*
B	17cm	19cm	18cm	*18cm*
C	15cm	15cm	18cm	*16cm*
D	18cm	20cm	19cm	*19cm*
E	11cm	13cm	15cm	*13cm*
F	14cm	16cm	15cm	*15cm*
G	18cm	19cm	20cm	*19cm*
H	9cm	9cm	11cm	*9.67cm*

Table 2 shows the minimum moisture needed for a crop that grows in the general area of Study Site T.

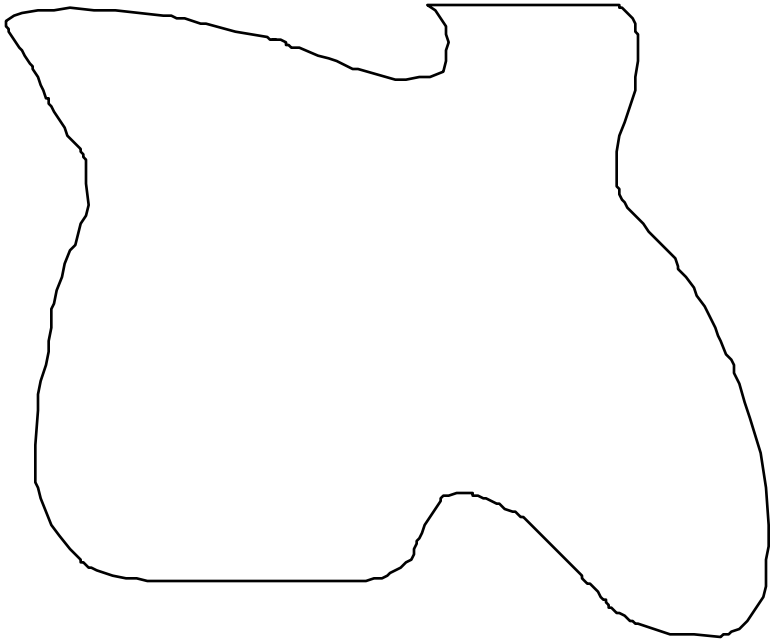
Table 2: pH and salinity tolerance

Plants	Minimum moisture produce a crop yield
Crop X	17.3 cm
Native Grasses	produces under variable moisture conditions

* 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

(Interpret GLOBE Data: Explain data & relationships)

3) Use the information in Table 1 and Table 2 to divide Study Site T into two areas – the area that should be left as native grasses and the area that is suited to growing crops. Explain how you decided to divide the land into these areas. Describe the evidence that supports your conclusions.



Study Site T

Student responses will vary depending on how they divided the data collection sites within Study Site T. Although the patterns may look different, the sites that are suitable for growing crops are: Soil samples A, C, E, F and H come from areas that have received too little precipitation in the past three years to support the growth and development of Crop X. These areas are best left as native grass growing areas.

Soil samples B, D and G come from areas that have received sufficient amounts of precipitation in the past three years to support the growth and development of Crop X.

After planting crops in some areas of Study Site T, the plan is to fence off the grass-growing regions. Animals will be allowed to graze in these areas after the native grasses have grown to the appropriate stage.

(Interpret GLOBE Data: Create multiple formats to represent data)

4) In the space below draw and label a diagram that shows how air, water, and living organisms interact in the two regions of Study Site T – the cropland and the grazing land.

Answers will vary but should include drawings and labels that identify various aspects of: the water cycle (evaporation, transpiration, rainfall) ; the carbon-oxygen cycle (photosynthesis, cellular respiration); and the nitrogen cycle (decomposition & decay).

Farmers can tell the maturity of a crop in two ways. One method involves simply looking at the plants. Figure 1 shows a drawing of a generalized grass plant at a stage when grazing can begin. This is a stage 3.5 plant.

This can be a very time consuming process when the cropland covers large areas. This process is even more difficult when the grazing site consists of several varieties of native grasses.

An alternative method used to determine crop maturity involves a calculation of "growing degree days" (gdd). This calculation is based on the fact that all plants use the radiant energy from the sun to combine carbon dioxide (CO_2) and water (H_2O) during photosynthesis. The amount of energy intake is specific for each plant type. Crop scientists use air temperature as a measure of the radiant energy available to plants.

This is how growing degree days (gdd's) are calculated:

$$\frac{\text{(temp max – temp min)}}{2} \text{ - temperature base = gdd}$$

The temperature base is the minimum temperature at which the plants can grow. Cool-season grasses have a base temperature of 0°C. Warm-season grasses have a base temperature of 11°C. Gdd's are added for each day starting when the plant emerges from the ground and begins to elongate. When the cumulative gdd reaches the appropriate number, the grass has grown to a specified developmental stage.

Table 3 shows the growing degree days required for some native grasses typically found growing in Study Site T. Grazing readiness occurs at stage 3.5.

Table 3: gdd for Native Grasses

Native Grass Variety	Developmental Stage				
	1	2	3	3.5	4
Green Needlegrass	346	691	1037	1209	1382
Needleandthread	290	580	859	1014	1159
Prairie Junegrass	216	432	548	756	864
Western Wheatgrass	297	603	954	1170	1386
Blue Grama	423	711	1062	1298	1530

(Interpret GLOBE Data: Explain data & relationships)

5) Which grass develops the fastest?

Prairie Junegrass develops the fastest because it requires the least number of gdd to reach stage 4.

Which develops the slowest?

Blue grama develops the slowest because it requires the highest number of gdd to reach stage 4.

(Interpret GLOBE Data: Explain data & relationships)

6) What is the disadvantage of beginning grazing a piece of land too early? What happens to the plant species that are less developed?

The disadvantage of grazing the land too early is that the plants are less mature. That means that there will be fewer plants that can reach the stage of producing seeds. This will decrease the growth in future years. Also, during the early stages before grazing readiness, the plant is using photosynthesis to make food for storage. Some of this will be stored in plant parts that are underground and these storage supplies will help plant growth.

(Take GLOBE Measurements: Measurements are accurate & appropriate)

7) Describe a procedure to pick the best time (gdd) to begin grazing an area that contains the five species of native grasses shown in Table 3. Explain how you reached this decision.

One way is to find the average gdd for these five plant species. If you do this, the average gdd is 1089. This means that two species will be grazing ready, one will be ready in a few days and the other two are still developing.

Another way is to look at the grazing area and find out which of the plant species is the dominant species. If one species is the majority of the grass in the area, then you can wait until the gdd is right for this plant.

Figures 2 and 3 shows the maximum and minimum temperatures for a portion of Study Site T's growing season from last year.

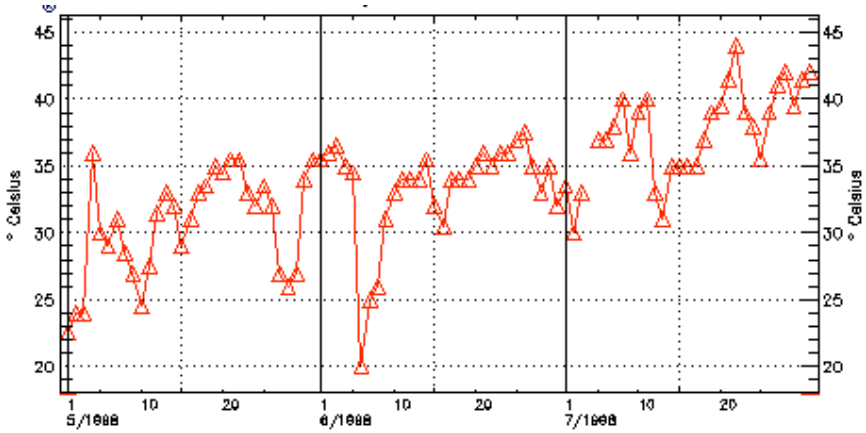


Figure 2: Maximum Air Temperatures for Study Site T

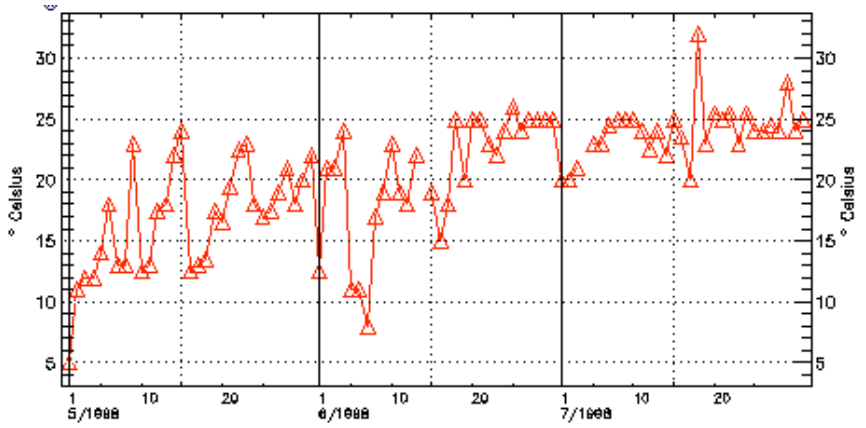


Figure 3: Minimum Air Temperatures for Study Site T

(Interpret GLOBE Data: Explain data & relationships)

8) After studying the equation for calculating gdd and looking at the maximum and minimum graphs on the previous page, describe a procedure for predicting which week has the lowest gdd and which week has the highest gdd *without* completing all the calculations.

You can predict which week has the lowest gdd and which has the highest gdd without doing all the calculations. You do this by looking for the week that has the lowest maximum temperature and the highest maximum temperature.

(Take GLOBE Measurements: Measurements are accurate & appropriate)

9) Table 4 shows you how to calculate a three day cumulative gdd. Choose a seven day period and complete the gdd calculations for this period. Show all calculations in Table 4 below.

Table 4: Cumulative gdd for native grasses in Study Site T

date	(temp max + temp min) ÷2	– temp base (-11)	cumulative gdd = add numbers in column 3 after each column 3 calculation)
5-4	(36 + 12) ÷2 = 24	(24 – 11) = 13	13 gdd
5-5	(30 + 14) ÷2 = 22	(22 - 11) = 11	13 + 11 = 24gdd
5-6	(29 + 17) ÷2 = 23	(23 – 11) = 12	24 + 12 = 36gdd
Calculations should follow the pattern shown in the examples above. They may cover any 7 day period.			

(Communicate: Create a report to explain or persuade)

10) Write a 1 - 2 page summary report to the farmers who work the land of Study Site T. Describe your recommendations for land use and describe how grazing will affect the land where the native grasses are growing. Explain how you made your decisions, why you made these recommendations, how you can predict the best time for grazing, as well as any limitations of your study and conclusions. (Communicate : Compose formal and informal reports)

Answer will vary, however student responses should include the items specified in the prompt:

- *recommendation for land use (item 3)*
- *summary of how grazing affects the land (item 4)*
- *how to predict grazing time*
- *limitations to the study (i.e. does precipitation continue to follow the 3-year pattern; are soil samples taken from Study Site in an appropriate pattern)*