

## CB 13 Investigating a Macro Ecosystem

Have you ever examined an ecosystem and wondered how it is made up? For example, what determines which organisms are present? What is the relationship between the organisms and their physical environment? What defines the boundaries of an ecosystem? Ecological systems may be named for their major physical, biological, or functional features. For example, biologists often refer to forest ecosystems, soil ecosystems, or pond ecosystems. They also talk about urban or agricultural ecosystems. Surveys are a quick way to observe and study ecological systems. In this inquiry, you will survey an ecosystem to find answers to the above four questions. You will also utilize current technology to help you do your study.

### Materials

- Plastic gloves
- Tongs
- Small plastic bags
- Field notebooks
- A well-defined area with vegetation, at least 5 x 10 meters in size, such as a typical backyard, a small portion of a park, or a small natural area.
- Casio fx2 or other calculator: (data calculations)
- The Internet
- Casio QV2800 or other Digital Camera: (visual images of environment and organisms)
- Garmin GPS III or other recent hand-held GPS device (to waymark location of study)
- Magnifying glasses
- Sketching materials
- Classification resources
- Plant presses/ insect collection materials

### Procedure

1. Identify a small but well-defined area to study (approximately 10 meters square). This is your macro ecosystem of study.
2. Conduct a survey of the area to identify its most visible features. Describe its location.
3. Using the GPS find and record its latitude and longitude to the nearest thousandth of a minute. Also using the GPS, find and record the altitude in meters above sea level.
4. Classify the ecosystem by its dominant features, such as plants, animals, and physical characteristics of the terrain.
5. Give a descriptive name to this area, perhaps based on the dominant life forms or physical activities of the area (such as forest ecosystem, urban ecosystem, agroecosystem, school ecosystem, etc.).
6. Measure and calculate the actual area of your macro ecosystem in m<sup>2</sup>. Since this is probably a small subset of a larger ecosystem, estimate also the size of the larger ecosystem of which it is a part.
7. Capture a digital image of the dominant living components, or communities, of your macro ecosystem.
8. Identify the dominant living components, or communities, of the macro ecosystem. If you cannot immediately identify the name of an organism, give it a descriptive name and write enough information in your *Log* for later identification.
9. If possible, collect representative features of the living components of the community and preserve the specimens (for example leaf, plants, and insects).

Interpretations

1. Construct a food web for your macro ecosystem. Describe it briefly in a narrative.
2. Describe what it would take for this macro ecosystem to maintain a stable state.
3. Review the information on typical biomes in Major World Biomes section of this lab on page 5 and identify the biome in which your study area resides.
4. Biomes are essentially determined by two physical factors: precipitation and temperature. What is the characteristic rainfall and temperature pattern in your biome? For example, does it rain all year around, or only during a portion of the year? Is there much rain at all? Does the temperature fluctuate greatly during the year, or are the seasons very mild and therefore not very distinct?

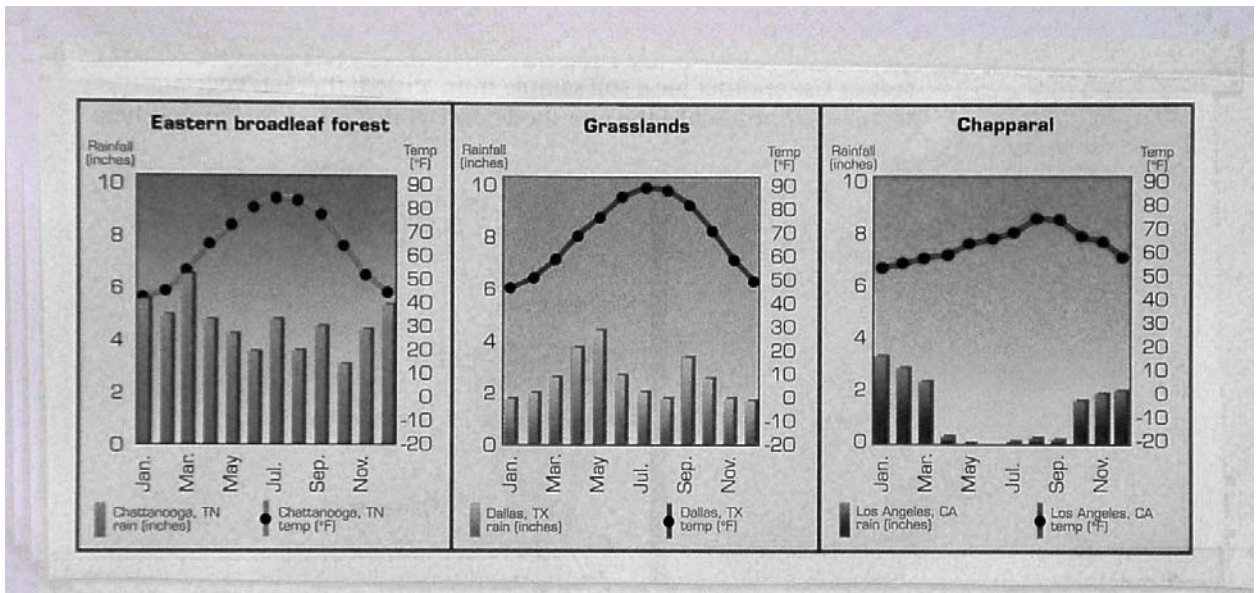
Applications

1. Biomes can also be characterized by graphs of temperature and precipitation called climatograms. Below are images of several climatograms typical of different biomes. Which is closest to your biome? Explain why.
2. In which biome would you like to live? Why?
3. Which biome(s) do you think contain the greatest numbers of humans? Why?

Report

Craft either an electronic report (word processing and digital images) or prepare a PowerPoint presentation that contains (1) your actual procedures and responses to procedural questions, (2) Your data (calculations and digital images) (3) Responses to the Inferences and Applications questions, (4) Any thoughtful inferences or comments you may have about this investigation.

Sample Climatograms. More climate data can be found at [www.ncdc.noaa.gov](http://www.ncdc.noaa.gov) or [www.weather.com](http://www.weather.com)



## Casio FX2.0 Calculator Procedures for CB 13

### *Graphs of Your Biome*

If you have access to the internet, you can find the average temperatures and rainfall amounts for your area. There are several sites which supply this information, one of which is [www.weather.com](http://www.weather.com). Enter the zip code of the area and click on the Average and Records tab. The table below is a part of the information taken from this site for Clemson, SC.

	Jan. 1	Feb. 2	Mar. 3	Apr. 4	May 5	Jun. 6	Jul. 7	Aug. 8	Sep. 9	Oct. 10	Nov. 11	Dec. 12
Mean Temp.	40°F	43°F	51°F	59°F	67°F	74°F	78°F	77°F	71°F	60°F	52°F	43°F
Accum. Rainfall	5.2"	4.9"	6.0"	4.2"	4.3"	4.2"	4.6"	4.4"	3.7"	4.1"	4.1"	4.8"

To enter this information into the FX 2.0:

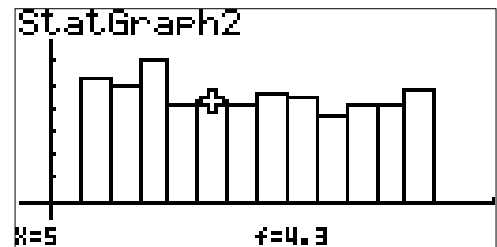
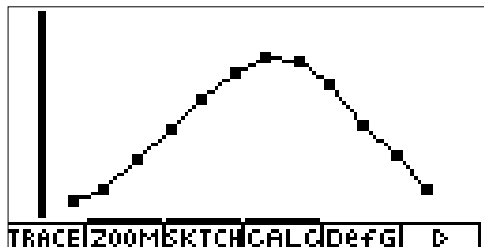
- ☞ Press the grey [MENU] key and choose [2] for STAT. If the first three lists are not clear, highlight any item in a list, press [F4] for DEL-A (delete all), then [EXE] for Yes.
- ☞ In List 1, enter 1 through 12 for the 12 months. Remember to press [EXE] after each entry.
- ☞ In List 2 enter the mean temperatures and in List 3 enter the accumulated rainfalls.
- ☞ Press the green [CTRL] key followed by [F3] for SET UP. Be sure that Stat Wind is set to Auto. If it isn't, press [F1] so the window will set automatically. Press [ESC] to return to the lists.
- ☞ Press [F1] for graph, then the [5] for Set.

We will set up two different graphs, but this can be done from the same screen. We will use a broken line graph in StatGraph1 for the temperatures and a histogram in StatGraph2 for the accumulated rainfalls.

- ☞ Press [F1] for GPH1 and then use the down arrow on the disk to cursor down.
- ☞ Press [F2] for XY which is the broken line graph and then cursor down.
- ☞ Press [F1] for LIST and [1] [EXE] for List 1 in the XList, then cursor down.
- ☞ Press [F1] for LIST and [2] [EXE] for List 2 in the YList, then cursor down.
- ☞ Press [F1] for 1 in the Frequency list, then cursor down.
- ☞ Choose the mark type you want for the points by pressing [F1], [F2], or [F3].
- ☞ Cursor back to the top line and press [F2] for GPH2, then cursor down.
- ☞ Press [F6] for more options (if necessary) until you see Hist at the bottom of the screen. Press [F1] for Hist and cursor down.
- ☞ Press [F1] for LIST and [1] [EXE] for List 1 in the XList, then cursor down.
- ☞ Press [F2] for LIST and [3] [EXE] for List 3 in the Frequency list. Press [ESC] to return to the List screen.

Now we will view the two graphs. Since they are different kinds of graphs, with different scales they cannot be viewed at the same time on the Casio FX2.0.

- ☞ To view the broken line graph of the temperatures, press [F1] for GRPH, then [1] for S-Gph1.
- ☞ To view the histogram graph of the accumulated rainfall, press [ESC] to return to the main List screen. Then press [F1] for GRPH, then [2] for S-Gph2.
- ☞ A window will pop up on the screen. Start should be set at 1. Cursor down to pitch and also enter [1], then press [EXE]. Then press [EXE] again. See graphs below.



Compare these climatograms to the ones shown on page 2 of this lesson. Which biome type is Clemson in terms of mean temperature? In terms of accumulated rainfall?

#### *Finding the Area of Your Ecosystem*

Students should be encouraged to do this calculation without technology.

Encourage students to attempt to survey off a rectangular or triangular area so that a known formula can be applied. If the area of the region is not rectangular or triangular, suggest that students block the region off into smaller rectangular and triangular shapes, find the individual areas and add them for the total area of the region. For the rectangle, students will multiply (*length*)(*width*). For a triangular area, students will multiply  $(0.5)(\text{length})(\text{width})$ .

## Major World Biomes

### *Tundra*

This area is characterized by permanently frozen soil, found primarily in the northernmost parts of North America, Europe, and Asia bordering the Arctic Ocean and surrounding the North Pole. The tundra may receive less rainfall than a desert, and its temperatures are usually below freezing. Winter lasts nine months; the growing season, only two. Vegetation includes mosses, lichens, grasses, and shrubs. Some animals—foxes, polar bears, and hares—live here year-round; others—caribou and moose—are migratory.

### *Taiga*

Taiga is found exclusively in the northern hemisphere, often in mountainous regions. The taiga has cold winters and mild summers. Precipitation is low, but the taiga is warmer and wetter than the tundra, causing the soil to be swampy in early summer. The taiga is dominated by dense coniferous forests that block sunlight; its other vegetation is limited to mosses, lichens, and shrubs. This biome is home to many animals, including squirrels, beavers, mice, hares, moose, foxes, wolves, birds, and bear.

### *Temperate Deciduous Forest*

Deciduous forest biomes are found mainly in North America, Europe, and Asia. Although these regions vary, they all have four distinct seasons, during which temperatures range from cold (~30o C) to hot (~35O C), and abundant precipitation, averaging 100 centimeters yearly. The climate is humid, and the soil is deep and rich, making decomposition rates high. Abundant vegetation includes many species of deciduous trees, shrubs, mosses, and ferns. Animals include mice, squirrels, birds, and deer.

### *Tropical Rain Forest*

The tropical rain forest biome exists on and around the equator in Africa, Asia, and the Americas. The warm temperature changes very little throughout the year, and rainfall is frequent—usually daily—and plentiful, averaging 200 centimeters yearly. The rain forest has a greater variety of plants than all the other biomes combined, containing more than half of the world’s animal and plant species. Vegetation is layered and includes tall trees that emerge above the topmost layer of the rain forest, called the canopy. Below the canopy are layers of shorter trees that can survive in shade. Because of low light intensity there are few plants on the floor of the rain forest. The animals in the rain forest are also vertically stratified and include jaguars, snakes, monkeys, and many species of birds and insects. Because rain forest soil is not fertile, cutting trees to clear land for agricultural use is not useful in the long-term, as nutrients are quickly exhausted.

### *Grassland*

Grassland biomes can be found in the interiors of most continents. Some, like those in the United States, have hot summers and cold winters; while those in tropical areas, called savannas, experience little temperature change. Grassland biomes may receive 25 to 75 centimeters of rain per year but are prone to drought. Low levels of rainfall limit vegetation to grasses of different kinds, which support a variety of plant-eating animals, varying by region but including kangaroos, elk, prairie dogs, and quail.

### *Desert*

Desert biomes are found in North America, South America, Asia, Africa, and Australia. Any areas that receive less than 25 centimeters of rain yearly are classified as deserts, but their characteristics may vary. Plants that in these dry environments have special features that enable them to absorb water. For example, some have long root systems; while others, such as cacti, store water in thick stems. Desert animals include ants, birds, rodents, and reptiles. Tropical deserts, nearer the equator, have little temperature variation during the year; midlatitude deserts have true winters and summers.

### *Chaparral*

Chaparral biomes exist in coastal regions where the climate is moderated by ocean currents. California, Chile, Portugal, and Italy are sites of classic chaparrals. These areas are subject to natural fires, which help to maintain the ecosystem. The dense, spiny shrubs of a chaparral biome have adapted to the long, hot summers and mild winters. Animal life includes deer, birds, rodents, lizards, and snakes. Chaparrals are very popular vacation spots for humans because of their mild, relatively dry climate.