Teaching Activity: Climatograms

Introduction: Large ecosystems can be described in terms of their climate, or long term weather patterns. The climate of an ecosystem, results from the interaction of several abiotic factors: radiant energy, temperature, wind, precipitation, humidity and evaporation. It is difficult to map a climate as a whole, because climatic factors overlap and interact with one another in complex ways. The overlap of the abiotic factors makes it difficult to measure climates. To simplify this task, scientists frequently use *climatograms.* Climatograms are graphs that summarize only two of the factors: monthly measurements of temperature and precipitation. Of course, other factors also affect climate, but a climatogram gives a rough idea of the climate in a particular area.

In each major kind of climate, a characteristic type of vegetation develops and maintains itself. For example, warm, arid climates -with little rainfall -are associated with desert vegetation. Semiarid climates usually support grasslands. Moist climates support forests. Each kind of plant in turn, supports a characteristic variety of animal life. The resulting ecological community of plants and animals is called a *biome.*

Objective:

- To create climatograms of ten identified regions of the globe;
- To focus attention on the relationship between climatic factors and biota;

Materials: Graph paper, (4-10 sheets per student) all the same type and size, maps of the major Earth biomes; classroom-size charts or overhead transparencies of the climatograms included with packet, paper/pencil, colored pencils, ruler;

Important Terms: Climatograms, precipitation, temperature, climatic factors, biome, Fahrenheit/Celsius scales, abiotic, biotic, humidity;

Procedure:

1. Prepare either classroom-size climatograms or overhead transparencies of the climatograms included in the packet and use these for class discussion.
    - Draw attention to the relation of climatic factors to the biota of the area. For example, in the climatogram for tundra, the graph indicates that the average monthly temperatures are above freezing for only 3 months of the year. During most of the year, the average monthly temperatures are far below freezing and precipitation is quite low. From these facts, it can be concluded that photosynthesis can only occur during a fraction of the year. However, the implications of the data need to be explored:
        - The amplitude of the yearly cycle of monthly average temperatures implies a high latitude.
        - A high latitude assures a long daily period of sunlight during the season when temperatures are high.
        - The low temperatures imply a low rate of evaporation.

- Conditions for plant growth are not as unfavorable as they seem at first glance.

- Point out to students that a climatogram does not summarize precipitation and temperature for an entire biome. Data has been chosen from stations that are typical for each type of biome.

2. After discussing the climatograms from the packet with the class, assign the graphing phase of the investigation.
   - Each student should prepare his/her own climatograms of Group I.
   - Assign students to draw at least half of the climatograms from Group II.

3. Point out to students that variables such as wind, cloud cover and humidity are not included in the data.
   - Temperature data are means that are derived from daily means; precipitation means are derived from monthly means over a period of years.
   - The number of years of observations varies from station to station.
   - The range of the means of these variables is of particular importance to organisms, as are the extremes.

4. When students have completed graphing the data for the climatograms they were assigned, they should answer the questions in the **Discussion** section for each graph they created.

Notes: Following are the stations from which the data in Group II was compiled:

a. Washington, D.C.- (Mid-latitudes deciduous forest)
b. Lisbon, Portugal - (Chaparral)
c. Iquitos, Peru - (Tropical rain forest)
d. Yuma, Arizona - (Mid-latitude desert)
e. Odessa, Russia - (Mid-latitude grassland)
f. Valpariaiso, Chile - (Chaparral)
g. Upernavik, Greenland - (Tundra)
10. San Antonio, Texas - (Mid-latitude grassland)
11. Bahia Blanca, Argentina - (Mid-latitude grassland)
12. Oaxaca, Mexico - (Tropical deciduous forest)
13. Moose Factory, Ontario, Canada - (Coniferous forest)
14. Fallon, Nevada - (Mid-latitude desert)

Student Activity Sheet: Climatograms

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Procedure:

1. Construct climatograms of the 4 regional data sets in Group I.
    - Label the Y-axis on the left side of the graph: Cm;
    - Label the Y-axis on the right side of the graph: *C;
    - Use a line graph to indicate the Temperatures;
        - Mark off each Cm box beginning with -0- at the bottom and continuing to -36- at the top;
    - Use a bar graph for the Precipitation;
        - Mark off each *C box beginning with -36 at the bottom and continuing to 36 at the top;
    - Choose a different colored pencil for each graph.

2. From the data in Group II, draw the climatograms assigned by your teacher.
    - Follow the same procedure for construction as you did in #1 above.

3. Complete the questions in the **Discussion** section.

Student Activity Sheet: Discussion Questions

1. What are the factors which determine the climate of an ecosystem?

_____

_____

2. What does the term *abiotic* mean?_____

_____

3.Why is mapping the climate of an entire area difficult to do? _____

_____

_____

4. What is a climatogram? _____

_____

5. What eventually happens within each major climate region?

_____

_____

_____

6. Using your climatograms and a map of the major Earth biomes, identify which of the climatograms that you drew would be classified as :

a. Mid-latitude grassland_____

b. Mid-latitude desert _____

c. Chaparral _____

d. Tundra _____

e. Mid-latitude deciduous forest _____

f. Coniferous forest _____

g. Tropical deciduous forest _____

h. Tropical rain forest _____

7. Choose two of the climatograms that you drew from Group II and analyze them in the same way that you did with your teacher.
   - Consider the relationship of the climatic factors to the biotic factors: temperature, precipitation, latitude, etc.,
   - Draw a conclusion for each one based on your analysis.

Climatogram 1: _____

Climatogram Data Tables

Table #1: Group 1 Climatograms

T = temperature (in degrees Celsius) *P* = precipitation (in centimeters)

	J	F	M	A	M	J	J	A	S	O	N	D
a. Tropical Deciduous Forest: Cuiabá, Brazil												
T	27.2	27.2	27.2	26.7	25.6	23.9	24.4	25.6	27.8	27.8	27.8	27.2
P	24.9	21.1	21.1	10.2	5.3	0.8	0.5	2.8	5.1	11.4	15.0	20.6
b. Chaparral: Santa Monica, California												
T	11.7	11.7	12.8	14.4	15.6	17.2	18.9	18.3	18.3	16.7	14.4	12.8
P	8.9	7.6	7.4	1.3	1.3	0.0	0.0	0.0	0.3	1.5	3.6	5.8
c. Savanna: Moshi, Tanzania												
T	23.2	23.2	22.2	21.2	19.8	18.4	17.9	18.4	19.8	21.4	22.0	22.4
P	3.6	6.1	9.2	40.1	30.2	5.1	5.1	2.5	2.0	3.0	8.1	6.4
d. Tropical Desert: Aden, Aden												
T	24.6	25.1	26.4	28.5	30.6	31.9	31.1	30.3	31.1	28.8	26.5	25.1
P	0.8	0.5	1.3	0.5	0.3	0.3	0.0	0.3	0.3	0.3	0.3	0.3

Table # 2: Group 2 Climatograms

		J	F	M	A	M	J	J	A	S	O	N	D
a.	*T*	1.1	1.7	6.1	12.2	17.8	22.2	25.0	23.3	20.0	13.9	7.8	2.2
	P	8.1	7.6	8.9	8.4	9.2	9.9	11.2	10.2	7.9	7.9	6.4	7.9
b.	*T*	10.6	11.1	12.2	14.4	15.6	19.4	21.1	21.7	20.0	16.7	13.9	11.1
	P	9.1	8.9	8.6	6.6	5.1	2.0	0.5	0.5	3.6	8.4	10.9	10.4
c.	*T*	25.6	25.6	24.4	25.0	24.4	23.3	23.3	24.4	24.4	25.0	25.6	25.6
	P	25.8	24.9	31.0	16.5	25.4	18.8	16.8	11.7	22.1	18.3	21.3	29.2
d.	*T*	12.8	15.0	18.3	21.1	25.0	29.4	32.8	32.2	28.9	22.2	16.1	13.3
	P	1.0	1.3	1.0	0.3	0.0	0.0	0.3	1.3	0.5	0.5	0.8	1.0
e.	*T*	−3.9	−2.2	1.7	8.9	15.0	20.0	22.8	21.7	16.7	11.1	5.0	−0.6
	P	2.3	1.8	2.8	2.8	3.2	5.8	5.3	3.0	3.6	2.8	4.1	3.3
f.	*T*	19.4	18.9	18.3	16.1	15.0	13.3	12.8	13.3	14.4	15.0	16.7	17.8
	P	0.0	0.0	1.5	0.5	8.9	14.7	12.2	8.1	2.0	1.0	0.3	0.8
g.	*T*	−22.2	−22.8	−21.1	−14.4	−3.9	1.7	5.0	5.0	1.1	−3.9	−10.0	−17.2
	P	1.0	1.3	1.8	1.5	1.5	1.3	2.3	2.8	2.8	2.8	2.8	1.3
h.	*T*	11.7	12.8	17.2	20.6	23.9	27.2	28.3	28.3	26.1	21.1	16.1	12.2
	P	3.6	4.1	4.6	6.9	8.1	6.9	6.4	6.6	8.9	5.1	5.6	4.6
i.	*T*	23.3	22.2	19.4	15.6	11.7	8.3	8.3	9.4	12.2	15.1	18.9	21.7
	P	5.1	5.6	6.6	5.6	2.8	0.9	2.5	4.1	5.8	5.8	5.1	5.3
j.	*T*	17.2	18.9	21.1	22.8	23.3	22.2	21.1	21.1	20.6	19.4	18.9	17.2
	P	0.3	0.5	1.5	3.6	8.6	9.2	9.4	11.4	10.9	5.3	0.8	0.3
k.	*T*	−20.0	−18.9	−12.2	−2.2	5.6	12.2	16.1	15.0	10.6	3.9	−5.6	−15.0
	P	3.3	2.3	2.8	2.5	4.6	5.6	6.1	8.4	7.4	4.6	2.8	2.8
l.	*T*	−0.6	2.2	5.0	10.0	13.3	18.3	23.3	22.2	16.1	10.6	4.4	0.0
	P	1.5	1.3	1.3	1.0	1.5	0.8	0.3	0.5	0.8	1.0	0.8	1.5