

## Climatogram Project: Temperature, Rainfall, and Biome Distribution

Welcome to your climatogram project. In this project you will investigate the relationship between the amount of rainfall and the variance of temperature and the effect on the distribution of biomes globally.

### Purpose:

This project provides practice in associating climate (as expressed in monthly averages of precipitation and temperature) with biomes. You will also make predictions about the distribution of a biome via altitude and latitude.

Large ecosystems or biomes can be described in terms of their climate, or long-term weather patterns. The climate of a biome is the result of the interaction of several abiotic factors. These factors include temperature, precipitation, and radiant energy from the sun, evaporation, wind and humidity. These abiotic factors serve to limit the diversity of plants and animals found within an ecosystem. The two most important of these limiting abiotic factors are temperature and precipitation. A climatogram is a graph with a double-Y axis that plots the average monthly temperature & precipitation in a biome.

Climatograms of a large ecosystem (or biome) show variation in only two factors- temperature and precipitation. Although there are other factors that affect the climate, a climatogram does give a rough idea of the climate in a particular biome.

### Score Sheet:

#### Part I:

##### Part A

- Calculations \_\_\_\_\_/8
- 4 Climatograms \_\_\_\_\_/28 (Labels, Format, Accuracy)

##### Part B

- Questions \_\_\_\_\_/12

#### Part II:

- Calculations \_\_\_\_\_/2
- Climatogram \_\_\_\_\_/7 (Labels, Format, Accuracy)
- Questions \_\_\_\_\_/8

#### Part III:

- Data Table \_\_\_\_\_/12
- Analysis Questions \_\_\_\_\_/16

#### Appearance:

- Neatness of Climatograms \_\_\_\_\_/4
- Legibility of Writing \_\_\_\_\_/3

Late Deduction (-10pts per day) \_\_\_\_\_

|   |
|---|
| <b>Total Project Score</b> _____/100 (2 Lab Grades) |
|---|

## Part I: Known Biomes—Building a Library of Examples

### Known Biomes Part A

1. **Graph** the climate figures for precipitation and temperature for the four locales in Known Biomes Part 1 onto your blank climatogram sheets (found at the end of the data).
  - a. Be sure that you **label** each location and its **biome** name.
  - b. Also be **extremely careful** as to how you record the information. All temperature readings are measured on the right side of the climatogram! All precipitation measurements are on the left side of the climatogram!
  - c. Be sure to draw a **line graph** for temperature data and a **bar graph** for precipitation data.
2. **Calculate the average temperature.** See me for help if necessary. Record the value below each data table and on the climatogram.
3. **Calculate the total precipitation** for each data set. Record the value below each data table and on the climatogram.

#### Cuiaba, Brazil: Tropical Deciduous Forest

|                        | J    | F    | M    | A    | M    | J    | J    | A    | S    | O    | N    | D    |
|------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Precipitation (in cm): | 24.9 | 21.1 | 21.1 | 10.2 | 5.3  | 0.8  | 0.5  | 2.8  | 5.1  | 11.4 | 15   | 20.6 |
| Temperature (in C°):   | 27.2 | 27.2 | 27.2 | 26.6 | 25.6 | 23.9 | 24.4 | 25.6 | 27.8 | 27.8 | 27.8 | 27.2 |

Average Temperature in Celsius: \_\_\_\_\_ Total Rainfall in cm: \_\_\_\_\_

#### Santa Monica, California: Chaparral

|                        | J    | F    | M    | A    | M    | J    | J    | A    | S    | O    | N    | D    |
|------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Precipitation (in cm): | 8.9  | 7.6  | 7.4  | 1.3  | 1.3  | 0    | 0    | 0    | 0.3  | 1.5  | 3.5  | 5.8  |
| Temperature (in C°):   | 11.7 | 11.7 | 12.8 | 14.4 | 15.6 | 17.2 | 18.9 | 18.3 | 18.3 | 16.7 | 14.4 | 12.8 |

Average Temperature in Celsius: \_\_\_\_\_ Total Rainfall in cm: \_\_\_\_\_

#### Moshi, Tanganyika: Tropical Grassland

|                        | J    | F    | M    | A    | M    | J    | J    | A    | S    | O    | N   | D    |
|------------------------|------|------|------|------|------|------|------|------|------|------|-----|------|
| Precipitation (in cm): | 3.6  | 6.1  | 9.2  | 40.1 | 30.2 | 5.1  | 5.1  | 2.5  | 2    | 3    | 8.1 | 6.4  |
| Temperature (in C°):   | 23.3 | 23.2 | 22.2 | 21.1 | 19.8 | 18.4 | 17.9 | 18.4 | 19.8 | 21.4 | 22  | 22.4 |

Average Temperature in Celsius: \_\_\_\_\_ Total Rainfall in cm: \_\_\_\_\_

#### Aden, Aden: Tropical Desert

|                        | J    | F    | M    | A    | M    | J    | J    | A    | S    | O    | N    | D    |
|------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Precipitation (in cm): | 0.8  | 0.5  | 1.3  | 0.45 | 0.3  | 0.3  | 0    | 0.3  | 0.3  | 0.3  | 0.3  | 0.3  |
| Temperature (in C°):   | 24.6 | 25.1 | 26.4 | 28.5 | 30.6 | 31.9 | 31.1 | 30.3 | 31.1 | 28.8 | 26.5 | 25.1 |

Average Temperature in Celsius: \_\_\_\_\_ Total Rainfall in cm: \_\_\_\_\_

|   |    |             |   |   |   |   |   |   |   |   |   |   |     |                          |   |
|---|----|-------------|---|---|---|---|---|---|---|---|---|---|-----|--------------------------|---|
| Location:   |    | Biome Type: |   |   |   |   |   |   |   |   |   |   |     |                          |   |
| P<br>R<br>E<br>C<br>I<br>P<br>I<br>T<br>A<br>T<br>I<br>O<br>N | 40 |             |   |   |   |   |   |   |   |   |   |   |     | 40                       | T<br>E<br>M<br>P<br>E<br>R<br>A<br>T<br>U<br>R<br>E |
|   | 38 |             |   |   |   |   |   |   |   |   |   |   |     | 36                       |   |
|   | 36 |             |   |   |   |   |   |   |   |   |   |   |     | 32                       |   |
|   | 34 |             |   |   |   |   |   |   |   |   |   |   |     | 28                       |   |
|   | 32 |             |   |   |   |   |   |   |   |   |   |   |     | 24                       |   |
|   | 30 |             |   |   |   |   |   |   |   |   |   |   |     | 20                       |   |
|   | 28 |             |   |   |   |   |   |   |   |   |   |   |     | 16                       |   |
|   | 26 |             |   |   |   |   |   |   |   |   |   |   |     | 12                       |   |
|   | 24 |             |   |   |   |   |   |   |   |   |   |   |     | 8                        |   |
|   | 22 |             |   |   |   |   |   |   |   |   |   |   |     | 4                        |   |
|   | 20 |             |   |   |   |   |   |   |   |   |   |   |     | 0                        |   |
|   | 18 |             |   |   |   |   |   |   |   |   |   |   |     | -4                       |   |
|   | 16 |             |   |   |   |   |   |   |   |   |   |   |     | -8                       |   |
| 14  |    |             |   |   |   |   |   |   |   |   |   |   | -12 |                          |   |
| 12  |    |             |   |   |   |   |   |   |   |   |   |   | -16 |                          |   |
| 10  |    |             |   |   |   |   |   |   |   |   |   |   | -20 |                          |   |
| 8   |    |             |   |   |   |   |   |   |   |   |   |   | -24 |                          |   |
| 6   |    |             |   |   |   |   |   |   |   |   |   |   | -28 |                          |   |
| 4   |    |             |   |   |   |   |   |   |   |   |   |   | -32 |                          |   |
| 2   |    |             |   |   |   |   |   |   |   |   |   |   | -36 |                          |   |
| 0   |    |             |   |   |   |   |   |   |   |   |   |   | -40 |                          |   |
|   |    | J           | F | M | A | M | J | J | A | S | O | N | D   |                          |   |
| Months of Year  |    |             |   |   |   |   |   |   |   |   |   |   |     |                          |   |
| Average Annual Temperature:                                   |    | °C          |   |   |   |   |   |   |   |   |   |   |     | (round to the tenth 0.1) |   |
| Total Annual Precipitation:                                   |    | cm          |   |   |   |   |   |   |   |   |   |   |     | (round to the tenth 0.1) |   |

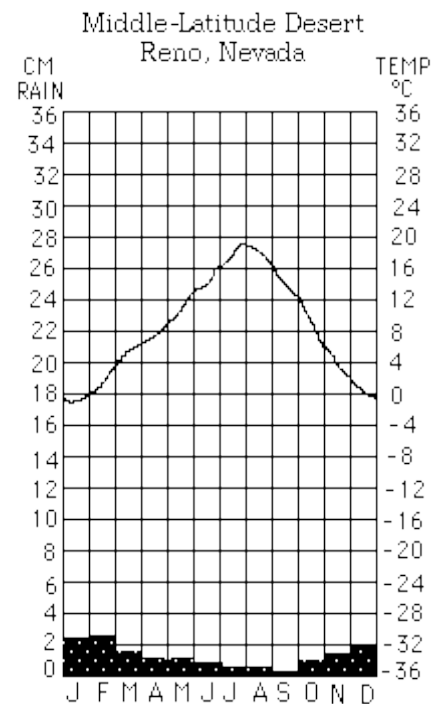
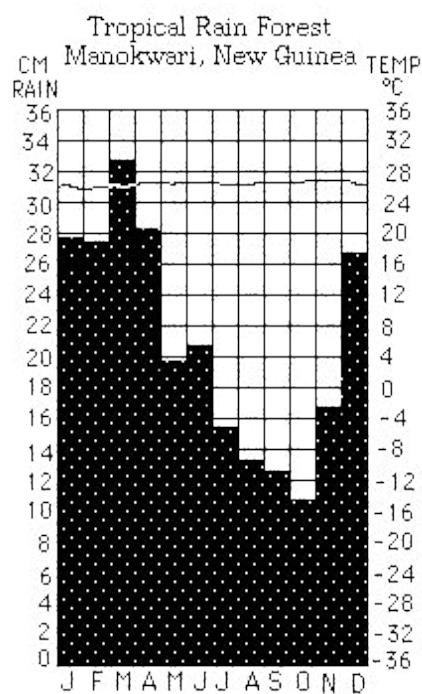
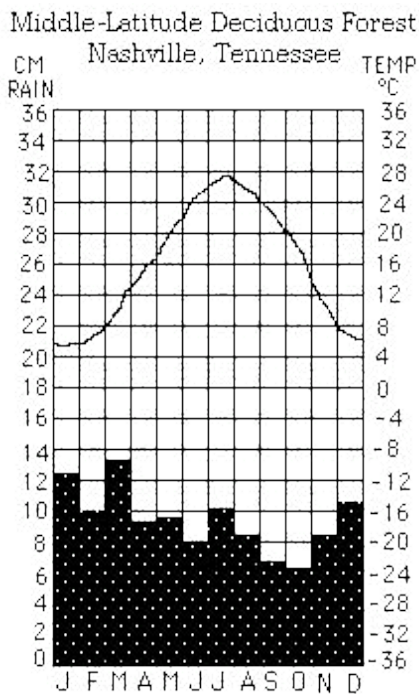
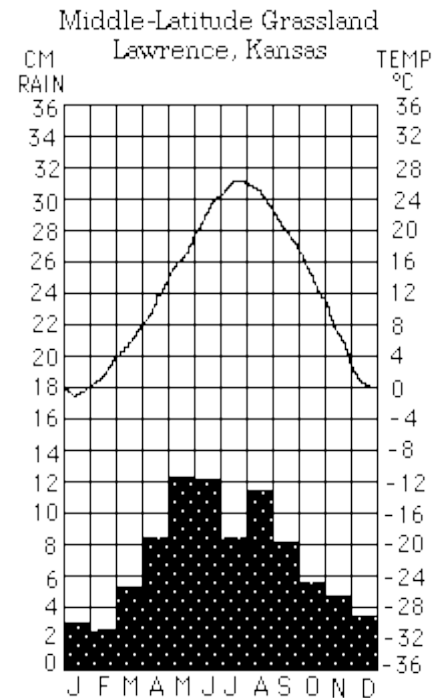
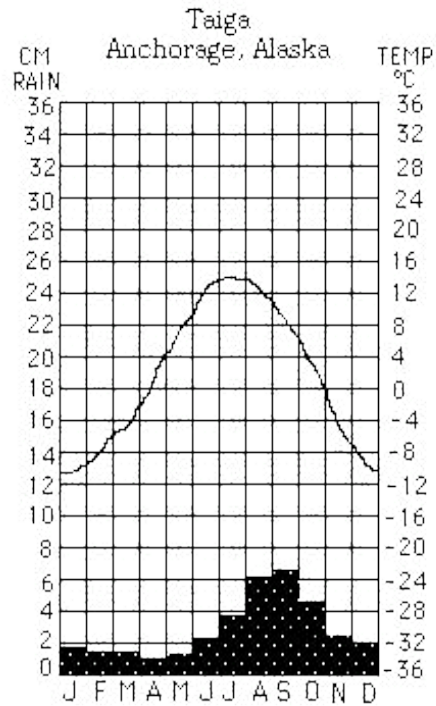
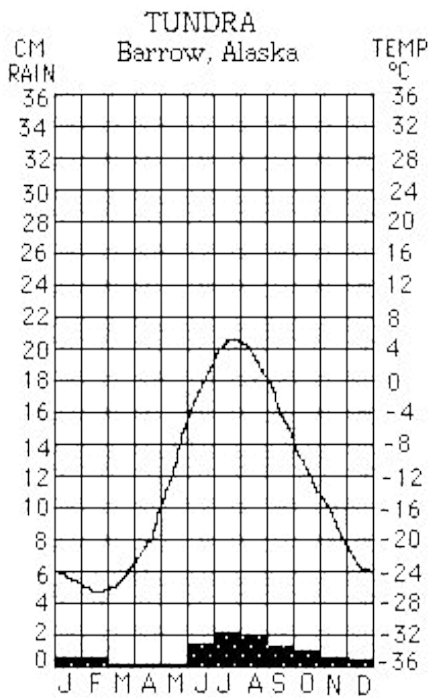
|   |    |             |   |   |   |   |   |   |   |   |   |   |     |                          |   |
|---|----|-------------|---|---|---|---|---|---|---|---|---|---|-----|--------------------------|---|
| Location:   |    | Biome Type: |   |   |   |   |   |   |   |   |   |   |     |                          |   |
| P<br>R<br>E<br>C<br>I<br>P<br>I<br>T<br>A<br>T<br>I<br>O<br>N | 40 |             |   |   |   |   |   |   |   |   |   |   |     | 40                       | T<br>E<br>M<br>P<br>E<br>R<br>A<br>T<br>U<br>R<br>E |
|   | 38 |             |   |   |   |   |   |   |   |   |   |   |     | 36                       |   |
|   | 36 |             |   |   |   |   |   |   |   |   |   |   |     | 32                       |   |
|   | 34 |             |   |   |   |   |   |   |   |   |   |   |     | 28                       |   |
|   | 32 |             |   |   |   |   |   |   |   |   |   |   |     | 24                       |   |
|   | 30 |             |   |   |   |   |   |   |   |   |   |   |     | 20                       |   |
|   | 28 |             |   |   |   |   |   |   |   |   |   |   |     | 16                       |   |
|   | 26 |             |   |   |   |   |   |   |   |   |   |   |     | 12                       |   |
|   | 24 |             |   |   |   |   |   |   |   |   |   |   |     | 8                        |   |
|   | 22 |             |   |   |   |   |   |   |   |   |   |   |     | 4                        |   |
|   | 20 |             |   |   |   |   |   |   |   |   |   |   |     | 0                        |   |
|   | 18 |             |   |   |   |   |   |   |   |   |   |   |     | -4                       |   |
|   | 16 |             |   |   |   |   |   |   |   |   |   |   |     | -8                       |   |
| 14  |    |             |   |   |   |   |   |   |   |   |   |   | -12 |                          |   |
| 12  |    |             |   |   |   |   |   |   |   |   |   |   | -16 |                          |   |
| 10  |    |             |   |   |   |   |   |   |   |   |   |   | -20 |                          |   |
| 8   |    |             |   |   |   |   |   |   |   |   |   |   | -24 |                          |   |
| 6   |    |             |   |   |   |   |   |   |   |   |   |   | -28 |                          |   |
| 4   |    |             |   |   |   |   |   |   |   |   |   |   | -32 |                          |   |
| 2   |    |             |   |   |   |   |   |   |   |   |   |   | -36 |                          |   |
| 0   |    |             |   |   |   |   |   |   |   |   |   |   | -40 |                          |   |
|   |    | J           | F | M | A | M | J | J | A | S | O | N | D   |                          |   |
| Months of Year  |    |             |   |   |   |   |   |   |   |   |   |   |     |                          |   |
| Average Annual Temperature:                                   |    | °C          |   |   |   |   |   |   |   |   |   |   |     | (round to the tenth 0.1) |   |
| Total Annual Precipitation:                                   |    | cm          |   |   |   |   |   |   |   |   |   |   |     | (round to the tenth 0.1) |   |

|   |    |             |   |   |   |   |   |   |   |   |   |   |     |                          |   |
|---|----|-------------|---|---|---|---|---|---|---|---|---|---|-----|--------------------------|---|
| Location:   |    | Biome Type: |   |   |   |   |   |   |   |   |   |   |     |                          |   |
| P<br>R<br>E<br>C<br>I<br>P<br>I<br>T<br>A<br>T<br>I<br>O<br>N | 40 |             |   |   |   |   |   |   |   |   |   |   |     | 40                       | T<br>E<br>M<br>P<br>E<br>R<br>A<br>T<br>U<br>R<br>E |
|   | 38 |             |   |   |   |   |   |   |   |   |   |   |     | 36                       |   |
|   | 36 |             |   |   |   |   |   |   |   |   |   |   |     | 32                       |   |
|   | 34 |             |   |   |   |   |   |   |   |   |   |   |     | 28                       |   |
|   | 32 |             |   |   |   |   |   |   |   |   |   |   |     | 24                       |   |
|   | 30 |             |   |   |   |   |   |   |   |   |   |   |     | 20                       |   |
|   | 28 |             |   |   |   |   |   |   |   |   |   |   |     | 16                       |   |
|   | 26 |             |   |   |   |   |   |   |   |   |   |   |     | 12                       |   |
|   | 24 |             |   |   |   |   |   |   |   |   |   |   |     | 8                        |   |
|   | 22 |             |   |   |   |   |   |   |   |   |   |   |     | 4                        |   |
|   | 20 |             |   |   |   |   |   |   |   |   |   |   |     | 0                        |   |
|   | 18 |             |   |   |   |   |   |   |   |   |   |   |     | -4                       |   |
|   | 16 |             |   |   |   |   |   |   |   |   |   |   |     | -8                       |   |
| 14  |    |             |   |   |   |   |   |   |   |   |   |   | -12 |                          |   |
| 12  |    |             |   |   |   |   |   |   |   |   |   |   | -16 |                          |   |
| 10  |    |             |   |   |   |   |   |   |   |   |   |   | -20 |                          |   |
| 8   |    |             |   |   |   |   |   |   |   |   |   |   | -24 |                          |   |
| 6   |    |             |   |   |   |   |   |   |   |   |   |   | -28 |                          |   |
| 4   |    |             |   |   |   |   |   |   |   |   |   |   | -32 |                          |   |
| 2   |    |             |   |   |   |   |   |   |   |   |   |   | -36 |                          |   |
| 0   |    |             |   |   |   |   |   |   |   |   |   |   | -40 |                          |   |
|   |    | J           | F | M | A | M | J | J | A | S | O | N | D   |                          |   |
| Months of Year  |    |             |   |   |   |   |   |   |   |   |   |   |     |                          |   |
| Average Annual Temperature:                                   |    | °C          |   |   |   |   |   |   |   |   |   |   |     | (round to the tenth 0.1) |   |
| Total Annual Precipitation:                                   |    | cm          |   |   |   |   |   |   |   |   |   |   |     | (round to the tenth 0.1) |   |

|   |    |             |   |   |   |   |   |   |   |   |   |   |     |                          |   |
|---|----|-------------|---|---|---|---|---|---|---|---|---|---|-----|--------------------------|---|
| Location:   |    | Biome Type: |   |   |   |   |   |   |   |   |   |   |     |                          |   |
| P<br>R<br>E<br>C<br>I<br>P<br>I<br>T<br>A<br>T<br>I<br>O<br>N | 40 |             |   |   |   |   |   |   |   |   |   |   |     | 40                       | T<br>E<br>M<br>P<br>E<br>R<br>A<br>T<br>U<br>R<br>E |
|   | 38 |             |   |   |   |   |   |   |   |   |   |   |     | 36                       |   |
|   | 36 |             |   |   |   |   |   |   |   |   |   |   |     | 32                       |   |
|   | 34 |             |   |   |   |   |   |   |   |   |   |   |     | 28                       |   |
|   | 32 |             |   |   |   |   |   |   |   |   |   |   |     | 24                       |   |
|   | 30 |             |   |   |   |   |   |   |   |   |   |   |     | 20                       |   |
|   | 28 |             |   |   |   |   |   |   |   |   |   |   |     | 16                       |   |
|   | 26 |             |   |   |   |   |   |   |   |   |   |   |     | 12                       |   |
|   | 24 |             |   |   |   |   |   |   |   |   |   |   |     | 8                        |   |
|   | 22 |             |   |   |   |   |   |   |   |   |   |   |     | 4                        |   |
|   | 20 |             |   |   |   |   |   |   |   |   |   |   |     | 0                        |   |
|   | 18 |             |   |   |   |   |   |   |   |   |   |   |     | -4                       |   |
|   | 16 |             |   |   |   |   |   |   |   |   |   |   |     | -8                       |   |
| 14  |    |             |   |   |   |   |   |   |   |   |   |   | -12 |                          |   |
| 12  |    |             |   |   |   |   |   |   |   |   |   |   | -16 |                          |   |
| 10  |    |             |   |   |   |   |   |   |   |   |   |   | -20 |                          |   |
| 8   |    |             |   |   |   |   |   |   |   |   |   |   | -24 |                          |   |
| 6   |    |             |   |   |   |   |   |   |   |   |   |   | -28 |                          |   |
| 4   |    |             |   |   |   |   |   |   |   |   |   |   | -32 |                          |   |
| 2   |    |             |   |   |   |   |   |   |   |   |   |   | -36 |                          |   |
| 0   |    |             |   |   |   |   |   |   |   |   |   |   | -40 |                          |   |
|   |    | J           | F | M | A | M | J | J | A | S | O | N | D   |                          |   |
| Months of Year  |    |             |   |   |   |   |   |   |   |   |   |   |     |                          |   |
| Average Annual Temperature:                                   |    | °C          |   |   |   |   |   |   |   |   |   |   |     | (round to the tenth 0.1) |   |
| Total Annual Precipitation:                                   |    | cm          |   |   |   |   |   |   |   |   |   |   |     | (round to the tenth 0.1) |   |

## Known Biomes Part B

Combined with the six climatograms given as examples below, you now have ten climatograms representing ten different biome found worldwide.



**Examine the 10 climatograms for the known biomes (your 4 plus the 6 provided) and answer the questions below.**

1. How are the Tundra and Desert similar? Different?
  - a. Similar-
  - b. Different-
  
2. How are the Tropical Rain and Tropical Deciduous Forests similar? Different?
  - a. Similar-
  - b. Different-
  
3. Lawrence, Kansas and Nashville, Tennessee occupy similar latitudes. Why is one found in grassland and the other in a forest biome?
  
4. Considering that the information in your climatograms is presented on a monthly basis. How would you determine which biomes are located in the southern hemisphere?
  
5. Which biome has the:
  - a. Most rainfall-
  - b. Least rainfall-
  - c. The highest average temperature-
  - d. The lowest average temperature-
  - e. Most consistent year-round temperature-
  - f. Most variable year-round temperature-

## Part II: San Francisco Case Study

### Create the climatogram for San Francisco.

- Be sure that you **label** each location and its **biome** name.
- Also be **extremely careful** as to how you record the information. All temperature readings are measured on the right side of the climatogram! All precipitation measurements are on the left side of the climatogram!
- Be sure to draw a **line graph** for temperature data and a **bar graph** for precipitation data.

|                        | J    | F    | M    | A    | M    | J    | J    | A    | S    | O    | N    | D    |
|------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Precipitation (in cm): | 4.5  | 2.8  | 2.6  | 1.5  | 0.3  | 0.1  | 0    | 0.1  | 0.2  | 1.1  | 2.5  | 3.5  |
| Temperature (in C°):   | 13.0 | 15.0 | 16.0 | 17.0 | 17.0 | 19.0 | 18.0 | 18.0 | 21.0 | 20.0 | 17.0 | 14.0 |

Average Temperature in Celsius: \_\_\_\_\_ Total Rainfall in cm: \_\_\_\_\_

| Location:   |    | Biome Type: |   |   |   |   |   |   |   |   |   |   |     |    |   |
|---|----|-------------|---|---|---|---|---|---|---|---|---|---|-----|----|---|
| P<br>R<br>E<br>C<br>I<br>P<br>I<br>T<br>A<br>T<br>I<br>O<br>N | 40 |             |   |   |   |   |   |   |   |   |   |   |     | 40 | T<br>E<br>M<br>P<br>E<br>R<br>A<br>T<br>U<br>R<br>E |
|   | 38 |             |   |   |   |   |   |   |   |   |   |   |     | 36 |   |
|   | 36 |             |   |   |   |   |   |   |   |   |   |   |     | 32 |   |
|   | 34 |             |   |   |   |   |   |   |   |   |   |   |     | 28 |   |
|   | 32 |             |   |   |   |   |   |   |   |   |   |   |     | 24 |   |
|   | 30 |             |   |   |   |   |   |   |   |   |   |   |     | 20 |   |
|   | 28 |             |   |   |   |   |   |   |   |   |   |   |     | 16 |   |
|   | 26 |             |   |   |   |   |   |   |   |   |   |   |     | 12 |   |
|   | 24 |             |   |   |   |   |   |   |   |   |   |   |     | 8  |   |
|   | 22 |             |   |   |   |   |   |   |   |   |   |   |     | 4  |   |
|   | 20 |             |   |   |   |   |   |   |   |   |   |   |     | 0  |   |
|   | 18 |             |   |   |   |   |   |   |   |   |   |   |     | -4 |   |
|   | 16 |             |   |   |   |   |   |   |   |   |   |   |     | -8 |   |
| 14  |    |             |   |   |   |   |   |   |   |   |   |   | -12 |    |   |
| 12  |    |             |   |   |   |   |   |   |   |   |   |   | -16 |    |   |
| 10  |    |             |   |   |   |   |   |   |   |   |   |   | -20 |    |   |
| 8   |    |             |   |   |   |   |   |   |   |   |   |   | -24 |    |   |
| 6   |    |             |   |   |   |   |   |   |   |   |   |   | -28 |    |   |
| 4   |    |             |   |   |   |   |   |   |   |   |   |   | -32 |    |   |
| 2   |    |             |   |   |   |   |   |   |   |   |   |   | -36 |    |   |
| 0   |    |             |   |   |   |   |   |   |   |   |   |   | -40 |    |   |
|   |    | J           | F | M | A | M | J | J | A | S | O | N | D   |    |   |
| <b>Months of Year</b>   |    |             |   |   |   |   |   |   |   |   |   |   |     |    |   |
| Average Annual Temperature: _____ °C (round to the tenth 0.1) |    |             |   |   |   |   |   |   |   |   |   |   |     |    |   |
| Total Annual Precipitation: _____ cm (round to the tenth 0.1) |    |             |   |   |   |   |   |   |   |   |   |   |     |    |   |

**Compare the climatogram for San Francisco with the ten known Biomes from Part I and answer the following questions about San Francisco.**

- 1) Which of the known biome climatograms closely resembles San Francisco?
  - a. In what ways were they similar?
  - b. In what ways were they different?
  - c. Would you consider them to truly be the same biome? Explain why/why not.
  - d. During the thirty-year period used for the figures in the San Francisco climatogram there were four drought periods. How would this effect the appearance of the climatogram?
  
- 2) In what biome is San Francisco actually found? Research this!
  - a. Does this match your analysis?
  - b. Explain why or why not.

### Part III: Comparing Air Quality related to Climates

#### Carbon Dioxide Emissions for known climates in the U.S.

1. Go to <http://coolclimate.berkeley.edu/maps>
  - a. Find both Lawrence, KS and Reno, NV on the Average Annual Household Carbon Footprint by Zip Code map. Fill in the following information for both cities.
  - b. Find the percentage for each source of emissions by dividing the amount of each listed on the graph by the total emissions of CO<sub>2</sub> in metric tons.

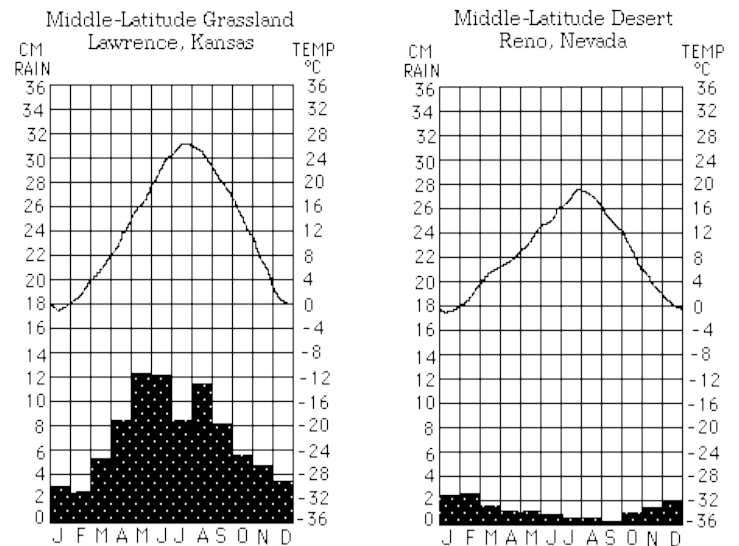
| <b>Carbon Emissions</b>                          | <b>Lawrence, KS</b> | <b>Reno, NV</b> |
|--|---------------------|-----------------|
| Total CO <sub>2</sub> Emissions (in metric tons) |                     |                 |
| % Transportation                                 |                     |                 |
| % Housing  |                     |                 |
| % Food   |                     |                 |
| % Goods  |                     |                 |
| % Services                                       |                     |                 |

#### Compare and contrast the above information by answering the questions below.

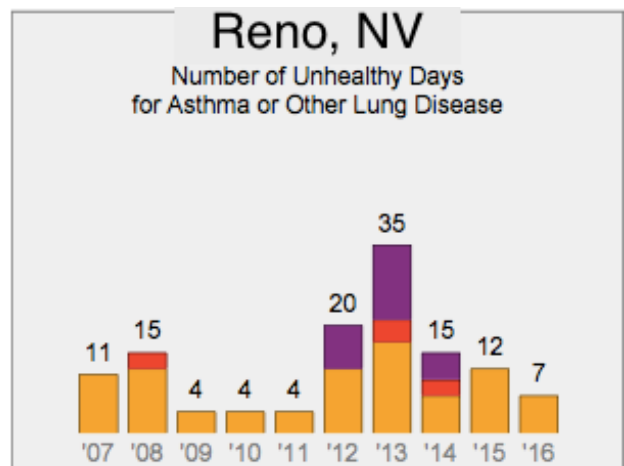
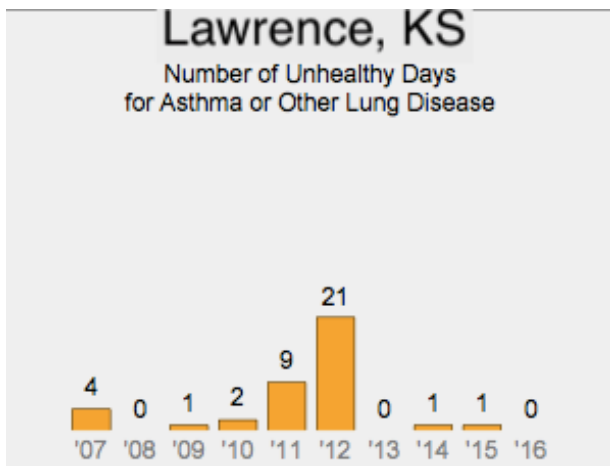
1. Compare and contrast both cities in terms of sources that are generating the metric tons of CO<sub>2</sub>.
  
  
  
  
  
  
  
  
  
  
2. Discuss the reason why Lawrence, KS produces more CO<sub>2</sub> emission in housing as compared to transportation.



3. Explain why approximately 50% of Reno's Co2 emission comes from transportation as compared to all of the other sources combined.
  
4. Explain the correlation between CO2 emissions of all sources and its impact on climate changes for both cities.
  
5. Predict what changes would occur (specifically for both temperature and precipitation) in the climatogram for both cities assuming that CO2 emissions continue to rise.



Reviewing the air quality for both cities, as listed below, answer the following questions.



- In comparing the above data with the city's climatogram, explain how the climate of the area impacts the number of healthy or unhealthy days each city may experience.
- Explain why Reno has more unhealthy days on record for the last 10 years as compared to Lawrence, KS.
- Predict the year(s) that both cities would have exhibited a drought season. Explain your reasoning for prediction.