Name: ____________________ Laboratory Section: ____________________

Date: ____________________ Score/Grade: ____________________

Video
Exercise 29
Pre-Lab Video

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LAB EXERCISE

Biomes: Analyzing Global Terrestrial Ecosystems

Lab Exercise and Activities

SECTION 1

Climate Controls of Ecosystem Structure and Form

Questions using Figure 29.1:

1. Describe in general terms the characteristic vegetation type and related temperature and moisture relationship that fit the area of your present town or school.

Personal answer

Now, describe the same for the region where you were born (if substantially different).

Personal answer

2. Using Figure 29.1, and referring to the world biome map (on the back cover of this lab manual), write these city names in the appropriate environmental location—locate and label each one on the figure. Discuss these with other lab members to make your determinations.

a) Your present region
b) Where you were born (if a different region from your present location)
c) New York City
d) Key West, Florida
e) Montreal, Québec
f) Dawson, Yukon
g) Yuma, Arizona
h) Omaha, Nebraska
i) Elko, Nevada
j) Everglades, Florida
k) Coastal Oregon

Recall that Köppen's climatic classification was based on two climate control regimes:

SECTION 2

Earth's Major Terrestrial Biomes

The global distribution of Earth's major terrestrial biomes is portrayed on the map on the back cover of this manual. Table 29.1 describes each biome on the map and summarizes other pertinent environmental information—a compilation from many aspects of physical geography, for Earth's biomes are a synthesis of the environment and biosphere.

Questions and completion items about this sample of Earth's terrestrial biomes.

1. From Table 29.1, the biome map, and the climate map, determine the terrestrial biome that best characterizes each of the following descriptions and write its name *on the first line* provided. *On the second line,* relate it to temperature and precipitation regimes and/or global pressure and wind belts outlined at the end of Section 1. The first one is completed for you as an example.

a) PRECIP less than 1/2 POTET: [*Warm desert and semidesert*]

[*midlatitude continental interior and on leeward side of mountain range*]

b) Southern and eastern U.S. evergreen pines: ***midlatitude broadleaf and mixed forest. humid subtropical and humid continental; coastal plain sandy soil***

c) Mollisols and aridisols: ***midlatitude grasslands. temperate continental interior, insufficient precipitation for trees (higher precipitation/tall grass, less precipitation/shorter grass)***

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d) Characteristic of central Australia: ***subtropical high pressure belt***

e) Selva: ***equatorial rain forest. high year-round temperatures and precipitation; equatorial low-pressure belt***

f) Characteristic of the majority of central Canada: ***boreal forest, northern needleleaf forest. subarctic continental interior; short summer, cold winter; poor waterlogged soils frozen in winter***

g) Transitional between rain forest and tropical steppes: ***tropical seasonal forest and scrub. year-round warm climates; variable rainfall (monsoons and drought)***

h) Tallest trees on Earth: ***temperate rain forest. mild summer and winter temps; coastal midlatitude; prevailing westerlies, windward side of mountains producing high rainfall***

i) Sedges, mosses, and lichens: ***arctic and alpine tundra. only 2 or 3 months above freezing, soil frozen most of the year, poorly drained in summer***

j) Characteristic of Zambia (south-central Africa): ***tropical seasonal forest and scrub. transition between rainforest and grassland; year-round warm climates; variable rainfall***

k) Four biome types that occur in Chile: ***warm desert and semidesert; Mediterranean shrubland; midlatitude broadleaf and mixed forest; needleleaf and montane forest. Latitudinal extent spans several zones (subtropical high to westerly winds); west coast; cold current increases desert; windward side of mountains increases rainfall on slopes, altitudinal zonation in mountains***

l) Precipitation of 150–500 cm/year, outside the tropics: ***temperate rain forest. mild summer and winter temps; coastal midlatitude; prevailing westerlies, windward side of mountains roducing high rainfall***

m) Characteristic of central Greenland: ***ice. high latitude, frozen year round***

n) Characteristic of Iran (northeast of the Persian Gulf): ***warm desert and semidesert. subtropical high pressure belt; high year-round temperatures, precipitation deficits***

o) Major area of commercial grain farming: ***tall grass-midlatitude grasslands. temperate continental interior, insufficient precip. for trees (higher precip = taller grass)***

p) Seasonal precipitation of 90 to 150 cm/year: ***tropical savanna. transition between rainforest and grassland, tending toward deficits***

q) Cfa and Dfa climate types: ***midlatitude broadleaf and mixed forest. summer maximum rainfall, water deficits in winter may result in deciduous or needleleaf***

r) Spodosols and permafrost, short summers: ***northern needleleaf forest. subarctic continental interior; short summer, cold winter; poor waterlogged soils frozen in winter***

s) Southern Spain, Italy, and Greece, central California: ***Mediterranean shrubland. borders subtropical high (desert) (influence in warm/dry summer) and prevailing westerly (mild, wet winter) belts, vegetation adapted to summer drought***

t) Characteristic of Ireland and Wales: ***midlatitude broadleaf and mixed forest. west coast prevailing westerlies, moderated by marine influence; mild temps, year-round precipitation***

u) Just west of the 98th meridian in the United States: ***short grass-midlatitude grasslands. midlatitude continental interior; leeward side of Rockies and inland from Gulf air masses; drier than tall grassland areas east of 98th meridian***

v) Just east of the 98th meridian in the United States: ***tall grass-midlatitude grasslands. midlatitude continental interior; warm, moist air masses from Gulf of Mexico bring summer precipitation; wetter than short grassland areas west of 98th meridian***

w) Bare ground and xerophytic plants: ***warm desert and semidesert. subtropical high pressure belt; high year-round temperatures, precipitation deficits***

x) East coast of Madagascar: ***equatorial rain forest. high year-round temperatures and precipitation; equatorial low-pressure belt; southeast trade winds bring higher precipitation on windward side of central mountain range***

y) West coast of Madagascar: ***tropical savanna. transition between rainforest and grassland, tending toward deficits***

z) Characteristic of northern Mexico: ***warm desert and semidesert subtropical high pressure belt; high year-round temperatures, precipitation deficits***

Finally, from the **GEOGRAPHY I. D.** that you completed in the Preface of this lab manual, complete the following for your hometown or college campus location:

Place name: ***Personal answer for all of this question.*** Köppen classification:

2. What are the main climatic influences for this station (air pressure, air mass sources, degree of continentality, temperature of ocean currents)?

Terrestrial biome characteristics:

SECTION 3

Life Zones—Conditions Changing with Elevation

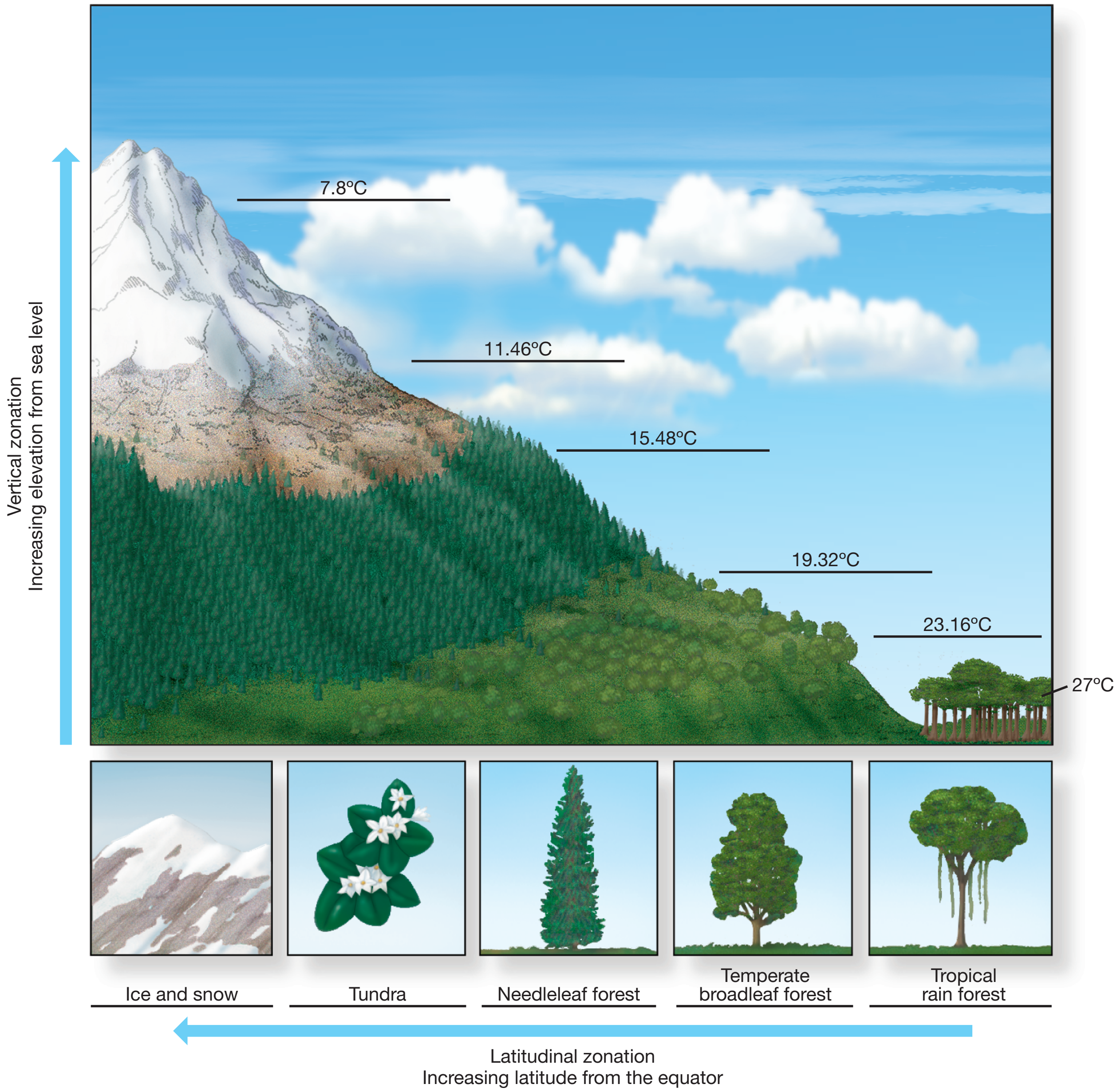
1. Using a physical geography text, such as *Geosystems*, add appropriate labels to **Figure 29.2** in the spaces provided at the bottom of Figure 29.2: tropical rain forest, temperate deciduous forest, needleleaf forest, tundra, and ice and snow. Next, assuming the normal lapse rate is in effect, beginning at sea level and the rain forest label, assume the temperature to be at 27°C (80°F). Assume the labels are spaced at 600m (2000 ft) intervals and calculate the temperature on this particular day at each label elevation. Calculate five temperatures decreasing with altitude (600, 1200, 1800, 2400, and 3000 m) and record your answers on the lines along the right side of the mountain in Figure 29.2.

2. Following discussion among lab members, compare climate controls (temperature and precipitation) and the effects of altitude—Figures 29.1 and 29.2. Briefly describe the importance of each control on ecosystem character and plants and animals.

a) Temperature: ***In mountain regions temperature is a function of altitude as described in earlier sections of the manual and shown in Figure 29.2. Flowering, growth, seed germination, leaf and soil temperature, leaf growth, and seasonal plant activities are temperature dependent.***

b) Precipitation: ***Precipitation controls soil moisture availability, nutrient availability and uptake by the roots and plants, moisture for photolysis in plant operations, and transpiration and respiration.***

c) Elevation: ***In mountain regions temperature is a function of altitude as described in earlier sections of the manual and shown in Figure 29.2.***



▲ **Figure 29.2** Progression of generalized plant community life zones with increasing elevation or latitude.

3. Relative to the life zone concept in Bolivia, South America, speculate on these items:

a) Given these concepts of elevation and temperature, why are there glaciers along the crest of the Andes Mountains so near the equator?

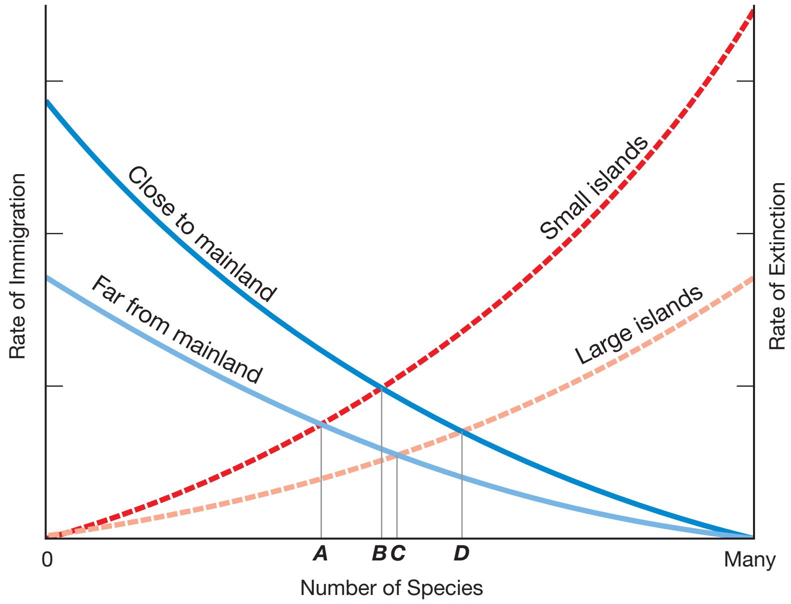
The normal lapse rate produces decreasing temperatures with altitude, cold enough for permanent ice near the Andes' summits.

b) Why are Bolivians able to grow wheat, potatoes, and barley at 4250 m (14,000 ft) at the same latitude of rain forests at low elevation where these same crops will not grow?

The mild temperatures because of altitude and the consistent temperatures because of nearness to the equator combine for conditions ideal for potatoes, wheat, and barley. Wheat would fail at this same latitude but near sea level where consistently warm conditions and heavier rainfall eliminates such crops.

SECTION 4

Island Biogeography



▲ **Figure 29.3** Equilibrium theory of island biogeography [Based on MacArthur, R. H., and E. O. Wilson. *The Theory of Island Biogeography*. 1967. Princeton University Press.]

1. Figure 29.3 shows four examples of species equilibrium numbers. In this hypothetical example, which combination of factors produces the highest number of species? The lowest number of species? In this example, is island size or distance from the mainland more important in producing a higher species equilibrium number?

   The highest number of species would be found on a large island, close to the mainland. The inverse would result in the smallest number. In this example the difference in extinction rates between small and large islands is larger than the difference in immigration rates between close and far islands, so island size is more important in species equilibrium numbers.

2. What are some of the characteristics of animals that you would expect to find on an island? What are some characteristics of animals that you would not expect to find?

   Animals on islands would had adaptations that would allow for initial dispersal, such as the ability to fly or swim long distances.

3. Some islands, such as the Hawaiian Islands, are far from the nearest land and were initially bare rock. Other islands, such as the Channel Islands, off the southern California coast, were part of the mainland and were isolated by rising sea levels. How might the organisms on the Hawaiian Islands differ from organisms found on the Channel Islands?

   The organisms on the Hawaiian Islands would be able to survive long distance voyages, while those on the Channel Islands would not necessarily be able to do so.

4. What are some examples of barriers to dispersal of organisms? What are examples of factors that would act as filters to only certain species? Why do you think this study looked at only nonflying mammals?

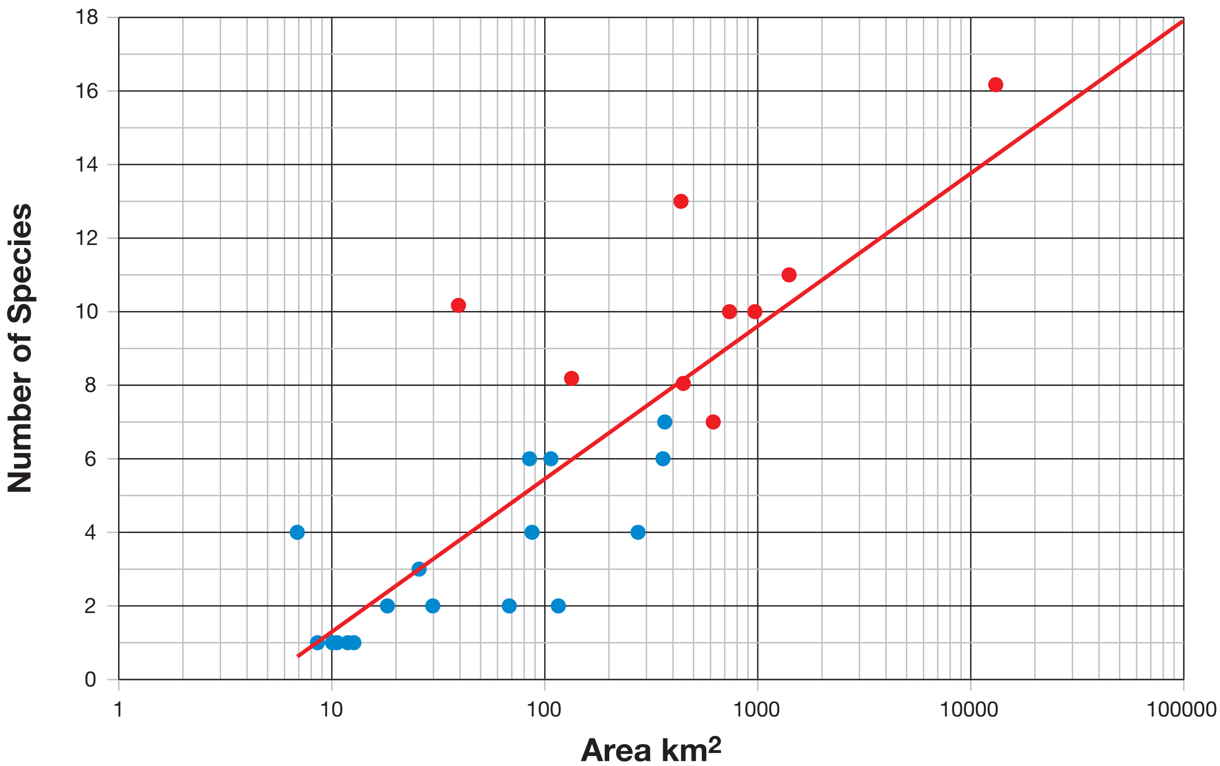
   Salt or fresh water would act as a barrier to fresh or salt water organisms. Climate zones act as a barrier. This study looked at nonflying mammals because climate and altitude would not be a barrier to flying organisms.

5. Plot the biodiversity and area values on Figure 29.4. The values for the first 10 forest islands and the trend line have been plotted for you.

   Activity

6. What is the ratio of species/area for the largest park compared with the smallest park? How many species should be in the largest park if the species/area ratio there is the same as the value for the smallest park?

   In the largest park 1 sp/ 696 km^2
   In the smallest park 1 sp 1.7 km^2
   The largest park would have 6549 spp.



▲ Figure 29.4 Species numbers and habitat size

Use Figure 29.4 and the trend line to answer the following questions.

7. How many square kilometers of habitat would be required to support 10 species?

1200 km^2

How many square kilometers of habitat would be required to support 5 species?

80 km^2

8. How large is the largest park? How many species does it support? How many species would you expect to find in a park half that size? What percentage reduction is this over the original population?

11134 km^2. 16 spp. 5567 km^2 should support 12.5 spp, which is a 22% reduction.

9. How many square kilometers are required to support four species? How many species would you expect to find in a park half that size? What percent reduction is this over the original population?

45 km^2 would theoretically support four spp. 22.5 km^2 should support 3 spp, which is a 25% reduction.

10. Based on your answers to Questions 7 and 8, are larger or smaller habitats more prone to species loss due to reduction in habitat size? If you were identifying habitat to protect, would you recommend protecting one 400 km^2 area or four 100 km^2 areas? What other factors might you consider? What factors would make a species more deserving of protection? Are all species deserving of equal protection?

The smaller habitat had a greater spp loss due to a halving of area. This suggests that larger habitats are less prone to spp loss. However, other factors to consider include the types of habitats. Protecting four smaller areas that are all different habitats could be more important than one larger area with one habitat type. When designing protected areas for species conservation another consideration could be what type of organisms are being protected. Birds would have very different requirements than tortoises. Protecting four species of ant might be viewed as less important than protecting one endangered species of a larger organism, such as panda bears or spotted owls or salmon.