

# **TwoOldGuys™ Study Guides**

## **BI114 Biological Concepts for Teachers**

### **Chapter 6. Ecology, Advanced**

#### **6.3. Biomes**

Based on Indiana's Academic Standards, Science, as adopted by the Indiana State Board of Education, Nov 2000.

*Numbers refer to the age-appropriate grade-level for the content.*

### **Review**

After noting why populations should not change much from year to year, we explained how populations and communities do change over decades, in a process called succession. Then in an apparent contradiction, we explained why communities ought to be able to remain stable over centuries. You might think we ought to make up our minds as to whether communities change or not. What we think is that it is a simple matter of scale. Over short time periods (year to year) populations do not change much, which also says that they may change slightly. If a population of 150 individuals were to increase by only 2 (1½ %, a small number) each year for 20 years, at the end of the 20 years it will have increased from 150 to 190 [a 27% increase, which is not small]. If the same population were then to decrease by only 10 individuals per year (5.3 %), in 19 more years the species will be locally extinct. Thus to be reasonably the same from year to year may produce change over decades. Similarly, over longer time periods if one roadside weed (aster, a tall, blue flowered species of the weedy fields of Pennsylvania and eastward) were to decline in Indiana and Illinois, but it was replaced by another roadside weed (chicory, a tall, blue flowered species of the weedy fields of Iowa) due to global warming, would the casual observer notice that the roadside weed community has changed over 75 years?

## Biomes

*grades 5: to 6:*

Different parts of the world have distinctly different communities

If your students have ever watched nature shows on television, or nature videos in class, or have read nature books written for the 5<sup>th</sup> to 6<sup>th</sup> grade reader, they have been exposed to the different communities one encounters in different parts of the world. If we consider only the Americas from arctic circle to the equator, we would encounter the following:

Arctic tundra

northern Alaska, Yukon, Northwest Territories and Greenland

North woods (taiga)

most of Canada

Temperate forest, Grassland, Steppe, Desert

forest – New York state to South Carolina

grassland – Saskatchewan to Oklahoma

steppe – eastern Montana, Wyoming, Colorado

desert – Utah, Nevada, Arizona, Sonora

Tropical forest, Savanna

forest – Caribbean, Brazil

savanna – Central America, southern México

These community types are called Biomes [a term frequently used in textbooks and supplemental materials for this age group].

This general pattern repeats in other parts of the World [South America, Europe & Scandinavia, Asia, Africa, Australia & New Zealand], although there will be differences in the details. There has been some debate among plant ecologists concerning whether or not these Biomes are real, or the products of the imaginations of plant ecologists. The best evidence for the reality of the Biome is that they can be seen in satellite

images. There are “clear air, natural color” satellite photos [actually a composite, assembled like a jigsaw puzzle from numerous photos with cloud cover cut out]. Not only can one draw boundaries on the photos outlining the Biomes, the resulting map of the Biomes matches those drawn from ground-based observations.

*grades 7: to 8:*

### Latitudinal zones support different Biomes, matching climate zones

When we map the Biomes on the globe [or on the clear-air, natural color satellite image] it is apparent that the biomes roughly follow latitude lines. In order to determine [by inductive reasoning] what hypothesis can explain what causes the Biomes and their distribution, we assume that the biome boundaries follow latitude lines closely. The obvious next question [the first and simplest question was “where are the biomes?”] is what aspect of the environment changes with latitude? Our guess was that the average annual temperature would vary with latitude (if the World were perfectly round and smooth) due to the angle of sunlight striking the Earth surface. On this hypothetical perfectly smooth Earth, the average annual temperature also establishes the climate zones (arctic, sub-arctic, north temperate, south temperate, sub-tropical, tropical). So, climate should cause Biomes.

### Mountains have similar zones, matching altitude

The first description of patterns over very large geographic areas was published by Merriam who described “Life Zones” on the San Francisco Mountains in southern Arizona, north-east of the University of Arizona, Tucson, AZ. The Life Zones from mountain tops to the lowlands are:

- Alpine,
- Hudsonian [Hudson Bay],
- Canadian,
- Transition,
- Sonoran.

Merriam arrived at his Life Zones based on his analysis of the distribution of animal species in the San Francisco Mountains. Whittaker analyzed the distribution of plants in the Great Smoky Mountains in east Tennessee and western North Carolina and demonstrated that plants form similar Life Zones. To confirm the similarity of Whittaker's plant life zones and Merriam's animal Life Zones, Whittaker repeated his study on the San Francisco Mountains where Merriam had done his work. Whittaker reported that the plant-based Life Zones in Arizona match the animal-based Life Zones.

Comparing the altitudinal zones to the latitudinal zones, we discovered that 300 meters (1,000 feet) altitude equals 160 kilometers (100 miles) latitude.

*grades secondary: to college:*

**The pattern of distribution of Biomes correlates with temperature and precipitation**

One problem noted by Dansereau with the observation that vegetation zones correlate with climate zones is that traditionally climate zones are based, in part, on vegetation present. To define climate zones by vegetation, then to conclude the vegetation zones correlate with climate zones is an excellent example of circular reasoning. We have attempted to remove this circular reasoning by redefining the climate on solely climatic factors.

When vegetation zones (Biomes) are correlated with climatic variables, it appears that the two most important variables are temperature and

precipitation. The following table illustrates the relationship of Biomes (vegetation) to temperature and precipitation:

biome distribution

BIOMES					
t e m p e r a t u r e	tundra				
	semidesert	taiga			
		scrubland	woodland	temperate deciduous forest	temperate rain forest
	desert	grassland			
		thorn scrub	savanna	tropical seasonal forest	tropical rain forest
precipitation					

## ***Descriptions of the Biomes***

### **Tundra**

Tundra consists of mostly grass-like plants called sedges, and willow “trees” up to 12 – 18 inches tall. The soil is soggy (marsh) during the growing season, and frozen during the rest of the year. Tundra is sometimes called cold desert due to the very low rainfall during the growing season.

### **Semidesert**

Semideserts are also called desert grasslands. They are characterized by short grasses, and a few taller weeds [but no cactus]. Semideserts can be found in eastern Washington and Oregon, Utah, Nevada, Arizona and New Mexico (and southward into Sonora, México).

## Taiga

Taiga (north woods) has mostly conifers (spruce and fir), with peat bogs in the low marshy areas. Taiga in North America is mostly in northern Canada and southern Alaska.

## Scrublands

The scrublands have scrubby shrubs, that are green during the wet (growing) season of spring and early summer, but dry up and are highly susceptible to wild fires during the late summer and fall. Typical shrubs include creosote bush and tumbleweed. Scrublands are best known from coastal southern California, but are also found in Arizona, Nevada, Utah, New Mexico and west Texas.

## Woodlands

Woodlands should not be confused with woodlots [which are small forests]. Woodlands frequently involve oaks that tend to be only 15 – 20 feet tall, with grassy areas among the trees. The best examples of woodlands in North America are in west Texas, the Texas panhandle, eastern Oklahoma and the Ozarks of Missouri.

## Desert

True deserts in North America are the only places where cactuses grow naturally [prickly pears is an exception, found in woodlands and even into parts of the deciduous forests of Illinois and Indiana]. Except during unusually wet years, there is more bare sand than plants. The American desert is in southern Arizona, northern Sonora, and inland southern California.

## Grassland

There are two separate grasslands. The drier grasslands are properly called steppes and consist of short grasses. These are found from eastern Montana and Wyoming, Colorado, New Mexico, and western Nebraska and Kansas. The wetter grasslands are properly called prairies. These are tall grass prairies found from Kansas to Saskatchewan.

## Temperate Deciduous Forest

The deciduous forest is also called the summer-green deciduous forest. Trees in these forests may reach 70 feet or more in height, and have leaves only during the growing season. They frequently turn brilliant colors in the autumn. Such forests can be found in most of eastern United States and parts of eastern Canada.

## Temperate rainforest

The North American temperate rain forests are on the Pacific coast from San Francisco Bay north to the British Columbia – Alaska border. The most familiar temperate rainforest is the Giant Sequoia forest, but the Douglas firs along the Oregon, Washington and British Columbia coasts are also rainforests.

## Thorn scrub

If this biome is represented at all in the Americas, it would be in the arid tropical areas of Central America west of the mountains.

## Savanna

The best known savannas are in Africa, but some limited areas of savanna exist in upland Brazil and northern Argentina. Savannas are grasslands with tall trees. The trees must be isolated (not touching) to qualify as a savanna.

## Tropical seasonal forest

Seasonal, not summer, because the climate is wet season – dry season, and both seasons are warm to hot. These forests are found at higher elevations throughout the tropical Americas. During the wet season these forests look like tropical rainforests, but during the dry season the trees lose their leaves. In one famous tropical seasonal forest, the dry season when the trees lose their leaves lasts one or two days.

## Tropical rainforest

True tropical rainforests in the Americas are found in the Amazon basin and northward into the Caribbean islands. These forests have very dense growth of tall trees and vines.