Hunter College - CUNY
Dept. of Geography & Environmental Science
GEOG 101 Lecture Presentation Summary
Spring 2021

***NOTE**: In the absence of face-to-face lecturing and explanation of the material presented in the lecture slides, I will summarize the content of each lecture presentation stressing the concepts and interrelationships that are essential to an introductory geography course.*

If, after viewing the lecture presentation, the imbedded short videos and hot links to articles, and after reading this summary, you have any questions, would like to contribute a comment or two, need clarification by other examples or would like additional information on the topic, please do not hesitate to email me at agrande@hunter.cuny.edu.

LECTURE 16: Earth Habitat: The Biosphere

- The topic of Lecture 16 is the **Biosphere.** Necessary to the understanding of the biosphere is a discussion of the **Biogeochemical Cycles**, the third portion of "natural controls and cycles." *(We have covered the Temperature Controls and the Geologic Cycle.)* This is the where geography, biology and chemistry interface in the study of **ecology** and **environmental science.** The biogeochemical cycles affect all life on earth.

- **Slides 3-4: Biosphere.** The biosphere is the fourth of the earth's physical systems. Here the focus is **life** on earth. The biosphere exists at the *interface* of air, water and land and is sun dependent. It includes all living things. Plants are the most sensitive lifeforms because they cannot relocate easily or adapt to quick changes in earth environment. Lifeforms with greater mobility can move with the changes. *(Think of the seasonal migration of the herds of African animals with the seasons.)* All lifeforms adapt to **slow** changes in the environment: warmer, cooler, drier or wetter conditions. *Aspects of the survival of the fittest or evolutionary changes come to mind.* The biosphere has numerous divisions with the top tiers being: **1) biomes** *(geographic divisions or zones);* **2) ecosystems** *(areas with lifeforms dependent on conditions of the physical environment);* **3) communities** *(a group of lifeforms that exist in the same spatial area or habitat);* **4) population** *(the number or headcount of lifeforms within a habitat);* and **5) organisms** *(the types of specific lifeforms, as plants, animals, birds, insects, fungi, bacteria, etc., that are found within a habitat).* We will talk about habitats in Population Geography and Biogeography.

- **Slide 5: Biomes.** World biomes (or ecoregions) which are zones of life having unique characteristics of temperature, moisture, elevation, slope and hours of sunshine that support plants and animals. (Note how it resembles the world climates, natural vegetation and soils maps.) Each major group can be divided into smaller and smaller more specialized units depending on local characteristics, as the flora and fauna on the sunny side of a hill or in wetlands at the bottom of a valley.

- **Slides 6-10: Terrestrial (land) Biomes**. Here we look are plant (flora) and animal (fauna) communities and their habitats. Conditions that are present allow them to survive and thrive. When conditions change (drier/wetter/hotter/colder/less food, etc.), so do the communities, since each exist within certain parameters. The necessary components of a biome have to be preserved, recycled and renewed to avoid reaching carrying capacity (maximum life support) and to maintain the quality of its habitat (quality of a habitat for a life form varies with conditions). *BTW, The Wildlife Conservation Society (Bronx Zoo), Audubon Society, Sierra Club and other such organizations employ geographers to study ecoregions.*

- **Slide 7: Biome Distribution.** Northern Hemisphere biomes are presented in this triangular graph. The bottom line represents the amount of moisture and the left side represents temperature. Four latitudinal zones of are illustrated (Tropical/Temperate/Subarctic and Arctic) and they focus on the major vegetation groups within the constraints of temperature and moisture.
  - ✓ *When reading the graph, note that moisture decreases from left to right on the graph* ***(Important: This DOES NOT represent west to east)*** *in each zone and that temperature decreases from the lower left corner to top corner as latitude increases. Therefore, the lower left corner has the most heat and moisture (equatorial zone = 0°) and supports a tropical rainforest and the top corner is cold and dry (Ice cap at 90°N). The lower right corner represents tropical deserts (hot and dry). The boundary between the subarctic and arctic zones is called the* ***tree line****. North of this point it is too cold for trees to grow and only tundra vegetation is supported.* This diagram may be inverted and annotated for the Southern Hemisphere

- **Slides 8-9: Vegetation Sequence.** The vegetation sequence diagrams represent the temperature (or the left) side of the biomes graph. It illustrates the vegetation sequence in more detail incorporating aspects of temperature and moisture. **Refresh your memory of the global wind systems diagram.**
  - We start in the equatorial zone (*tropical rainforest*) at bottom left, moving northward to the *subtropical desert* (25°*N* - this would be the Sahara in Africa).
  - Notice how the vegetation changes moving northward from the rainforest; trees become less dense and shorter until you reach seasonal semi-arid areas (*savannas*) and year-round semi-arid areas (*steppes*). It is too dry for trees. The area merges into the desert (roughly 20°*N*-30°*N)*.
  - Starting around 35°N, when rainfall starts to increase, the steppe reappears before blending into a Mediterranean-type climate. Continuing northward both rainfall and seasonality increases. The forest returns with *deciduous (leaf-dropping*) trees, then blends into *coniferous (evergreen)* trees.
  - The great forests of Canada and Russia, called "**taiga**" (boreal forest in some literature), have a limited variety of coniferous tree species (seasonality+cold). Soon it becomes too cold and too short a growing season for all but the hardiest trees to survive. Here the taiga merges with the *tundra* and the **tree line** is set: too cold for any tree species. The tundra supports grasses, mosses and lichen.
  - Finally, poleward of 80°N *permanent snow and ice* dominate; too cold for even moss or lichen to survive.

- **Slide 10 is a composite of Slides 8 and 9.** Here the vegetation sequence is represented as a continuous line from the equator to the North Pole. *(The same diagram may be constructed for the equator to South Pole sequence.)* Segments are placed in their latitudinal positions against the sides of the triangle.

- **Slide 11: Animal Distribution.** This is an extremely simplified world map of animal distribution. *Zoogeography studies the distribution of animal species past and present in relation to their physical surroundings and also in relation to the human population.*

- **Slide 12: Biome Modeling using GIS**. This slide shows two examples of how a geographic information system (GIS) is used in biogeography and ecology to model potential changes to ecosystems and habitats. By changing the variables, we can experiment with future scenarios by using the "What if …?" component of a GIS. **(A)** We can make an area warmer or wetter or colder or change the timing of seasonal rainfall to see what would happen to certain communities, both wild and agricultural. **(B)** We can chance water quality of a marine environment and see what may happen.

- **Slide 13: Soil Formation.** This slide brings us back to soils. It shows the relationship between temperature and moisture working on organic and inorganic (rock) material in soil formation. Cold temperatures and dry conditions both slow the process. That's why deserts and subpolar areas have such a thin soil layer. Conversely, tropical rainforests have thick soils because of the constant breakdown of material. **NOTE:** However, just heat and water cannot maintain a soil if there is no vegetation to provide organic material. When rainforests are cut down, soil loses its fertility in a matter of decades, whereas it takes thousands of years to create a soil.

- **Slides 14-15: Climax Vegetation.** The concept of habitat creation and stability is presented here. *Climax vegetation* is the best species of plant(s) for a particular set of physical circumstances. On a bare surface plants will go through a series of stages where one becomes dominant under a set of conditions. After a major fire, grasses return first, then bushes and shrubs, then sun-loving trees. Taller tree species grow over the sun-loving trees as they try to reach sunlight, eventually killing the shorter trees. This continues until stability is reached and nature is balanced. Climate change will also affect the population of a habitat by creating conditions not as conducive to certain plants. **Climax community** takes this one step further by bringing in other life forms (mammals, birds, insects, reptiles, fungi) that live in and share this habitat providing for each other: a deer eats grass and its waste fertilizes the ground; the deer provides food for a wolf or mountain lion.

- **Slide 16: Natural Controls and Cycles.** The last part of this lecture deals with **natural controls and cycles**. It seeks to explain why the earth has not run out of things needed for its and our survival. ***We have already covered temperature controls and the geologic cycle. Review the material from previous lectures.*** Now we will be introduced to the chief parts of the **biogeochemical cycle**: water, carbon-oxygen, nitrogen and nutrient. **Everything listed is interrelated and do not stand alone.**

- **Slide 17: Biogeochemical Cycles.** Look over this simplified diagram. Notice the direction of the arrows. Also notice that the atmosphere, hydrosphere, lithosphere and biosphere are part of the cycle. ***View the 5-minute video on the carbon cycle which also incorporates information about the other cycles since they are interrelated*.**

- **Slides 18-19**: **Hydrologic Cycle**. The hydrologic cycle is the reason we have not run out of fresh water. Even though most of the water on earth is salty ocean water, evaporation removes the water molecules (H_2O) and leaves behind the dissolved mineral salts that came from the land. That is why the oceans are salty and water in desert areas tends to be salty, e.g., Great Salt Lake in Utah. ***Know the 7 parts of the Hydrologic Cycle*. *View the 6-minute video on the water cycle*.**

- **Slides 20- 21: Carbon-Oxygen Cycle.** Look over the diagram. Oxygen (O_2) and carbon dioxide (CO_2) are mutually dependent. The processes that create CO_2 depend on oxygen to sustain them. Sunlight-powered **photosynthesis** using chlorophyll in green plants and other organisms uses carbon dioxide as part of its food supply. Oxygen is a byproduct of this process. Unfortunately, CO_2 has very efficient heat-retaining capabilities. Any increase in CO_2 production is greatly magnified and therefore the human-driven global warming from the burning of fossil fuels and reduction of carbon-absorbing processes is contributing to global warming (Slide 21).

- **Slide 22: Nitrogen Cycle**. Nitrogen gas makes up more than three-quarters of the atmosphere, but it is not usable unless it is converted. The chief parts of the cycle for us are **nitrogen fixation**, **assimilation** (absorption by plant roots), **chlorophyll production**, and **denitrification**. For plants water-soluble compounds of ammonia and nitrate are most important. Plants can absorb them with the water taken up by roots and use them to make *chlorophyll* (green matter) that is important in photosynthesis. Nitrogen-fixing bacteria on the roots of plants, especially legumes, easily convert nitrogen. Atmospheric nitrogen is converted by the intense electrostatic discharge generated by lightning; the compounds created return to earth in rain and snow and then soak into the ground (recall the hydrologic cycle). Artificial nitrogen compounds can be made by fertilizer manufacturers. Lastly, *denitrification* is the term that refers to the return of nitrogen to the gaseous state as the compounds break down. ***Review the carbon cycle video which has information about the nitrogen cycle.***

- **Slides 23-26: Nutrient Cycle.** The Nutrient Cycle overlaps with the other cycles and is the basis of soil fertility. It is water and temperature dependent and relies on organic, inorganic, and gaseous elements to maintain a balance.
  - **Slide 24:** The three major **sources of organic material** in the Nutrient Cycle come from decomposition of organic material (plant/animal), residue from fire, and deposition from flooding. All mix with inorganic surface material to recharge soil fertility.
  - **Slide 25:** Some of the **benefits that forest/grassland fires provide** are listed. Only the rare inferno is 100% destructive – bark protects the tree truck and roots are protected by soil. Nature rebounds from the devastation and is most cases is better than before. The chance of another catastrophic fire is lessened. Dead, old and sick vegetation is removed; insect pests and plant diseases are checked; nutrients are released into the soil; some tree seeds need the heat of a fire to burst their pods; the climax vegetation sequence begins anew, sometimes with greater diversity than before. The illustration and the graph show timelines.
  - **Slide 26:** Here we look at the **human impact** on the Nutrient Cycle. The list includes the deterioration of nutrients by the works of people, as well as decision-making that may be environmentally harmful.

- **Slide 27: Next – Natural Hazards and Human Impact**