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

NOTE: In the absence of in-person lecturing and face-to-face explanation of the material presented in the PowerPoint lecture slides, I will summarize the content of each lecture presentation, stressing the concepts and interrelationships that are essential to an introductory geography course. In essence, it is like giving you a transcript of my classroom lectures.

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

LECTURE 11: The Hydrosphere – Oceans

- We will now begin the Earth Systems portion of the physical environment. The purpose of this lecture is to introduce you to the **hydrosphere**, here limited to the oceans, but in general, including all water areas on earth: salt water areas, freshwater areas and underground water supplies.
- **Slide 3: Overview.** Here's a list of the highlights we will be looking at in this section. The earth has been called the "Water Planet" since 71% of its surface is covered by water. ***View the 2-minute introduction to using satellite remote sensing to study the oceans.***
- **Slide 4: Hydrologic Cycle.** The Hydrologic Cycle diagram illustrates how the earth recycles its water supplies and creates fresh water. It will be covered in detail in Lecture 16: The Biosphere.
- **Slide 5: Ocean Basin Topography.** Many people have a misconception that the ocean floor is flat just like a beach appears at low tide. From the map and the diagram, you will notice that the ocean floor's configuration is just as complicated as that of the land areas of earth. These diagrams will be looked at more closely in Lecture 14: The Lithosphere.
- **Slides 6-8: Ocean Terminology.** There is a great deal of movement in the oceans. The study of *fluid dynamics* in physics explains much of the detail; however, here we just need to know the definitions of the terms and the general aspects of energy transfer that creates the motions.
  - **Ocean current**: a conveyor belt of sea water with distinct characteristics of temperature and salinity; they are both horizontal (surface) and vertical (deep ocean) in nature.
  - **Gyre**: a sub-planetary circulation system caused by the earth's rotation and the Coriolis Effect.
  - **Ocean gyre**: circular ocean current system important in circulating water around the earth. There are 5 primary ocean gyres (see slide7).
  - **Wave** (or wind wave): created by friction as wind passes over the ocean surface, touching and dragging the surface water in its direction, and creating a crest (or swell). This is a transfer of energy from the atmosphere to the oceans.

- **Tsunami** (seismic wave): created by a shock external to the ocean water, as an earthquake, landslide or meteor strike that transfer seismic energy to the water; they are **not** tidal waves.
- **Tide:** a bulge of water drawn off the earth's surface by the *gravitational pull* of the moon and sun plus *centrifugal force* from the earth's rotation. The **tidal bore** is the true tidal wave; it is the visible leading edge of the incoming high tide. The **tidal range,** the local difference between high and low tides, is very importance to coastal areas.

- **Slide 9: Simplified Ocean Salinity Map:** The salt content by volume of the oceans *(shown here as "ppt" – parts per thousand)* is not equal throughout the world. The map shows areas of very high salinity (as areas A, B and C). The diagram illustrates why some areas would have higher salinity (ppt) and others lower salinity (ppt). ***View the 3-minute video on ocean water salinity.*** *Note the effect of freshwater discharge from major rivers; areas of low precipitation and the effect of ice melt.*

- **Slide 10: Surface Ocean Circulation:** This is a very important map. Be aware of the names, locations and direction of flow of the major currents. The map key shows that the **red arrows** designate "warm" currents and the **blue arrows** designate "cold" currents. Be aware that the currents' designations are based on the source regions (where they come from) not their actual temperature. **Surface currents influence climate on land through the transfer of temperature and moisture characteristics from the oceans to the atmosphere where they are blow on to the land.**

- **Slide 11: Deep-sea Ocean Currents.** This is a very important diagram. Total ocean circulation is a 3-D model with all parts connected. This global conveyor belt is called the *Thermohaline Circulation System* and is driven by differences in water temperature and water salinity. Cold, salty water is very dense and sinks while warm, less saline water is less dense and stays near the surface. *View the 3-minute video of the Thermohaline Circulation System (there is no sound).*
  - Starting in the Atlantic Ocean between Africa and South America, follow the light blue ribbon of water with your finger.
  - Follow the arrows to North America, then east to Europe. Notice that the ribbon turns a darker shade of blue south of Greenland and gets darker approaching the Arctic Circle.
  - The ribbon is dark blue as it turns west and south as it sinks into the depths of the Atlantic Basin and makes its way (follow the arrows) to Antarctica.
  - The ribbon actually circles Antarctica. (You need a globe to see that.) Offshoots are drawn into the Indian Ocean and the Pacific Ocean.
  - The "upwelling" into the Indian and Pacific oceans warms the ribbon, turning it a lighter blue. This happens because evaporation of warm surface water in the Indian Ocean and Pacific Ocean basins draws the cold water up from the ocean depths toward the surface. Remember, if water is being evaporated, it has to be replaced: *Planet Earth is a closed system*.
  - When at the surface, the ribbon is warmer and less salty so it shows as light blue. It then become part of the global surface water circulation system. Follow the arrows of the light blue ribbon back to the Atlantic Ocean where you began the journey.

- ➢ **Also notice:** There is no interchange of water between the Pacific Ocean and Arctic Ocean because the Bering Strait is too narrow and too shallow for this to happen. ***The <u>only place</u> surface water can return to the depths of the ocean is in the North Atlantic Ocean between Europe and Greenland.***

- **Slide 12: Gulf Stream System.** Here we focus on one portion of the Thermohaline Conveyor Belt: *<u>Gulf Stream/North Atlantic Drift</u>*. Ocean and atmospheric scientists, as well as climate specialists, consider this to be the most important segment of the oceanic conveyor belt because of the return of warm, less salty water Atlantic surface current waters into the depths of the Atlantic Basin. What happens if something interferes with the natural dynamics where the red arrows turn to blue on the map?

- **Slide 13: What if the Gulf Stream Weakens?** **<u>Read the article and view the animation in the NYTimes article (03/02/21) accessed through the hot link.</u>** Can you see a scenario where global warming is cooling the Gulf Stream? And, if the Gulf Stream is cooling before it gets to the Arctic Ocean, what will happen to the Thermohaline Circulation system? What will the east coast of the U.S. experience? What will be the effect on Europe? The article provides insights into possible scenarios.

- **Slide 14: Wave Formation.** This slide illustrates the process of the formation of ocean waves (swells) to their destruction in the surf zone (swash and backwash). On the wave diagram, pay attention to the circles below the surface of the waves. The circular motion is called a "<u>wave orbit</u>." A circular orbit means that wave energy is evenly distributed.
  - ✓ As the orbits change shape and become ovals, wave energy gets concentrated in the upper forward portion.
  - ✓ When the ovals become too steep to contain the energy, the orbits collapse and the wave "breaks;" we see "white water".
  - ✓ Waves approaching a shoreline encounter shallow water. When the bottom of an orbit hits the ocean floor, it forces the wave energy to push higher and forward, creating oval orbits.
  - ✓ They, in turn, produce higher, more forceful swells that pound the coast. The latter affects all shorelines by constantly changing coastline configurations.
  - ✓ ***Know all the terms listed on the slide.***

- **Slides 15 and 16: Tsunami Formation.** Tsunamis are sea waves generated by the energy created by a shock: earthquake, landslide, meteor strike. Tsunamis are most destructive when the waves encounter shallow water: **there is no way for the energized water to go but up** (in height) **and forward** (toward the shoreline). **View the short videos.** (*When we do "Natural Hazards," we will view the major Japanese tsunami at Fukushima in 2011.)*

- **Slide 17: Oceans and People.** This is a summary of the role oceans play with regard to the environmental factors influencing people. It is also a segue to Part III: Human Geography. ***Read the NYTimes article on changes in ocean environment and marine food supplies.***

- **Slide 18: NEXT – The Atmosphere: Weather and Climate**

©AFG 022021