

Quiz 4 - Study Guidelines

Study Outline

The Study Outline should be used as a means for organizing your class notes. Important concepts discussed in class are listed below.

Winds and Surface Ocean Circulation

- Review the locations of the prevailing High and Low Pressures
- Know how the prevailing surface winds are produced from the atmospheric pressure differences
- Be sure you understand the role of the Coriolis Effect in producing the prevailing winds
- Understand the effect of the Ekman Spiral/Ekman Transport on water motion. Be sure you know the forces at work to produce the spiral.
- Understand the nature of Dynamic Topography and Westward Intensification. Be sure you know the forces at work and why the western side is intensified.
- Know the major surface currents: This includes the name and direction of the geostrophic currents (Note: these are also known as sub-tropical gyres) Be sure you review the information from Assignment #3.
- Understand the nature of wind-induced vertical circulation:
- Know the processes producing the Indian Ocean Monsoon System and the effects of the Monsoon in terms of ocean circulation patterns

Water Density and Deep Ocean Circulation

- Review the hydrologic cycle and the vertical circulation cells of the atmosphere and understand the roles that they play in controlling surface ocean properties related to density (especially salinity)
 - Know the definitions of thermocline, halocline, and pycnocline (This includes an understanding of the vertical patterns of temperature, salinity, & density in the ocean)
 - Know the difference between the Surface Mixed Zone and the Deep Zone
 - Know what is meant by Thermohaline Circulation and where this circulation originates in the ocean environment
 - Know how water masses in general are identified and named. Pay special attention to Antarctic Bottom Water and North Atlantic Deep Water
 - Understand how seafloor topography can affect the flow of bottom water (This is the effect of sill depth)
 - Know what processes can cause deep water to "age" and how oxygen content is used to determine the age of the water masses
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Review Questions

The following questions are designed to help you review the concepts presented in class. You should refer to both your class notes and the textbook when answering the questions. Remember to review the information from Assignments and any activities completed in class.

Winds and Surface Ocean Circulation

1. The portions of the vertical circulation cells in the lower atmosphere initially move in north-south directions and yet none of the prevailing winds at the Earth's surface move in a north-south direction. This is due to the Coriolis Effect. Is the Coriolis Effect the same in polar and equatorial regions?

Is the Coriolis Effect the same in both Hemispheres?

2. Sketch the prevailing winds at the Earth's surface. Be sure you indicate the location of atmospheric high pressures and low pressures since these are responsible for initiating the wind flow.

3. What prevailing winds are responsible for producing the sub-tropical gyre currents?
4. Referring to the Ekman Spiral, give the angle and direction of net transport of water for the Northern Hemisphere and the Southern Hemisphere. (This is the Ekman Transport.) What forces are at work to produce the spiral effect?
5. As a result of Ekman Transport, water piles up in the centers of the sub-tropical gyres forming a "hill". This is called dynamic topography of the sea surface. The dynamic topography of the sea surface is balanced by two forces to produce geostrophic currents. What are the two balancing forces?
6. The "hill" of water is asymmetric. Which side of the hill has a thicker pile of water? What causes this effect?
7. How do the boundary currents of the gyres respond to the asymmetric nature of the "hill"? (Compare the strength of the western versus the eastern boundary currents)
8. Name the strongest boundary currents for the North Pacific and North Atlantic and indicate their direction of flow.
9. Is the intensification effect different for the Southern Hemisphere? Name the strongest boundary currents for the Southern Pacific and Atlantic and indicate their direction of flow.
10. The West Wind Drift is a circum-global current. What winds drive this current? Does the West Wind Drift have a Northern Hemisphere counterpart? Why or why not?
11. Describe the relationship between the wind, the surface current it creates and the development of equatorial and both types of Coastal Upwelling.
12. How would you change the wind direction in the coastal environment to produce downwelling of surface water? Remember there are two types of coastal downwelling.
13. The Indian Ocean Monsoon System describes a system of reversing winds and ocean currents for the Northern Hemisphere Indian Ocean. Explain the basic reason for the reversal of the winds (What is controlling this effect?)
14. Under which conditions (summer or winter) would you expect coastal upwelling to develop in the northwest Indian Ocean (Arabian Sea)?
15. How is the climate of India and Somalia affected by the Monsoon System?

Water Density and Deep Ocean Circulation

1. What processes affect the distribution of temperature, salinity, and density of the surface ocean waters?
2. Describe the thermocline. Is the thermocline better developed in low latitudes or high latitudes? Why?
3. Describe the halocline. The halocline is better developed in the sub-tropics. Why?
4. Describe the pycnocline. Is the pycnocline better developed in low or high latitudes?
5. What is Thermohaline Circulation? What drives Thermohaline Circulation?
6. What are the 2 major deep/bottom water masses and where do they form?
7. The aging process of water masses may be monitored by measuring the amount of dissolved oxygen in deep waters (below 4000 meters).
Where are the highest concentrations of dissolved oxygen found?
(This identifies the youngest deep waters.)
8. What processes are responsible for the decrease in dissolved oxygen content?
(This is the aging process of deep water.)
9. Where are the oldest waters found?
10. How long may a deep water mass be isolated from the surface (and therefore a new supply of oxygen)?
11. Describe what is meant by the term "sill depth".
Note: Fracture Zones along oceanic ridges and rises as well as the connection between the Mediterranean Sea and the Atlantic Ocean can all be used as excellent examples of sill depth.