

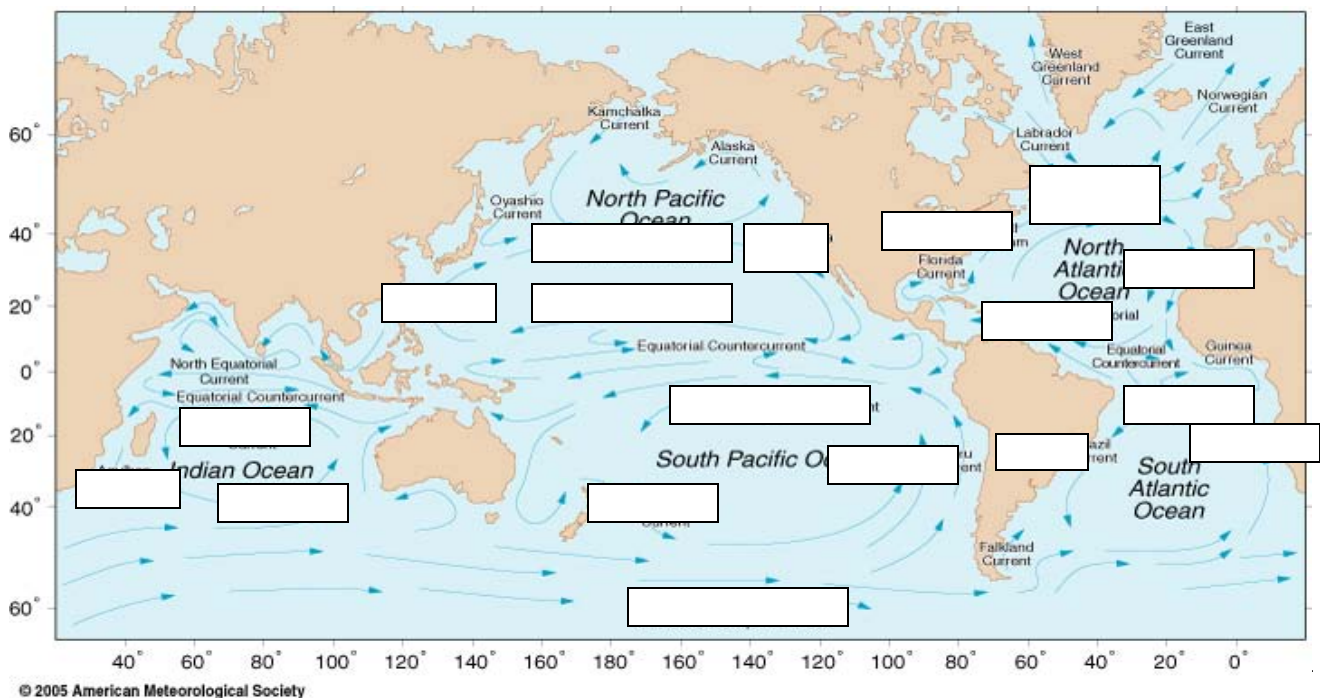
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Marine Biology Chapter Review Questions

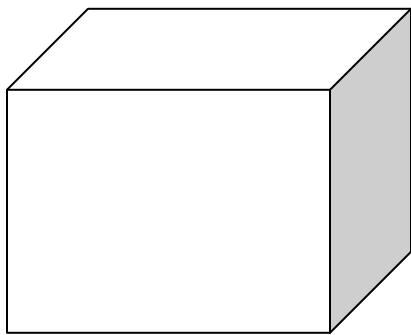
Chapter 9: Highways in the Sea

Part 1: Surface Currents (pages 3-8)

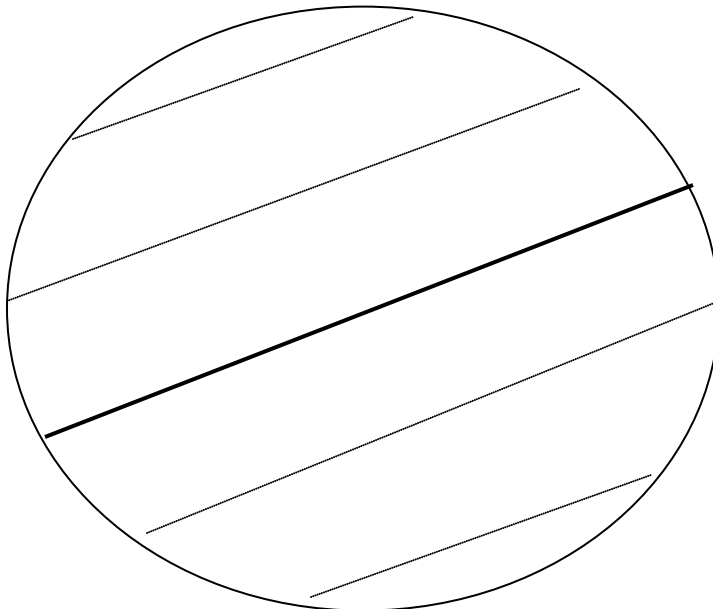
1. Surface currents are generally from _____ to about _____ meters (_____ feet). Deep currents are those whose _____ below the surface.
2. What are the 3 major factors that set ocean currents in motion?
 - a.
 - b.
 - c.
3. How do winds affect currents?
4. Changes in sea level occur at across _____. Sea level is defined as _____.
5. Ocean circulation causes _____ to develop.
6. Differences in water density also cause _____ in water pressure. Horizontal pressure gradient initiates a _____ that flows _____.
7. What is the exception to the fact that large currents eventually run into land?
8. The combination of the Westerlies pushing water _____ along the upper _____, and the trade winds pushing it _____ near the equator, and the _____ effect results in a circular flow called a _____. There are _____ major gyres.
9. Label the major currents in each of the 5 gyres on the map (use fig. 9-5)



10. A gyre is a _____ water flow, even though oceanographers divide it into _____ interconnected _____.
11. What 4 currents make up the North Atlantic current
- a.
 - b.
 - c.
 - d.
12. What winds affect the North Atlantic current? _____. What winds affect the North Equatorial current? _____.
13. The spiraling effect of water continually moving slightly to the right of the water above it (left in the Southern hemisphere) is called an _____.
14. Draw and label the Ekman transport diagram (fig. 9-4) on the figure below.



15. What is the Ekman Transport? How far does it move water?
16. On the earth diagram below, draw and label the major surface wind patterns and the direction of air flow (fig. 9-1). Draw and label the major ocean currents that match the wind patterns.



Part 2: Western/Eastern Boundary currents (pages 8-16)

1. Satellite pictures show that in some areas of the ocean, circulation causing water to _____ forming a 'hill'. In other areas water _____, this forms _____.
2. All five gyres are called _____ currents, this means relative to the Earth's _____.
3. The two large gyres in the north rotate _____, these are the _____ Gyre and the _____ Gyre. The three large gyres in the south rotate _____, these are the _____ Gyre, the _____ Gyre and the _____ Gyre.
4. Use the chart to describe the four types of boundary currents found in each gyre.

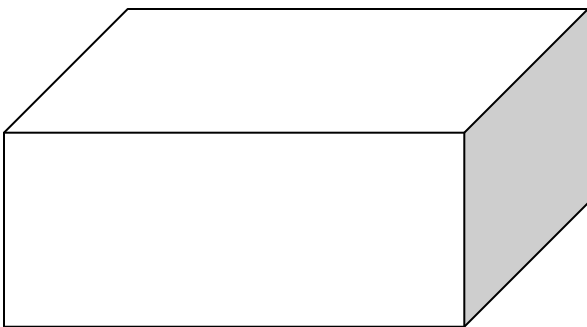
Type of Current	Side of ocean basin	Characteristics	Direction/ winds	Examples (4)
Western Boundary				Gulf stream
	West			
			West-east	
Southern transverse				

5. An eddie is a _____
6. Why are eddies important?
7. What causes western intensification?
8. How does the 'dome' of water inside an ocean gyre affect the boundary currents?
9. What current carries the most water?

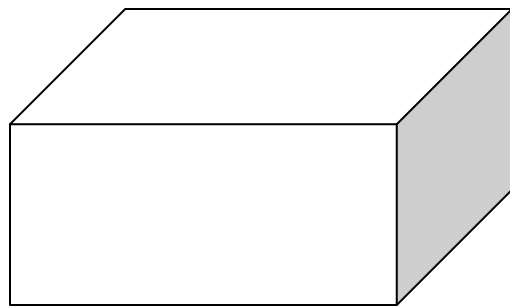
Part 3: Countercurrents/Upwelling and Downwelling (pages 16-20)

1. Countercurrents are associated with _____. A countercurrent runs in the _____ direction of its adjacent current.
2. An undercurrent flows _____ the adjacent current instead of beside it.
3. Why is the Cromwell current significant?
4. How do undercurrents affect land masses such as the Galapagos Islands?
5. Define upwelling:
6. Define downwelling:
7. What causes a coastal upwelling?
8. Sketch the diagrams comparing coastal upwelling (fig. 9-13) to equatorial upwelling (fig. 9-15).

Coastal upwelling fig. 9-13



Equatorial upwelling fig. 9-15



9. An upwelling tends to bring deepwater _____ up into shallow water. How does this increase biological productivity?
10. What are the biological effects of downwelling?

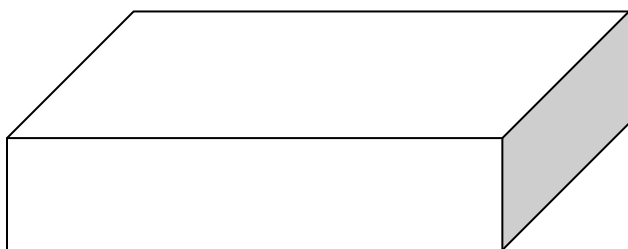
Part 4: Heat Transport/El Nino (pages 20-24)

1. Currents redistribute about a _____ of the heat in the tropics. Transporting all this heat affects climate by moderating temperatures. How would climates change without heat transfer?
2. What is an ENSO event?

3. In the space provided draw the diagram showing Pacific circulation pattern. Explain what is happening below

Normal patterns fig 9-16

El Nino patterns fig 9-17



4. How can ENSO events affect Southern California coastal waters?

5. How is La Nina different from El Nino?

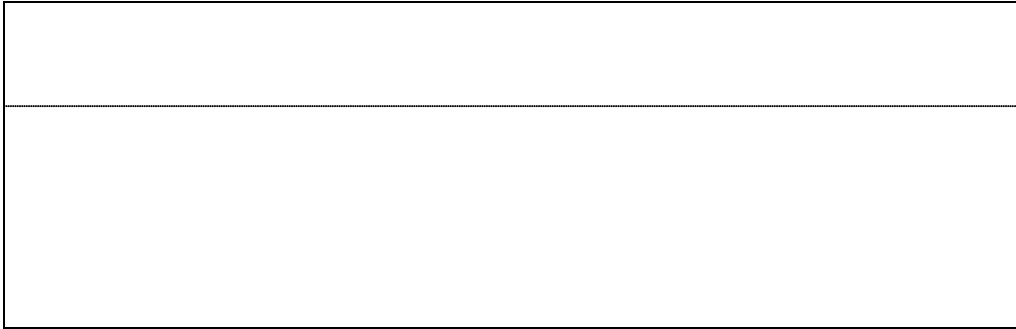
Are You Learning? (page 25)

- | | | | |
|----------|----------|----------|-----------|
| 1. _____ | 4. _____ | 7. _____ | 10. _____ |
| 2. _____ | 5. _____ | 8. _____ | 11. _____ |
| 3. _____ | 6. _____ | 9. _____ | 12. _____ |

Part 5: Deep Currents (pages 24-32)

1. What is thermohaline water circulation?
2. When water becomes denser than the water below it ,the _____ water sinks, causing an _____ flow.
3. What are the five recognized primary water masses?
 - a.
 - b.
 - c.
 - d.
 - e.
4. Why do differences in water masses develop at the surface?
5. Where is the densest water mass and what is it called?

6. How does dense bottom water form?
7. What is Mediterranean Deep Water ? How is it different from Antarctic Bottom Water?
8. Draw and label the pattern of thermohaline circulation as seen in fig. 9-25.



9. What is the ocean conveyor belt? Why is it important?

Are You Learning? (page 25)

1. _____
2. _____
3. _____
4. _____
5. _____

Part 6: Studying Ocean Currents (pages 34-36)

1. What are the two approaches used in studying ocean currents?
2. Describe the following methods and instruments used:
 - a. Lagrangian
 - b. Eulerian
 - c. Doppler Acoustic Current Meter
 - d. Satellites
 - e. Shoe and duck incidents