

Name: \_\_\_\_\_ Period: \_\_\_\_\_

**Computer Lab, Standard Set 5. Energy in the Earth System (Ocean and Atmospheric Convection)**

Uneven heating of Earth causes air movements and oceans and the water cycle influence weather. Heat is transferred by radiation, conduction and convection and radiation from the Sun is responsible for winds and ocean currents which in turn influence the weather and climate. Less-dense fluids rise and cooler, denser fluids sink. Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents. There is a relationship between the rotation of Earth and the circular motions of ocean currents and air in pressure centers.

Go to: <http://geosun1.sjsu.edu/~dreed/105/exped8/1.html> **DO NOT** download expedition. Read each page, answer the questions at the bottom of each page and complete questions #1 to #30 below—good luck!  
Expedition #8 Global Circulation and the California Current

**1. Objective: Study the flow of ocean water along with its climatic impact and environmental consequences.**

**2. Ocean Temperature** - If there was no motion in the ocean, how would the sea surface temperature distribution be different from the global sea surface temperature shown in the WWW exercise?

_____	Arctic	_____
_____	Equator	_____
_____	Antarctic	_____

**3. Temperature Within the Sea** - from Expedition 7 - What is the temperature of the vast majority of the ocean \_\_\_\_\_?

**4. Seawater Density** - from Expedition 7 - Which properties cause an increase in the density of seawater \_\_\_\_\_ & \_\_\_\_\_?

**5. Ocean Circulation** - The two types of ocean currents are \_\_\_\_\_ & \_\_\_\_\_. The \_\_\_\_\_ circulation is driven by \_\_\_\_\_ whereas \_\_\_\_\_ is driven by \_\_\_\_\_?

**6. Atmospheric Heat** - Make a simple sketch of the global distribution of heat in the atmosphere.

**7. Atmospheric Heat and Pressure**

What happens to the air pressure below masses of warm, rising air \_\_\_\_\_?

What happens to the air pressure below masses of cold, sinking air \_\_\_\_\_?

Make a diagram of this process with labels

--	--

**8. Global Atmospheric Pressure** - Make a sketch of the global distribution of atmospheric pressure. (Put H's in High Pressure regions and L's in low pressure areas.)

**9. Air Pressure and Wind** - Make a simple sketch of the relationship between atmospheric pressure, vertical motion of air masses and the direction of the wind.

--	--

What direction does the wind blow, in regards to systems of atmospheric pressure away from \_\_\_\_\_ pressure and towards \_\_\_\_\_ pressure?

**10. Wind Directions on a Rotating Earth** - Why doesn't the wind flow in a straight direction on our Earth \_\_\_\_\_?

The deflection of the wind is in which direction in the northern hemisphere (if viewed in the direction of the wind) \_\_\_\_\_?

The deflection of the wind is in which direction in the southern hemisphere (if viewed in the direction of the wind) \_\_\_\_\_?

At the equator will the coriolis effect will deflect objects in motion \_\_\_\_\_?

**11. Global Wind Patterns** - Sketch a diagram showing the directions of the wind around low and high pressure systems in the northern and southern hemispheres of the Atlantic and Pacific Ocean.

**12. Measuring Surface Circulation** - List four methods that are used to trace the direction of ocean currents in the global oceans?

1) \_\_\_\_\_

2) \_\_\_\_\_

3) \_\_\_\_\_

4) \_\_\_\_\_

**13. Tracking Major Ocean Surface Currents** - Distribution of Instruments

How will the distribution of drifters influence the accuracy of our ability to trace ocean currents

\_\_\_\_\_ ? (not directly mentioned on WWW site)

**14. Tracking the Ocean Surface Currents in the Equatorial Pacific** - Make your drawing of the arrows showing the motion of the drifters (draw at least eight of the arrows, but uniformly distributed through the ocean in this region)

**15. Tracking the Ocean Surface Currents in the North Pacific** - Make your drawing of the arrows showing the motion of the drifters (draw at least eight of the arrows, but uniformly distributed through the ocean in this region)

Where on the map have the buoys drifted the farthest distance over this month of observations  
\_\_\_\_\_? (Look for longest arrows)

Tracking the Ocean Surface Currents in the South Pacific - Make your drawing (draw at least eight of the arrows, but uniformly distributed through the region)

**16. Tracking the Ocean Surface Currents in the North Atlantic** - Make your drawing (draw at eight the arrows, but uniformly distributed through the ocean in this region).

Where on the map have the buoys drifted the farthest distance over the past month in the north Atlantic ocean \_\_\_\_\_? (Look for longest arrows)

Make your drawing of ten arrows in the South Atlantic Ocean

**17. Tracking the Ocean Surface Currents in the Indian Ocean** - Make your drawing (draw eight of the arrows, but uniformly distributed through the ocean in this region)

**18. Compare your diagrams** in parts 14-15 with the diagrams of Annual Mean Current Velocity in the Pacific Ocean as shown on the expedition WWW page. The arrows on the WWW page represent averages of the surface currents over several years and do not include the important variations and complications shown in the buoy trajectories (variance in statistics) due to ocean eddy currents, which are irregular circular currents many 10's to 100's kilometers in diameter – Modify your diagrams if you wish to show the average direction of flow.

**19. and 20. Tracking the Ocean Surface Currents** - Now Compile a Global Map of Surface Currents - Compile a few vectors in each ocean basin to show the flow (Use maps in parts 18, 19, and 20 of expedition.)

**21. Major Ocean Surface Currents** – Label the names of the major surface currents on the map above. The big circular currents are called \_\_\_\_\_?

In what direction do the large, central gyres flow in the northern hemisphere \_\_\_\_\_?

In what direction do the large, central gyres flow in the southern hemisphere \_\_\_\_\_?

In what direction do the gyres flow near the equator (i.e. the north and south equatorial currents)? \_\_\_\_\_

Which surface current encircles the entire globe and therefore affects every ocean \_\_\_\_\_?

**22. The Equatorial Counter Currents** - In what direction does the counter currents along the equator flow in relation to the central gyres \_\_\_\_\_?

**23. Western and Eastern Boundary Currents - Complete the table below:**

Current Name	Western or Eastern Boundary Current	Relative Speed Fast or Slow?	Relative Temperature Warm or Cold?
Example: Peru Current	Eastern	Slow	Cold
Kuroshio			
California			
Gulf Stream			
Aguthas			
Brazil			

**24. Western and Eastern Boundary Currents II** - How might the western boundary currents, such as the Gulf Stream or Kuroshio, influence coastal climates?

**25. Western and Eastern Boundary Currents III** - How might the eastern boundary currents, such as the Peru current or California current, influence coastal climates?

**26. The California Current** - And It's Not Some Trendy Bistro! --Jim Bettinger Eastern boundary currents carry \_\_\_\_\_ (temperature) water and flow at a relatively \_\_\_\_\_ speed. Western boundary currents carry \_\_\_\_\_ (temperature) water and flow at a relatively \_\_\_\_\_ speed.

**27. Current Marine Conditions** - Complete the table. **Note** that station 46059 is in the open ocean whereas the other stations are closer to the coast

Real-Time Observation	46026	46012	46042	46059
1) Latitude				
2) Longitude				
3) General Location				
4) Air Temperature				
5) Sea surface temperature				

**28. Why is the water at the coast so cold along California?**

**29. How does upwelling set the framework for the marine ecosystem along California?**

**30. How does coastal upwelling relate to the habitats and ecosystems examined during your trip to the Monterey Bay Aquarium?**

**Summarize what you learned in the expedition**

**Things you need to know about Standard 5.** Know the origin and effects of temperature inversions.

Know the properties of ocean water, such as temperature and salinity, which can explain the layered structure of the oceans, the generation of horizontal and vertical ocean currents and the geographic distribution of marine organisms.

Rain forests and deserts on Earth are distributed in bands at specific latitudes

Go to: [http://www.students.r.csbsju.edu/rahoffman/hadley\\_cells.htm](http://www.students.r.csbsju.edu/rahoffman/hadley_cells.htm) What is a Hadley Cell?

Go to: <http://www.atmos.umd.edu/~owen/CHPI/IMAGES/circs02.html> Where does it occur?

The interaction of wind patterns, ocean currents and mountain ranges results in the global pattern of latitudinal bands of rain forests and deserts.

Go to: <http://pubs.usgs.gov/gip/deserts/types/> What are the types of deserts and how is each defined?

Go to: <http://topex-www.jpl.nasa.gov/overview/climate-climatic.html> What latitude do the deserts lie in and why are they located in that latitude?

ENSO (El Nino southern oscillation) cycle affects sea-surfaced and air temperature variations across the Pacific and some climatic results of this cycle.

Go to: <http://nsipp.gsfc.nasa.gov/enso/primer/index.html> and select your language of choice.

Use the black triangle that points to the right (located in the yellow margin on the left side), to navigate this site. You may also use the audio portion to assist you in learning about the El Nino.

ENSO Primer 1: What is El Nino?

ENSO Primer 2: How often is El Nino experience? How does it occur?

ENSO Primer 4: How does the change in water temperature affect the atmosphere above it?

ENSO Primer 5: How does El Nino affect the southern California weather?

ENSO Primer 6: How does El Nino affect the southern California precipitation (rainfall)?

ENSO Primer 7: How is Africa affected in the El Nino years?

ENSO Primer 8: Are there financial disadvantages in El Nino years? Why?

ENSO Primer 9: What changes faster during an El Nino, the atmosphere or the ocean?