

Name: _____

Introduction to Oceanography 112 - M. Yasuda

Date: October 22, 2009

Assignment 9

Reading – Week 9 - The nature of water

1. Chapter 8: Circulation in the Atmosphere
2. Appendix V: The Coriolis Effect

Vocabulary list

- | | | |
|---------------------------------|----------------------------|--------------------------|
| 1. Energy | 12. Emission of energy | 24. Precipitation |
| 2. Heat | 13. Geographic equator | 25. Heat |
| 3. Temperature | 14. Meteorological equator | 26. Atmospheric pressure |
| 4. Processes of energy transfer | 15. ITCZ | 27. Monsoon |
| 5. Potential energy | 16. Coriolis effect | 28. Seasonal variability |
| 6. Global energy budget | 17. Surface winds | 29. Climate |
| 7. Earth systems | 18. Trade winds | 30. Weather |
| 8. Dynamic equilibrium | 19. Westerlies | 31. Storms |
| 9. Electromagnetic radiation | 20. Polar easterlies | 32. Cyclones |
| 10. Reflection of energy | 21. Hadley cell | 33. Hurricanes |
| 11. Absorption of energy | 22. Doldrums | |
| | 23. Evaporation | |

Websites related to lecture

California's Water - A vanishing resource

Ambitious overhaul of state water system in works

<http://www3.signonsandiego.com/stories/2009/oct/20/ambitious-overhaul-system-works/?california&zIndex=185610>

The Earth's climate, both local and global, is set by linked processes involving transfer of the Sun's energy between air and sea around the world. In the section on The Atmosphere, we'll see that California sits at an arid latitude although it enjoys pleasant weather associated with near the coast. But water supply is short and expected to be more so into the future – to the extent that the prosperity of the state, individuals and living things in our coastal marine habitats are threatened. Multiple solutions have been proposed. For San Diego, that includes conservation, greater efficiencies, more storage, and perhaps desalination, making fresh water by removing the dissolved ions in sweeter, in addition to other things. Deciding on the right set of solutions to meet natural hazards and other priorities is part of everyone's business. A basic science background lets you make personal choices in a useful ways, to support groups that advocate for your preferences, and to participate directly in finding new solutions if you have an inclination. The idea collectively is to avoid a worst-case scenario. In the case of water supply, even though the subject seems land- rather than ocean-oriented, it is related to oceans – because climate is dependent on oceans and how we decide to deal with water supply will impact coastal marine environments.

GOALS

1. Know the generalized pattern of winds at the earth's surface and in a vertical cross-section
2. Know the general latitudes associated with high and low atmospheric pressure, and high and low precipitation
3. Be able to identify the source of energy for atmospheric circulation
4. Be able to explain why sunlight isn't received evenly over the surface of the earth
5. Be able to explain why regional differences in heating lead to air circulation
6. Know what happens to a moving object as a result of the Coriolis Force
7. Be able to identify conditions that cause clouds to form
8. Know the common names given to the three naturally-occurring phases of water found at the Earth's surface
9. Know whether energy is released or consumed with water changes phase
10. Know whether the water in clouds is in the gas, liquid or ice phases
11. Know what happens at the ITCZ and where the ITCZ is located
12. Know the definition of a cyclone
13. Know the definition of monsoon
14. Be able to describe the relationship between hurricanes and warm sea surface temperatures
15. Know why hurricanes die out over land

In-class/homework activities

Homework questions

Type your answers on a separate sheet of paper, double-spaced with wide margins so I have space to write comments. No credit for essay answers that are not typed. Deduction for answers that are not double-spaced. Where an essay answer is required, make sure to write out a complete and logical explanation using the best grammar and spelling that you can. Write in complete sentences.

A. Sound, sonar and mechanical waves

1. **Read about the SOFAR channel.**
 - a. **Sound Fixing and Ranging (SOFAR)**
<http://oceanexplorer.noaa.gov/explorations/sound01/background/acoustics/media/sofar.html>

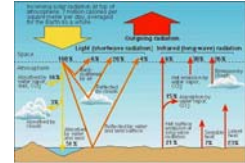
Project MOGUL and the Roswell Incident (FYI only)
<http://www.roswellfiles.com/Articles/ProjectMogul.htm>
 - b. **See page 175 in your textbook, Figure 6.24**
2. **True or false. No explanation required.**
 - a. Sound waves and all mechanical waves require a medium (i.e. matter) in order to pass through
 - b. Matter is generally composed of atoms, molecules and parts of atoms
 - c. A “vacuum” is full of matter
 - d. Sound travels through air faster than through water
 - e. Sound travels at the speed of light.
 - f. Sound, earthquake and ocean waves are all kinds of mechanical waves
 - g. Sound travels through cold water faster than warm water
 - h. Sound travels through water at high pressure faster than low pressure
 - i. When sound waves travel from place-to-place, it moves matter with it
 - j. When sound waves travel from place-to-place, it moves energy with it
 - k. Sound wave can only travel a short distance in seawater
 - l. Sound travels through outer space
3. **At what depth is the SOFAR channel?**

B. Energy

1. **Read about the electromagnetic spectrum**
 - a. **Electromagnetic spectrum**
http://imagine.gsfc.nasa.gov/docs/science/know_11/emspectrum.html
 - b. **See page 173 of your textbook, Figure 6.22**
2. **True or false. No explanation required.**
 - a. Electromagnetic (EM) waves require a medium (i.e. matter) in order to pass through
 - b. All EM waves travel at the speed of light
 - c. X-rays, microwaves, visible light and infrared waves are all types of EM waves
 - d. Infrared waves are more harmful to humans than ultraviolet waves
 - e. Infrared waves have shorter wavelength than ultraviolet waves
 - f. The energy content of infrared waves is less than ultraviolet waves

- g. Our eyes and brain can sense and visualize different wavelengths in the visible part of the spectrum as different colors
- h. The Sun mainly emits visible light
- i. When EM waves travel from place-to-place, it transmits and carries matter with it
- j. When EM waves travel from place-to-place, it transmits and carries energy with it
- k. EM waves can only travel a short distance in seawater
- l. EM waves enter the ocean from the top
- m. EM waves travel through outer space
- n. EM waves are the only way that information can travel between satellites and the surface of the Earth

C. Global energy budget and balance



1. See page 205 of your textbook, Figure 8.3
2. Which of the following Earth processes are ultimately fueled by sunlight? Circle your answers.

a. Volcanoes	f. Melting ice
b. Plate motion	g. Water cycle
c. Winds	h. Most living things
d. Ocean circulation	i. Hot springs and geysers
e. Evaporation	
3. True or false, no explanation required.
 - a. All sunlight is absorbed by molecules and atoms in the atmosphere
 - a. Nitrogen absorbs significant amounts of incoming visible light
 - b. Carbon dioxide absorbs significant amounts of incoming visible light
 - c. Carbon dioxide absorbs significant amounts of outgoing infrared radiation
 - d. Earth processes utilize sunlight in complex ways before that energy is ultimately released back to space in the form of EM radiation
 - e. By getting a handle on numbers associated with parts of the global energy budget, it helps us understand how major Earth processes work
 - f. Once it has absorbed solar energy, matter in the atmosphere and oceans carry and redistribute energy around the Earth
 - g. Energy from sunlight was in your breakfast
 - h. The solid and liquid surface of the Earth, and thus plate tectonics, influences the details of the global energy budget
 - i. The global energy budget influences the Earth's climate and weather
 - j. Climate and weather influence life on Earth
 - k. Life on Earth influences the climate
 - l. Life on Earth influences plate tectonic processes
 - m. Life influences plate tectonic processes
4. Energy arrives from the Sun on a regular basis. Does it pile up on Earth and cause the temperature of the Earth to rise? Explain.
5. When the substances in air absorb energy, atoms and molecules move faster. Thus, the temperature of air becomes higher.

When these materials release or emit energy back into the environment, they emit infrared radiation (i.e. heat).

Looking at the diagram, when does the atmosphere gain the most energy?

- a. As sunlight first passes through the atmosphere on the way down
 - b. As absorbed sunlight is emitted back through the atmosphere on its way out
6. Some sunlight gets snagged in the atmosphere by water vapor, dust and carbon dioxide on the way in. Why don't the same materials snag sunlight on the way out? Explain.

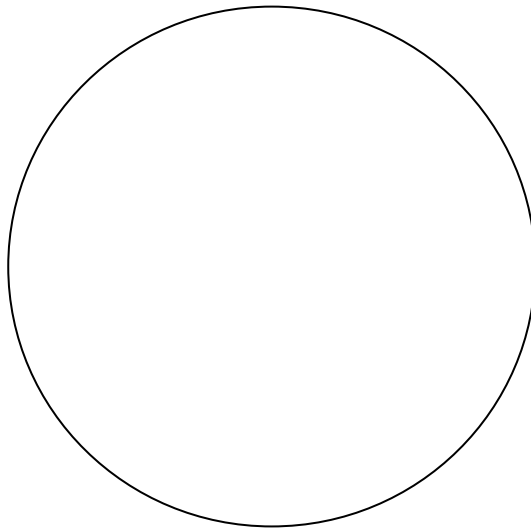
D. Atmospheric circulation

1. Drawing – Surface winds

Draw the pattern of winds at the earth's **surface** on the globe below.
Add the names of the winds and show arrows representing wind direction.
Show the proper spacing of winds with respect to latitude.

Include:

1. Equator, 30°N, 30°S, 60°N, 60°S, 90°N, 90°S
2. Northeast trades
3. Southeast trades
4. Westerlies in both hemispheres
5. Polar easterlies in both hemispheres
6. Intertropical Convergence Zone - ITCZ



2. Drawing

Draw the pattern of winds in a **vertical section** across the earth's surface.
You might want to refer to Figure 8.13 in your text too.

Show:

1. The direction of the winds in vertical cells
2. High and low pressure areas
3. Areas of high and low cloud cover

