Adult Basic Education

Science

Science 3104
Introduction to Oceanography

Study Guide

Prerequisites: None

Credit Value: 1

Text: ***Earth Science***; Tarbuck, Edward J. and Frederick K. Lutgens; Prentice Hall: Massachusetts; 2006.

Science Courses [General College Profile]

Science 2100A
Science 2100B
Science 2100C
Science 3101
Science 3102
Science 3103
Science 3104
Science 3105
Science 3106

Table of Contents

To the Student

I. Introduction to Science 3104

Science 3104, ***Introduction to Oceanography***, will give you a basic understanding of the ocean's cyclic movements which include waves, currents and tides. You will have opportunities to investigate interactions between the oceans and shorelines, relationships between ocean currents, wind, and climates, and the chemical and physical composition of seawater and the ocean floor. The context of this course will include local coastlines in the region, as well as how the ocean and local coastlines interact.

You will be required to complete three **Assignments** in this course. You will also be required to complete one **Core Lab**. Additional assignments and/or laboratory investigations may be added by your instructor.

The textbook that you will need for this course is ***Earth Science****;* Tarbuck and Lutgens; Prentice Hall: 2006.

II. Use of Study Guides

Before beginning this course, ensure you have the text and any other resources needed *(see the information in the Introduction to this course for specifics)*.

As you work through the Study Guide, you will see that it is divided according to the Units listed in the Table of Contents. When you open a unit it will have the following components:

Reading for this Unit:
Here you will find the chapters, sections and pages of the text you will use to cover the material for this unit. Skim the sections of the textbook, look at the titles of the sections, scan the figures and read any material in the margins. Once you have this overview of the unit, you are ready to begin. Do not be intimidated by the content. You will work through the text, section by section, gaining knowledge and understanding of the material as you go.

References and Notes	Work to Submit
This left hand column guides you through the material to read from the text. Read any highlighted notes that follow the reading instructions. The symbols ▶▶ direct you to the questions that you should complete when finished a reading assignment..	You come across three (3) headings in this right hand column. **Writing:** This section comprises your notes for the unit. Here you will find either written questions or references to specific questions or problems from your text. You may want to write out each question followed by the answer. This material should be checked by your instructor before moving on to the next unit. **Laboratory:** This section indicates if there is a Core Lab that should be completed for the unit. Let the instructor know in advance that you will be ready for the lab. A lab report should be submitted for each Core Lab. Your instructor will provide guidelines as to how s/he wants the report written. **Assignment:** This section indicates if there is an assignment that should be completed for the Unit. The information in the "References and Notes" column will indicate how you obtain the assignment. These assignments frequently relate the science content to technology, society and the environment.

III. Recommended Evaluation

Written Notes	10%
Labs/Assignments	20%
Test(s)	20%
Final Exam *(entire course)*	50%
	100%

Unit 1 - Features of the World Ocean

To fulfill the objectives of this unit, students should complete the following:

Reading for this unit: *Earth Science*
Chapter 14: Section 14.1: pages 394 - 400
Section 14.2: pages 401 - 405

References and Notes

Refer to pages 394 - 400 and answer questions 1.1 to 1.9 ⏩⏩

Note:
You should practice labeling the map of the Earth's Oceans on the activity sheet until you are able to do it without looking in the text. All activity sheets are found in Appendix A and must be included with your notes. You will need to know this material for your tests.

Work to Submit

Writing:

1.1 What percent of Earth's surface is covered by the global ocean?

1.2 What is oceanography?

1.3 List the four main ocean basins.

1.4 Complete *Earth's Oceans Activity Sheet* (found in Appendix A).

1.5 What is bathymetry?

1.6 What are some examples of technology that allow scientists to study the ocean floor?

1.7 (a) What does the acronym SONAR stand for?

(b) How does sonar work?

(c) How does multibeam sonar differ from simple sonar?

1.8 How do satellites map the ocean floor?

1.9 (a) What is a submersible?

(b) What are some advantages of using a submersible?

Unit 1 - Features of the World Ocean

References and Notes

Refer to pages 401 - 403 and answer questions 1.10 to 1.17
⏵⏵

Note:
On average, the depth of the oceans is four times the elevation of the continents! The average elevation of the continents is about 840 m above sea level. The average depth of the oceans is 3729 m. If Earth's solid mass were perfectly smooth and spherical, ocean water would cover it all to a depth of more than 2000 meters!

Note:
You should practice labeling the continental margin on the activity sheet until you are able to do it without looking in the text.

Work to Submit

Writing:

1.10 What are the three main ocean floor regions?

1.11 (a) What is a continental margin?

(b) Compare and contrast the continental margins in the Atlantic and Pacific Oceans.

1.12 (a) What is a continental shelf?

(b) What important resources are found on the continental shelf?

1.13 What is a continental slope?

1.14 What is a submarine canyon?

1.15 (a) What is a turbidity current?

(b) What impact do turbidity currents have on the continental slope?

1.16 What is a continental rise?

1.17 Complete *Atlantic Continental Margin Activity Sheet* (found in Appendix A).

Unit 1 - Features of the World Ocean

References and Notes

Refer to pages 404 - 405 and answer questions 1.18 to 1.21
⏯⏯

Note:
You should practice labeling the features of the ocean floor on the activity sheet until you are able to do it without looking in the text. Ask your instructor for additional sheets if you would like extra practice.

Note:
See your instructor to discuss which questions you should do from the "Section Assessment" and/or "Chapter Assessment" sections of the textbook and any additional work that may be required for this unit.

Work to Submit

Writing:

1.18 Describe the ocean basin floor.

1.19 Define and explain how the following structures are formed:

(a) deep ocean trenches
(b) abyssal plains
(c) seamount
(d) island
(e) guyot

1.20 What is a mid-ocean ridge?

1.21 Complete *Ocean Floor Topography Activity Sheet* (found in Appendix A).

Notice that the profile shown in the activity sheet is a side view of the ocean floor. If the topographic features were drawn to a realistic scale, the map would be 40 times bigger than it is! So the features have to be exaggerated to make them more distinct.

Unit 2 - Seafloor Resources and Seawater Composition

To fulfill the objectives of this unit, students should complete the following:

Reading for this unit: *Earth Science*
Chapter 14: Section 14.4: pages 410 - 413
Chapter 15: Section 15.1: pages 422 - 424

References and Notes

Refer to pages 410 - 413 and answer questions 2.1 - 2.5 ⏩⏩

Note:
Dozens of oil exploration companies have been busy drilling off the coast of Newfoundland and Labrador since 1965. There have been significant discoveries off the Grand Banks, including the Hibernia, Terra Nova, and White Rose oil fields which have had significant economic impacts on the province. There are unique challenges such as icebergs, pack ice, and extreme weather conditions, with drilling for oil on the Grand Banks. There is also the concern of the potential environmental impacts of an oil spill.

Work to Submit

Writing:

2.1 What are the two main energy products currently being obtained from the ocean floor?

2.2 (a) Explain how oil and natural gas are formed.

(b) Where are some of the major offshore oil reserves found?

(c) What is the main environmental concern with offshore petroleum exploration?

2.3 (a) What are some uses of offshore sand and gravel?

(b) What are some valuable materials found in offshore sand and gravel?

2.4 (a) What are manganese nodules?

(b) What are some of the challenges of mining manganese nodules?

References and Notes

Note:
Precipitation *is the formation of a solid in a solution during a chemical reaction. The solid material that is formed is called the* ***precipitate****.*

Refer to pages 422 - 424 and answer questions 2.6 - 2.9 ⏩⏩

Note:
If salinity is expressed as 35 ‰, this means that every 1000 grams of seawater has 35 g of salt and 975 g of water.

Note:
Sodium chloride (NaCl), the most abundant dissolved substance in seawater, is a salt. It has the same chemical composition as the salt you put on food. However, there are many other substances that can also be called salts. Most of these salts, along with many other substances, are also dissolved in seawater.

Work to Submit

Writing:

2.5 (a) How are salts removed from seawater?

(b) Which salt is most economically important?

(c) What are some uses of salt?

2.6 (a) Define salinity.

(b) What unit of measurement is most commonly used to express salinity?

(c) What is the average salinity of seawater?

2.7 What is the most common salt in seawater?

2.8 What are the two main sources of sea salt?

2.9 (a) What are some processes that decrease salinity?

(b) What are some processes that increase salinity?

(c) Look closely at Figure 2 on page 423 and answer the *Applying Concepts* questions there.

Unit 2 - Seafloor Resources and Seawater Composition

References and Notes	Work to Submit
Refer to page 425 and answer questions 2.10 - 2.11 ▶▶	**Writing:** 2.10 (a) Define density. (b) Why is density an important property of seawater? 2.11 (a) What factors influence seawater density? (b) Describe how an increase in each of these factors affects seawater density.
See your instructor to discuss which questions you should do from the "Section Assessment" and/or "Chapter Assessment" sections of the textbook and any additional work that may be required for this unit.	

Unit 3 - Ocean Circulation

To fulfill the objectives of this unit, students should complete the following:

Reading for this unit: *Earth Science*
Chapter 16: Section 16.1: pages 448 - 453
Section 16.2: pages 455 - 460

References and Notes

Refer to pages 448 - 451 and answer questions 3.1 - 3.6. ▶/▶

Note:
Newfoundland and England are at about the same latitude, but the climate in Newfoundland is much cooler than England. How can you explain this?

Work to Submit

Writing:

3.1 What is an ocean current?

3.2 (a) What are surface currents?

(b) How do surface currents develop?

3.3 (a) What are gyres?

(b) List the five main ocean gyres.

3.4 (a) What is the Coriolis effect?

(b) What impact does the Coriolis effect have on currents in the Northern and Southern Hemispheres?

3.5 Explain how each of the following affects climate and give an example:

(a) Currents moving from regions of low latitude to higher latitude.

(b) Currents moving from regions of high latitude to lower latitude.

3.6 (a) What is an upwelling?

(b) How are upwellings important to populations of fish and other marine life?

Unit 3 - Ocean Circulation

References and Notes

Assignment 1 is found in Appendix B of this Study Guide. Read the material carefully and complete the assigned questions. ⏩⏩

Note:
You should submit the completed assignments to your instructor for marking.

While the general concepts in this assignment (e.g. currents, climate, etc) will be included on tests, the specific questions from the assignment will not.

Refer to pages 451 - 453 and answer question 3.7 ⏩⏩

Note:
Recall that in Unit 2 you learned that salt water is more dense than fresh water and that cold water is more dense than warm water. Remember that denser objects sink and less dense objects float.

Referring to Laboratory 1, "Density Currents", found in Appendix B, do the following. ⏩⏩

Note:
Pass your completed lab to your instructor for marking.

Work to Submit

Assignment:

Complete Assignment 1, *Ocean Currents*.

Writing:

3.7 (a) What are density currents?

(b) What are two causes of density currents?

(c) Explain how latitude influences density currents.

(d) Explain how evaporation influences density currents.

Laboratory:

3.8 Complete the investigation and record your observations.

Unit 4 - Waves, Tides and Shorelines

To fulfill the objectives of this unit, students should complete the following:

Reading for this unit: *Earth Science*
Chapter 16: Section 16.2: pages 455 - 460
Section 16.3: pages 461 - 467

References and Notes

Refer to pages 455 - 457 and answer questions 4.1 - 4.7 ⏯⏯

Note:
You should practice labeling the wave diagram on the activity sheet until you are able to do it without looking in the text. Ask your instructor for additional sheets if you would like extra practice.

Note:
Why do you think submarines dive during stormy weather?

Work to Submit

Writing:

4.1 From what source to most waves obtain their energy and motion?

4.2 Define the following parts of a wave:

(a) wave height
(b) wavelength
(c) wave period
(d) crest
(e) trough

4.3 Complete *Wave Activity Sheet* (found in Appendix A).

4.4 Define fetch.

4.5 What three factors determine the height, length and period of a wave?

4.6 (a) Describe the movement of particles in a wave.

(b) At what depth does the movement of water particles stop?

4.7 What causes waves to “break” on a shore?

Unit 4 - Waves, Tides and Shorelines

References and Notes

Assignment 2 is found in Appendix B of this Study Guide. Read the material carefully and complete the assigned questions ⏩⏩

Note:
You might be interested in reading the novel ***Tsunami: The Newfoundland Tidal Wave Disaster****, by Maura Hanrahan. It provides a detailed account of the tsunami through the lives of some of the people who experienced it.*

Refer to pages 458 - 460 and answer questions 4.9 - 4.14 ⏩⏩

Note:
Remember that it takes the moon about one month to revolve around the earth. Therefore, the sun, moon and earth will be lined up twice a month and at right angles twice a month. (See figure 13 on page 459.)

Work to Submit

Assignment:

4.8 Complete Assignment 2, *Grand Banks Earthquake and Tsunami*.

Writing:

4.9 What are tides?

4.10 (a) What force is responsible for ocean tides?

(b) What two bodies in outer space influence tides?

4.11 (a) Briefly explain how tides are produced.

(b) What is a tidal bulge?

(c) Why do most places on Earth experience two high tides and two low tides each day?

4.12 Define tidal range.

4.13 Explain the difference between spring and neap tides.

4.14 List and describe the three main types of tidal patterns.

References and Notes

Assignment 3 is found in Appendix B of this Study Guide. Read the material carefully and complete the assigned questions ▶▶

Refer to pages 461 - 463 and answer questions 4.16 to 4.21 ▶▶

Note:
***Erosion** is the mechanical process of wearing or grinding something down.*

Work to Submit

Assignment:

4.15 Complete Assignment 3, *Tidal Range*.

Writing:

4.16 (a) What is a beach?

(b) Where does most beach sediment originate?

4.17 Describe the effects of wave impact on shorelines.

4.18 (a) What is abrasion?

(b) Where is abrasion most intense?

(c) How does abrasion affect the shoreline?

4.19 (a) What is wave refraction?

(b) How does wave refraction play an important part in the shoreline process?

4.20 (a) What is a longshore current?

(b) How do longshore currents affect shorelines?

4.21 (a) What are erosional features?

(b) What are depositional features?

Unit 4 - Waves, Tides and Shorelines

References and Notes

Refer to pages 464 - 467 and answer questions 4.22 to 4.25
⏯⏯

Note:
Living in this province, you have probably seen examples of many of the erosional and depositional features that you are learning about. Can you think of some specific examples?

You probably also know of places in this province where structures have been built to protect the coastline. Can you give some examples?

Note:
You should practice labeling the shoreline features on the activity sheet until you are able to do it without looking in the text.

See your instructor to discuss which questions you should do from the "Section Assessment" and/or "Chapter Assessment" sections of the textbook and any additional work that may be required for this unit.

Work to Submit

Writing:

4.22 Describe the following erosional features and explain how each is formed:

(a) wave-cut cliff
(b) wave-cut platform
(c) sea arch
(d) sea stack

4.23 Describe the following depositional features and explain how they are formed:

(a) spit
(b) baymouth bar
(c) tombolo
(d) barrier islands

4.24 Complete *Shoreline Features Activity Sheet* (found in Appendix A).

4.25 Describe some examples of structures built to protect a coast from erosion or to prevent the movement of sand along a beach.

Appendix A
Activity Sheets

Earth's Oceans Activity Sheet

Study this map of the Earth and answer the following questions:

1. Label each of the four major oceans.

2. Which ocean is the deepest? _____

3. North America is between which two oceans ? _____

4. Which three continents border the Arctic Ocean? _____

   _____

5. Which ocean is the largest?
   _____

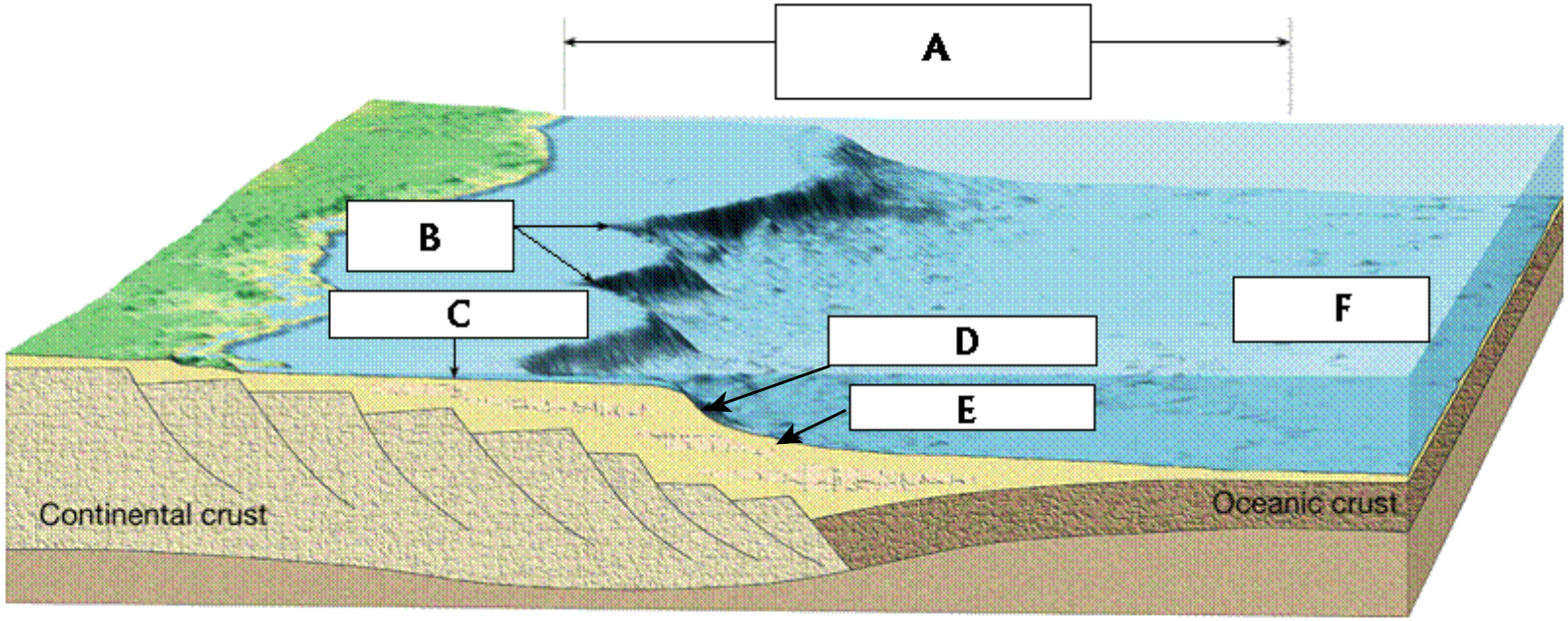
6. In which hemisphere* is the Indian Ocean found? _____

7. Draw a line that proves that all of Earth's oceans are connected

*A hemisphere is the northern or southern half of the Earth as divided by the equator.

Atlantic Continental Margin Activity Sheet

Label the following regions found in the continental margin.



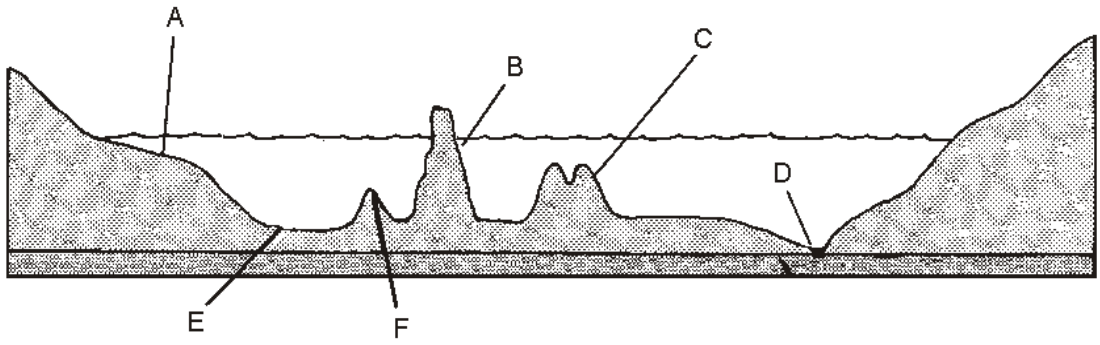
A. _____ D. _____

B._____ E. _____

C. _____ F. _____

Ocean Floor Topography Activity Sheet

On the diagram below, label the structures on the ocean floor.



A. _____

B. _____

C. _____

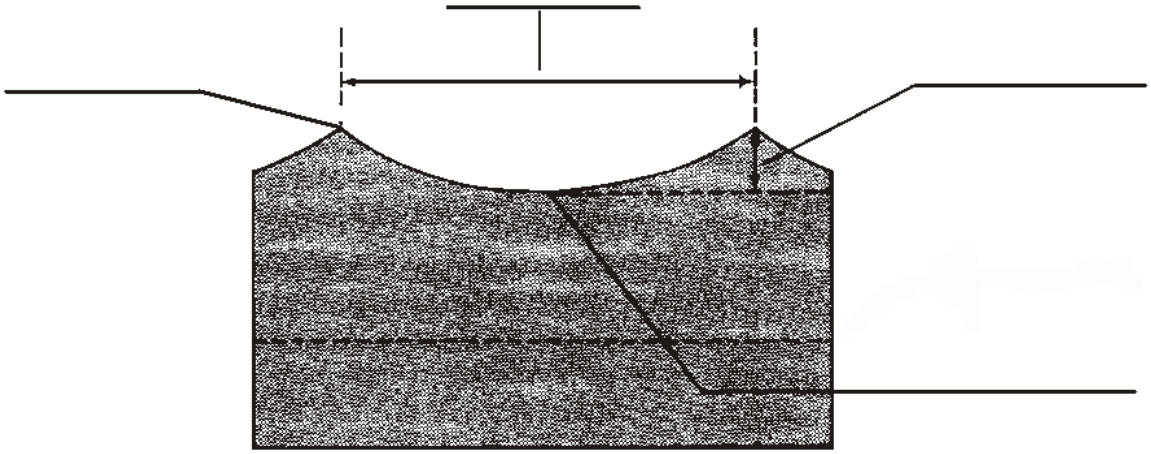
D. _____

E. _____

F. _____

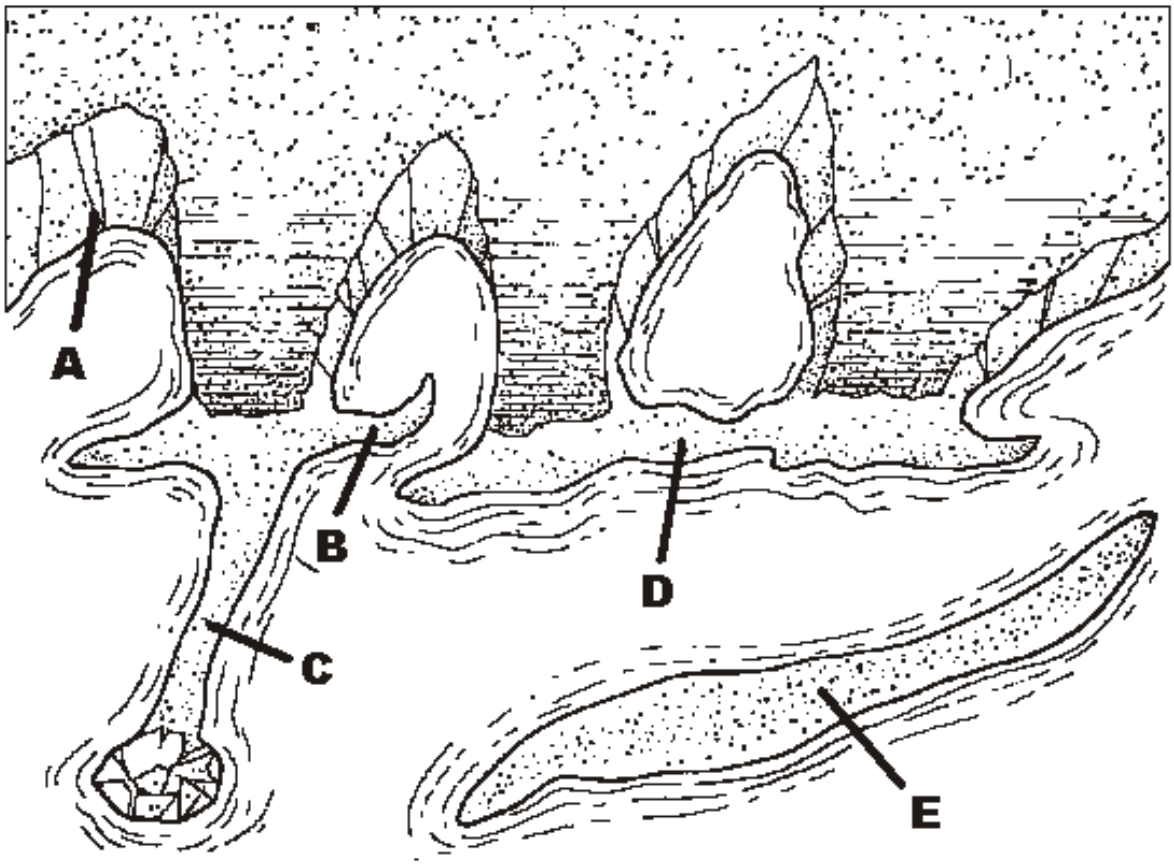
Wave Activity Sheet

On the diagram below, label the four parts of a wave.



Shoreline Features Activity Sheet

Label the shoreline features in the diagram below.



A. _____

B. _____

C. _____

D._____

E. _____

Appendix B
Assignments
Lab

Name: _____ Date: _____

Assignment 1: Ocean Currents

In this assignment, you will learn how two ocean currents affect living organisms. In Part A, you will study the relationships between surface currents and the distribution of some marine organisms. In Part B, you will investigate upwellings and their relationship to the environment.

Part A. Surface Currents

Figure 2 on page 449 of your textbook illustrates the major global surface currents. Use Figure 2 to answer the following questions.

1. Hypothesize why 80% of the species of seaweed found in the British Isles are also found along the eastern coast of the United States. _____

   _____

2. Hypothesize why species of mollusks, starfish, and shrimp found along the west coast of Africa are also found along the southern edge of Asia. _____

   _____

3. Would the temperature of the water off the west coast of the United States tend to be cold or warm? Explain. _____

   _____

4. Does the South Equatorial Current flow clockwise or counterclockwise? _____

   _____

5. What causes currents in the Northern Hemisphere to rotate clockwise, while currents in the Southern Hemisphere rotate counterclockwise? _____

   _____

Part B. **El Nino**

If you examine Figure 2 of your text, you see that the Peru Current flows along the western coast of South America. Actually, the Peru Current consists of two currents. One current flows close to the shoreline. The other current flows in the same direction but at a greater distance from the shore. However, a warmer countercurrent flows between the two Peru Currents and in the opposite direction. Even though the Peru Current is a cold current, it is still warmer than the cooler, deeper water over which it flows.

6. What provides the energy to move the Peru Current? _____

_____

7. Winds blowing off the coast of South America skim the surface water and move it westward. What happens to the cooler, deeper water? _____

_____

8. Explain how the process in Question 7 is responsible for the highly productive fishing industry in Peru. _____

_____

_____

_____

9. Give two reasons to explain why the Peru Current is cold. _____

_____

_____

10. Why is the countercurrent warm? _____

_____

Every three to eight years the trade winds slacken and the strong Peru Current diminishes. For reasons not completely understood, a warm underwater surge called a Kelvin wave flows eastward from the western Pacific. The wave thickens the warm upper ocean surface off the coast of South America. This phenomenon is called El Nino.

11. Aside from the Kelvin wave, what other factor contributes to the warming of the waters off the western coast of South America? _____

_____

12. What happens to the cooler, deeper water as a result of the warming upper layers?

_____

_____

The effects discussed in Question 12 produce disastrous results. The fishing industry declines. Bird populations plummet. Because of the warming water, 90 to 98 percent of the coral reefs west of Panama have died. The effects of the ocean warming on the weather are experienced one-fourth of the way around the world. Australia has droughts, North and South America receive too much rain, and Hawaii has rare hurricanes. Scientists cannot totally explain the development of El Nino but are learning what the consequences can be.

Name: _____ Date: _____

Lab 1: Density Currents

Introduction

Some ocean currents are set in motion by the differences in the density of the water from place to place. These density differences are caused by differences in the water temperature / salinity of seawater. In this lab we will set a density current in motion.

Problem

What effect does temperature and salinity have on the density of water?

Materials

2 baby food jars	stir rod	water
red food coloring	1000 ml beaker	index card
green food coloring	large dishpan	salt

Procedure

PART 1 TEMPERATURE

1. Fill one baby food jar with hot water. Add a few drops of red food coloring. Set the jar in the dishpan.

2. Fill the second jar with cold water. Add a few drops of green food coloring. Place the index card firmly over the top of the jar.

3. Hold the index card firmly in place and carefully turn the jar of cold water upside down over the top of the hot water. **Note: Be sure that the jars are exactly matched.**

4. Carefully remove the index card. Record your observations: _____

   _____

   _____

5. Repeat steps one and two. This time put the index card over the hot water jar.

6. Carefully invert the jar of hot water over the cold water and remove the index card. Record your observations. _____

_____

_____

PART 2 SALINITY

1. Fill one baby food jar with very salty water. Add a few drops of red food coloring. Set the jar in the dishpan.

2. Fill the second jar with fresh tap water. Add a few drops of green food coloring. Place the index card firmly over the top of the jar.

3. Hold the index card firmly in place and carefully turn the jar of fresh water upside down over the top of the salt water. **Note: Be sure that the jars are exactly matched.**

4. Carefully remove the index card. Record your observations: _____

_____

_____

5. Repeat steps one and two. This time put the index card over the salt water jar.

6. Carefully invert the jar of saltwater over the freshwater and remove the index card. Record your observations. _____

_____

_____

Analysis and Conclusion

1. When you placed warm water on top of cold water, did currents form? Explain. _____

_____

_____

2. When you placed cold water on top of warm water, did currents form? Explain.

_____

_____

3. Which water is more dense, hot or cold? How do you know? _____

_____

_____

4. Did the salt water mix with the freshwater? Defend your answer. _____

_____

_____

5. Explain what happens when the cold Labrador Current meets the warm Gulf Stream. How does this impact ocean life in the area? _____

_____

_____

_____

6. Holyrood Pond in Newfoundland has many different species of fish, including cod, hake, sticklebacks, smelts, salmon, and trout. Do you think the lake is fresh, salt, or both? Where in the water column would you expect to find cod? Trout? _____

_____

_____

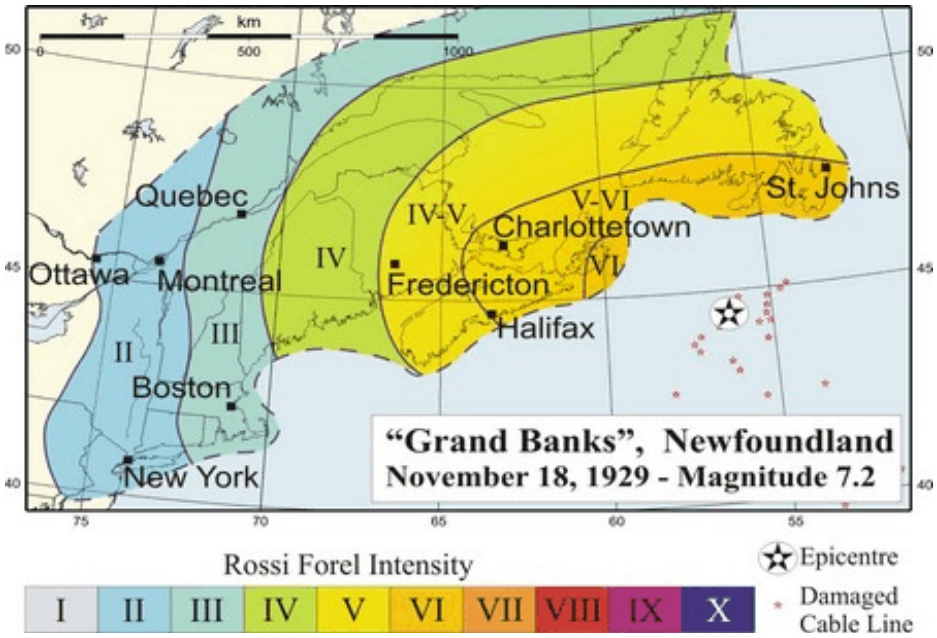
_____

Name: _____ Date: _____

Assignment 2 - Grand Banks Earthquake and Tsunami

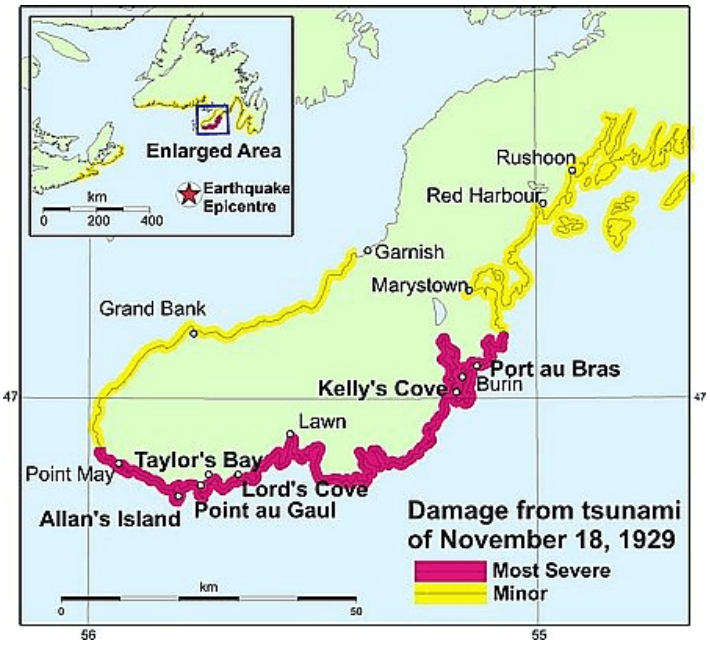
Directions: Read the following passage and answer the questions that follow.

On November 18, 1929 at 5:02 pm Newfoundland time, a major earthquake occurred approximately 250 km south of Newfoundland along the southern edge of the Grand Banks. This magnitude 7.2 tremor was felt as far away as New York and Montreal (see shaded area on map below). On land, damage due to earthquake vibrations was limited to Cape Breton Island where chimneys were overthrown or cracked and some highways were blocked by minor landslides. A few aftershocks (one as large as magnitude 6) were felt in Nova Scotia and Newfoundland but caused no damage. The earthquake triggered a large submarine slump (an estimated volume of 200 cubic kilometers of material was moved near the Grand Banks) which broke 12 transatlantic cables in multiple places (locations of cable breaks can be seen as small dots on the map) and generated a tsunami (a large induced sea wave). The tsunami was recorded along the eastern seaboard as far south as South Carolina and across the Atlantic Ocean in Portugal.



Approximately 2 ½ hours after the earthquake the tsunami struck the southern end of the Burin Peninsula in Newfoundland as three main pulses, causing local sea levels to rise between 2 and 7 metres. At the heads of several of the long narrow bays on the Burin Peninsula the momentum of the tsunami carried water as high as 27 metres. This giant sea wave claimed a total of 28 lives - 27 drowned on the Burin peninsula and a young girl never recovered from her injuries and died in 1933. This represents Canada's largest documented loss of life directly related to an earthquake, although oral traditions of First Nations people record that an entire coastal village

was completely destroyed by the tsunami generated by the year 1700 magnitude 9 Cascadia earthquake off the coast of British Columbia. More than 40 local villages in southern Newfoundland were affected, where numerous homes, ships, businesses, livestock and fishing gear were destroyed. Also lost were more than 280,000 pounds of salt cod. Total property losses were estimated at more than $1 million 1929 dollars (estimated as nearly $20 million 2004 dollars).



On Dec 26, 2004, an undersea earthquake in the Indian Ocean off the west coast of Sumatra, Indonesia triggered a series of devastating tsunamis that spread throughout the Indian Ocean. Large numbers of people were killed and coastal communities were flooded across South and Southeast Asia, including parts of Indonesia, Sri Lanka, India, and Thailand. Although initial estimates put the worldwide death toll at over 275,000 with thousands of others missing, recent analysis compiled lists a total of 229,866 persons lost, including 186,983 dead and 42,883 missing.

Questions:

1. What is a tsunami? What caused the 1929 tsunami?

2. What was the exact date of the Grand Banks earthquake and tsunami? What was the magnitude of the earthquake?

3. Where was the earthquake's epicenter?

4. How long after the earthquake did the tsunami strike the Burin Peninsula?

5. How high did sea levels rise?

6. How many people died directly or indirectly from the tsunami?

7. What were total property losses in 1929 dollars? In 2004 dollars?

8. What possible impact do you think the tsunami had on the fishery during the Great Depression?

Name: _____ Date: _____

Assignment 3: Tidal Ranges

Materials:

graph paper red pencil blue pencil

Procedure:

This table lists the highest high tides and lowest low tides in the harbour of St. John's, Newfoundland for the month of April.

Date	Highest High Tide (m)	Lowest Low Tide (m)
1	1.5	0.2
2	1.4	0.3
3	1.3	0.4
4	1.2	0.5
5	1.2	0.6
6	1.1	0.7
7	1.1	0.7
8	1.1	0.6
9	1.2	0.5
10	1.2	0.5
11	1.2	0.4
12	1.3	0.4
13	1.3	0.3
14	1.4	0.3
15	1.4	0.3
16	1.4	0.3

Date	Highest High Tide (m)	Lowest Low Tide (m)
17	1.4	0.3
18	1.4	0.4
19	1.3	0.5
20	1.3	0.6
21	1.2	0.6
22	1.1	0.6
23	1.1	0.5
24	1.2	0.4
25	1.3	0.3
26	1.4	0.3
27	1.4	0.2
28	1.5	0.1
29	1.5	0.2
30	1.5	0.2

Use the data to make a graph.

1. On the horizontal (x) axis, mark the days.

2. On the vertical (y) axis, mark tide heights ranging from 1.5 to 0.1 meters.

3. Plot the tide heights for each day on the graph. Connect the high tide points with a blue pencil and the low tide points with a red line.

Questions

1. What day(s) had the lowest tidal range? _____

2. What day(s) had the highest tidal range? _____

3. On what days would you suspect that the moon was new or full? Explain. (Hint: Twice a month, at the new moon and the full moon, the sun and moon are lined up.)

   _____

   _____

4. On what days would you suspect that the moon was in first or third quarter positions? Explain. (Hint: At the first and third quarters of the moon, the sun and moon pull at right angles to each other.)

   _____

   _____

   _____

5. Did there seem to be any pattern to your graph? Describe any pattern observed.

   _____

   _____

   _____