Adult Basic Education

Science

Science 3104

Introduction to Oceanography

Curriculum Guide

Prerequisites: **None**

Credit Value: 1

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 Instructor

I. Introduction to Science 3104

Science 3104, ***Introduction to Oceanography***, gives students a basic understanding of the ocean's cyclic movements which include waves, currents and tides. Students 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.

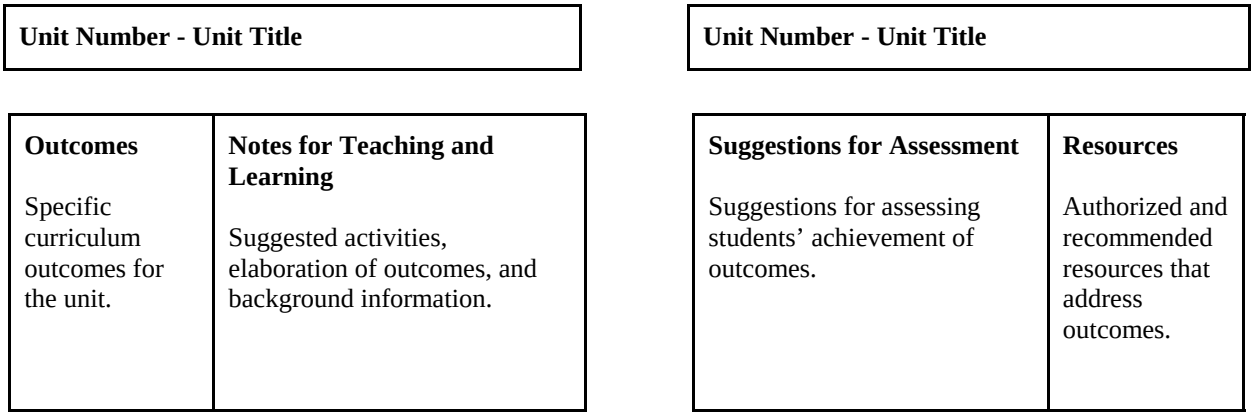
Students will be required to complete three **Assignments** in this course. However, there are many topics included in the course that students may be interested in exploring further. They could be given the opportunity to investigate topics in group work or complete additional assignments. Coordination with the English program is possible in assigning and evaluating additional work.

Students will be required to complete one **Core Lab** in this course. Additional laboratory investigations may be added.

II. Curriculum Guides

Each new ABE Science course has a Curriculum Guide for the instructor and a Study Guide for the student. The Curriculum Guide includes the specific curriculum outcomes for the course. Suggestions for teaching, learning, and assessment are provided to support student achievement of the outcomes. Each course is divided into units. Each unit comprises a **two-page layout of four columns** as illustrated in the figure below. In some cases the four-column spread continues to the next two-page layout.

Curriculum Guide Organization:
The Two-Page, Four-Column Spread



III. Study Guides

The Study Guide provides the student with the name of the text(s) required for the course and specifies the sections and pages that the student will need to refer to in order to complete the required work for the course. It guides the student through the course by assigning relevant reading and providing questions and/or assigning questions from the text or some other resource. Sometimes it also provides important points for students to note. (See the *To the Student* section of the Study Guide for a more detailed explanation of the use of the Study Guides.) The Study Guides are designed to give students some degree of independence in their work. Instructors should note, however, that there is much material in the Curriculum Guides in the *Notes for Teaching and Learning* and *Suggestions for Assessment* columns that is not included in the Study Guide and instructors will need to review this information and decide how to include it.

IV. Resources

Essential Resources

Earth Science; Tarbuck, Edward J. and Frederick K. Lutgens; Prentice Hall: Massachusetts; 2006. ISBN 0131258524

Earth Science - Teacher's Edition; Tarbuck, Edward J. and Frederick K. Lutgens; Prentice Hall: Massachusetts; 2006. ISBN 0131258974

Recommended Resources

Earth Science; Guided Reading and Study Workbook, Student Edition; Prentice Hall: Massachusetts; 2006; ISBN: 0131259016

Earth Science; Lab Manual, Student Edition; Prentice Hall: Massachusetts; 2006; ISBN: 0131258982

Earth Science; Lab Manual, Teacher's Edition; Prentice Hall: Massachusetts; 2006; ISBN: 0131259008

Earth Science web site:
http://www.phschool.com/

Hanrahan, M. ***Tsunami: The Newfoundland Tidal Wave Disaster.*** *St. John's: Flanker Press, 2004. ISBN 1-894463-63-3*

V. Recommended Evaluation

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

Introduction to Oceanography

Unit 1 - Features of the World Ocean

Outcomes

1.1 Define oceanography.

1.2 Describe the distribution of water on the surface of the Earth.

1.2.1 Identify the four main ocean basins.

1.2.2 Compare and contrast the characteristics of the ocean basins.

1.3 Explain how scientists study the topography of the ocean floor.

1.3.1 Define bathymetry.

1.3.2 Describe the modern technologies used to study the ocean floor. Include:

(i) sonar
(ii) satellites
(iii) submersibles

Notes for Teaching and Learning

The investigation and study of the processes that lead to the development of ocean basins are often based on evidence and data collected from indirect observations (e.g. sonar readings, satellite imaging) and inferential geological processes. This unit provides an opportunity to investigate some of the technologies used to gather evidence about the ocean floor. Investigating the utility of technologies such as sonar, core sampling, satellite imaging, bathyscaphs, tracking devices, and underwater photography and videography in helping us explore and understand the ocean floor will help students better appreciate the interconnectedness of various science disciplines and how we can learn about parts of the world from indirect observation. Students could investigate how some technologies have changed and improved over time.

Students could explain, through investigations, research, and/or discussions, that all technologies have their own particular strengths and weaknesses. Classroom activities designed to gather data using indirect observation would allow students to extrapolate their experiences to a greater scale. A closed shoebox filled with modeling clay or a variety of other objects at varying depths can be investigated indirectly, for example, by making small holes in the top at various regular intervals and using a measuring device such as a calibrated straw to collect data on the unseen “bottom”. Students should then be encouraged to identify the strengths and weaknesses in these types of data collection activities. Students will see that they can determine relative depths but are unable to identify the composition of the “bottom” using this method.

Unit 1 - Features of the World Ocean

Suggestions for Assessment

Instructors should review all the student answers to the questions in the *Study Guide* for this unit. Their written work should be assigned a mark to be used as part of the final evaluation for the course. (**Note**: An overall mark of 10% is recommended for the written work from the Study Guide, excluding lab reports and assignments. An overall mark of 20% is recommended for the labs and assignments.)

Students could start a glossary of terms that they discover and will use in this course. New terms could be added to the glossary as students progress through the course.

Students should identify and compare and contrast the Earth's oceans on a map. Instructors should ensure that students are able to correctly label the ocean basins on a map of the world without referring to the text or any other resource. *Earth's Oceans Activity Sheet* is provided in Appendix A for this purpose.

Resources

Prentice Hall Earth Science, pp. 394 - 400.

Earth's Oceans Activity Sheet, Appendix A.

Unit 1 - Features of the World Ocean

Outcomes

1.4 Identify and describe the major topographic features of the ocean basin floor.

1.4.1 Name the three main regions of the ocean floor.

1.4.2 Define continental margin.

1.4.3 Compare and contrast the continental margin in the Atlantic and Pacific Oceans.

1.4.4 Differentiate between the following structures:

(i) continental shelf
(ii) continental slope
(iii) continental rise

1.4.5 Describe turbidity currents and their impact on continental slopes.

1.4.6 Identify and explain how key features of the ocean basin floor are formed. Include:

(i) deep ocean trenches
(ii) abyssal plains
(iii) seamount
(iv) guyot
(v) mid-ocean ridges

Notes for Teaching and Learning

It should not be assumed that students have a working knowledge of physical geography. Using a world map and/or globe, instructors could conduct a brief geography lesson to ensure that students are familiar with basic global geography; including an overview of the location of continents, oceans, and other areas of interest. Students should be able to locate this province and the part of it in which they live on a map/globe.

Instructors should ask students to point out the regions on the globe where the oceans connect.

The website www.scilinks.org provides many sites containing information for both instructors and students. By entering the web code provided in the textbook, instructors have access to additional resources such as lesson plans, activities, and supplementary information. Students may find some of the sites helpful in clarifying or expounding some of the topics encountered in the course. Instructors should consult the Teacher's Edition of the text for more detailed information about resources available through this site.

The website www.phschool.com also provides additional resources for instructors and students. By entering the web code provided at the beginning of each chapter, students and instructors have access to online field trips, chapter quizzes, study guide summaries, and additional information.

Unit 1 - Features of the World Ocean

Suggestions for Assessment

Students should label a diagram of the topography of the ocean floor using the *Ocean Floor Topography Activity Sheet* provided in Appendix A (or any other that instructors make available). Instructors should make sure that students are able to label a diagram of the ocean floor correctly without referring to the text or any other resource.

Students should label the key features of the Atlantic continental margin using the *Atlantic Continental Margin Activity Sheet* provided in Appendix A (or any other that instructors make available). Instructors should make sure that students are able to label a diagram of the continental margin correctly without referring to the text or any other resource.

As a unit review students could complete # 1 - 6 of the *Reviewing Content* and # 11 - 17 of the *Understanding Concepts* sections on page 417. For further review, students may complete # 1 - 7 of the *Standardized Test Prep* section on page 419.

Instructors should review all the student answers to the questions in the *Study Guide* for this unit. Their written work should be assigned a mark to be used as part of the final evaluation for the course.

Resources

Prentice Hall Earth Science, pp. 401 - 405, 417, 419.

Ocean Floor Topography Activity Sheet, Appendix A.

Atlantic Continental Margin Activity Sheet, Appendix A.

Websites:

www.scilinks.org

www.phschool.com

Unit 2 - Seafloor Resources and Seawater Composition

Outcomes

2.1 Discuss the use of ocean resources for energy production.

2.1.1 Identify the two main energy sources (oil and natural gas) currently being obtained from the ocean floor.

2.1.2 Explain how oil and natural gas are formed.

2.2 Discuss the use of other resources obtained from the ocean floor and seawater.

2.2.1 Describe the uses of offshore sand and gravel.

2.2.2 Identify some valuable minerals found in offshore sand and gravel.

2.2.3 Describe manganese nodules and identify some of the minerals found in them.

2.2.4 Identify some of the problems with mining manganese nodules.

2.2.5 Describe how salt is removed from seawater.

2.2.6 List some of the uses of sea salt.

Notes for Teaching and Learning

Dozens of oil exploration companies have been busy drilling off the coast of Newfoundland and Labrador since 1965. Students should be aware of the significant discoveries off the Grand Banks, including the Hibernia, Terra Nova, and White Rose oil fields, and their economic impacts on the province. Instructors could discuss some of the unique challenges with drilling for oil on the Grand Banks, such as icebergs, pack ice, and extreme weather conditions. Instructors could also discuss the potential environmental impacts of an oil spill.

Unit 2 - Seafloor Resources and Seawater Composition

Suggestions for Assessment

Students could research a particular topic related to offshore development, such as the Hibernia project or the Ocean Ranger disaster. This may offer an opportunity to link with courses that students are working on in the English program.

Resources

Prentice Hall Earth Science, p. 410 - 413.

Website:
http://www.nr.gov.nl.ca/mines&en/oil/

Unit 2 - Seafloor Resources and Seawater Composition

Outcomes

2.3 Analyze the chemical composition of seawater and the sources of sea salts.

- 2.3.1 Define salinity.
- 2.3.2 Identify the units used to express the salinity of ocean water.
- 2.3.3 Identify the most common salt in seawater.
- 2.3.4 State the two main sources of sea salt.
- 2.3.5 Explain some processes that decrease and increase salinity.

2.4 Explain the variation in ocean water density.

- 2.4.1 Define density.
- 2.4.2 Recognize the factors that affect the density of ocean water.
- 2.4.3 Describe the influence of salinity and temperature on seawater density.

Notes for Teaching and Learning

Most students will probably associate “salt” with table salt, sodium chloride. Instructors should emphasize that while sodium chloride is the most common salt in seawater, there are numerous other salts found in the ocean.

Instructors should point out to students that it is mass (usually measured in grams) rather than volume, that is used to determine the amounts of salts in seawater.

Students will likely be familiar with the notation % for parts per hundred (percent), but may be confused by the notation for parts per thousand, ‰. Instructors should make sure that they see the difference. Point out to students that if salinity is expressed as 35 ‰, this means that every 1000 grams of seawater has 35 g of salt and 965 g of water.

Unit 2 - Seafloor Resources and Seawater Composition

Suggestions for Assessment

The *Quick Lab, Evaporative Salts,* page 412, could be completed by students or done as a demonstration to let students observe that salt dissolved in water is left behind when the water evaporates. During the activity, students could heat some tap water in a pan (preferably one with a black bottom) until it boils off. A residue should remain in the pan illustrating that even fresh water has mineral salts dissolved in it.

Instructors should review all the student answers to the questions in the *Study Guide* for this unit. Their written work should be assigned a mark to be used as part of the final evaluation for the course.

Unit 2 can be reviewed by completing # 10 of the *Reviewing Content* section and # 21 & 23 of the *Understanding Concepts* section on page 417, as well as # 1 - 2 of the *Reviewing Content* section, # 11 - 14 of the *Understanding Concepts* section, and # 24 of the *Critical Thinking* section on pages 443 - 444.

Instructors may give a test at the end of Unit 2 to include material covered in the first two units. The mark for the test would be used as part of the final mark for the course.

Resources

Prentice Hall Earth Science, pp. 412, 417, 422 - 424, 443 - 444.

Unit 3 - Ocean Circulation

Outcomes	Notes for Teaching and Learning
3.1 Identify the causes of surface currents and explain how surface currents affect climate.	Experiences that develop notions about how oceans and ocean currents such as the Labrador current and the Gulf Stream influence our regional climates should be made available to students. Students should come to understand that surface currents carry tropical heat to various parts of the ocean. The Gulf Stream, for example, influences the general climate of the Atlantic provinces.
3.1.1 Define ocean current.	
3.1.2 Define surface current.	
3.1.3 Explain how surface currents develop.	Students should be able to explain how currents, convections, and winds are affected by temperature, density differences, and the Earth's rotation. El Nino and La Nina and their impact on the world's climates can be a context for discussion and investigation. The effect that wind has on water is probably the one with which most students will have personal experience. In an investigation how oceans influence onshore breezes can be compared and contrasted to offshore breezes which are prevalent in our coastal communities.
3.1.4 Define gyres.	
3.1.5 Identify the five main ocean gyres.	
3.1.6 Describe the Coriolis effect and its influence on ocean currents.	
3.1.7 Describe how ocean currents influence climate.	
3.1.8 Define upwelling and explain the importance of upwellings to fish and other marine populations.	
3.2 Identify the causes of deep currents and describe their effects.	Students should follow a set of procedures that will permit them to experience the formation of water currents. Using a large beaker of water at room temperature, for example, students can investigate how temperature differences in the water cause currents. By placing a drop of food coloring near a bag of ice located at the edge of the beaker, students will see that colder water moves down. The reading of thermometers placed inside the beaker will permit the students to gather evidence that the colder water moves downward.
3.2.1 Define density currents.	
3.2.2 Identify two causes of density currents.	
3.2.3 Describe the effect of evaporation and latitude on density currents.	

Unit 3 - Ocean Circulation

Suggestions for Assessment

Students must complete Assignment 1, *Ocean Currents*.

NOTE: The assignment should be marked and the mark used as part of the evaluation for the course. The assignment is designed to reinforce the concepts covered in the text. Any new information presented in the assignment should not be tested.

Students must complete Laboratory 1, *Density Currents*.

NOTE: The lab should be marked and the mark used as part of the evaluation for the course.

Instructors should review all the student answers to the questions in the *Study Guide* for this unit. Their written work should be assigned a mark to be used as part of the final evaluation for the course.

Resources

Prentice Hall Earth Science, pp. 448 - 453.

Assignment 1, *Ocean Currents,* Appendix B.

Core Lab:
Laboratory 1, *Density Currents,* Appendix B.

Unit 4 - Waves, Tides, and Shorelines

Outcomes

4.1 Explain how waves form and describe the characteristics of waves.

4.1.1 Identify the source of waves' energy.

4.1.2 Describe and identify the components of a wave. Include:

(i) wave height
(ii) wavelength
(iii) wave period
(iv) crest
(v) trough

4.1.3 Define fetch.

4.1.4 Identify the factors that determine the height, length, and period of a wave. Include:

(i) wind speed
(ii) fetch
(iii) length of time the wind has blown

4.1.5 Describe the movement of particles in a wave.

4.1.6 Describe how waves change near the shore.

Notes for Teaching and Learning

Most shoreline processes are either directly or indirectly related to the action of waves. An understanding of waves is very important for the study of shorelines. **Note**: *Waves are generated primarily by the wind and transfer the energy of the wind across the surfaces of bodies of water. When the waves come into contact with the shoreline, the energy is then used to erode the coast as well as reshape it.*

Students can investigate wave structure by generating waves in a basin, sink or large baking pan. Ropes and slinkys may also be used to illustrate wave action and the direct relationship between the shape of waves and the forces used to create them. Sstudents should be able to identify or determine the wave length, height, crest and trough of an ocean wave.

Other types of waves on oceans are quite rare. Tsunamis (caused by earthquakes) and tidal bores also cause waves in oceans and estuaries. Students should come to understand that all waves are essentially similar in structure.

Ask students to recall what they remember about the tsunami that occurred in Southeast Asia in December, 2004.

Suggestions for Assessment

Students should label a diagram of a wave. Instructors should make sure that students are able to label the diagram correctly without referring to the text or any other resource.

Students must complete Assignment 2, *Grand Banks Earthquake and Tsunami*.

The novel *Tsunami: The Newfoundland Tidal Wave Disaster*, by Maura Hanrahan, provides a detailed account of the tsunami. Students could read this novel and use it as part of one of their English courses**.**

NOTE: The assignment should be marked and the mark used as part of the evaluation for the course. The assignment is designed to reinforce the concepts covered in the text. Any new information presented in the assignment should not be tested.

Another opportunity for research that may be linked with an English course would be to have students report on the tsunami that took place in Southeast Asia in December, 2004.

Resources

Prentice Hall Earth Science, pp. 455 - 457.

Wave Activity Sheet, Appendix A.

Assignment 2, *Grand Banks Earthquake and Tsunami,* Appendix B.

Unit 4 - Waves, Tides, and Shorelines

Outcomes

4.2 Identify and describe the general features and causes of ocean tides.

4.2.1 Define tides.

4.2.2 Describe the cause of ocean tides.

4.2.3 Describe the factors that affect tidal height.

4.2.4 Define tidal range.

4.2.5 Differentiate between spring and neap tides.

4.2.6 Identify and describe the three main types of tidal patterns. Include:

(i) diurnal tides
(ii) semidiurnal tides
(iii) mixed tides

Notes for Teaching and Learning

Tides are the rising and falling of the ocean's surface because of gravitational interactions with the moon and the sun. A model of the Earth, moon and sun can be used to demonstrate the reasons for the frequency of tides and the differences in tidal forces. It would be appropriate to investigate local conditions that accentuate or nullify tidal forces, such as the tides of the Bay of Fundy or the smaller tides in other regions.

Unit 4 - Waves, Tides, and Shorelines

Suggestions for Assessment

Students must complete Assignment 3, *Tidal Range*, found in Appendix B.

NOTE: The assignment should be marked and the marks used as part of the evaluation for the course.

As an additional assignment, students could complete the *Exploration Lab, Graphing Tidal Cycles*, on pages 468 - 469 of the text.

Resources

Prentice Hall Earth Science, pp. 458 - 460.

Assignment 3, *Tidal Range*, Appendix B.

Unit 4 - Waves, Tides and Shorelines

Outcomes

4.3 Identify and describe the forces that affect shorelines and beaches.

4.3.1 Define beach and identify the sources of beach sediment.

4.3.2 Describe the effects of wave impact on shorelines.

4.3.3 Define abrasion and describe its affects on shorelines.

4.3.4 Define wave refraction and discuss its importance in creating shorelines.

4.3.5 Define longshore current and describe its affects on shorelines.

Notes for Teaching and Learning

In this unit, students may have the opportunity to bring personal observations and experiences into the study of shorelines. By beginning with a focus on shorelines and how they are different yet similar in many ways, students can begin to explore the reasons for the differences and similarities. Pictures and videos of a variety of shorelines can further stimulate discussion regarding the features of shorelines. A class trip may be taken to survey the type of shoreline in the local community.

Identification of and focus on the two main factors influencing shorelines, wave action and tidal action, can help students to appreciate the ongoing influence these two energy sources have on our shoreline. Examples of intense wave action such as that produced during a winter storm or a hurricanes can help illustrate how shorelines can be changed quickly over a short period of time. If historical data are available, students can relate wave action, ocean currents, and tides to the local shoreline over a period of time.

Suggestions for Assessment

Students could be asked to look carefully at Figure 15, page 461, and answer the following questions:

1. What could have caused this? *waves crashing on the cliff*

2. Why is it so smooth? *The sand carried by crashing waves acts like sandpaper on the cliff.*

3. What would most likely happen to the waves on top of the cliff? *They will fall into the ocean.*

Depending on where they live, students could be asked similar questions about a shoreline that is close to their home or school. They could take pictures and bring them to class for observation and discussion with other students.

Resources

Prentice Hall Earth Science, pp. 461 - 463.

Unit 4 - Waves, Tides and Shorelines

Outcomes	Notes for Teaching and Learning
4.4 Compare and contrast erosional and depositional features.	Visual learners would benefit from a discussion of Figures 16 and 17 on pages 462 and 463 of the text. See the Teacher's Edition of the text for suggestions on how to effectively use these figures.
4.4.1 Describe erosional features and explain how each is formed. Include: (i) wave cut cliffs (ii) wave cut platform (iii) sea arch (iii) sea stack	Similarly, Figures 18 - 23 provide good visuals to help students understand what they are learning. These could be supplemented with local examples wherever possible. Living in this province, students may be familiar with many of the erosional and depositional features that they are learning about. Encourage them to give examples from their local area whenever possible.
4.4.2 Describe depositional features and explain how each is formed. Include: (i) spit (ii) baymouth bar (iii) tombolo (iv) barrier islands	
4.5 Discuss how humans have attempted to stabilize the seashore.	Students should have opportunities to investigate technological attempts to prevent or reduce damage to coastal areas due to wave action and tides. Students could use local exemplars such as piers, jetties, breakwaters, dykes, dune vegetation, and coastline reconfiguration to help them investigate and understand their uses.
4.5.1 Describe groins, breakwaters, and seawalls and explain how they protect beaches.	Students may offer local examples of how people have used technologies to slow down the effect of wave and tidal erosion and deposition. Sea walls, the use of large boulders against wharves, the use of jetties and groins are examples that can be used to illustrate our attempt to cope with the effects of tides and waves.

Unit 4 - Waves, Tides and Shorelines

Suggestions for Assessment

Students should label a diagram of a shoreline. Instructors should make sure that students are able to label the diagram correctly without referring to the text or any other resource.

Unit 4 can be reviewed by completing # 7 - 10 of the *Reviewing Content* section, and # 21 - 22 of the *Understanding Concepts* section on pages 471 - 472. Students may also complete # 2 of the *Standardized Test Prep* on page 473.

Instructors should review all the student answers to the questions in the *Study Guide* for this unit. Their written work should be assigned a mark to be used as part of the final evaluation for the course.

A final exam that covers the entire course (excluding the material covered by the assignments) should be given and the mark used as a minimum of 50% of the final mark for the course.

Resources

Shoreline Activity Sheet, Appendix A.

Prentice Hall Earth Science, pp 463 - 467, 471 - 473.

Appendix A
Activity Sheets

Earth's Oceans Activity Sheet

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

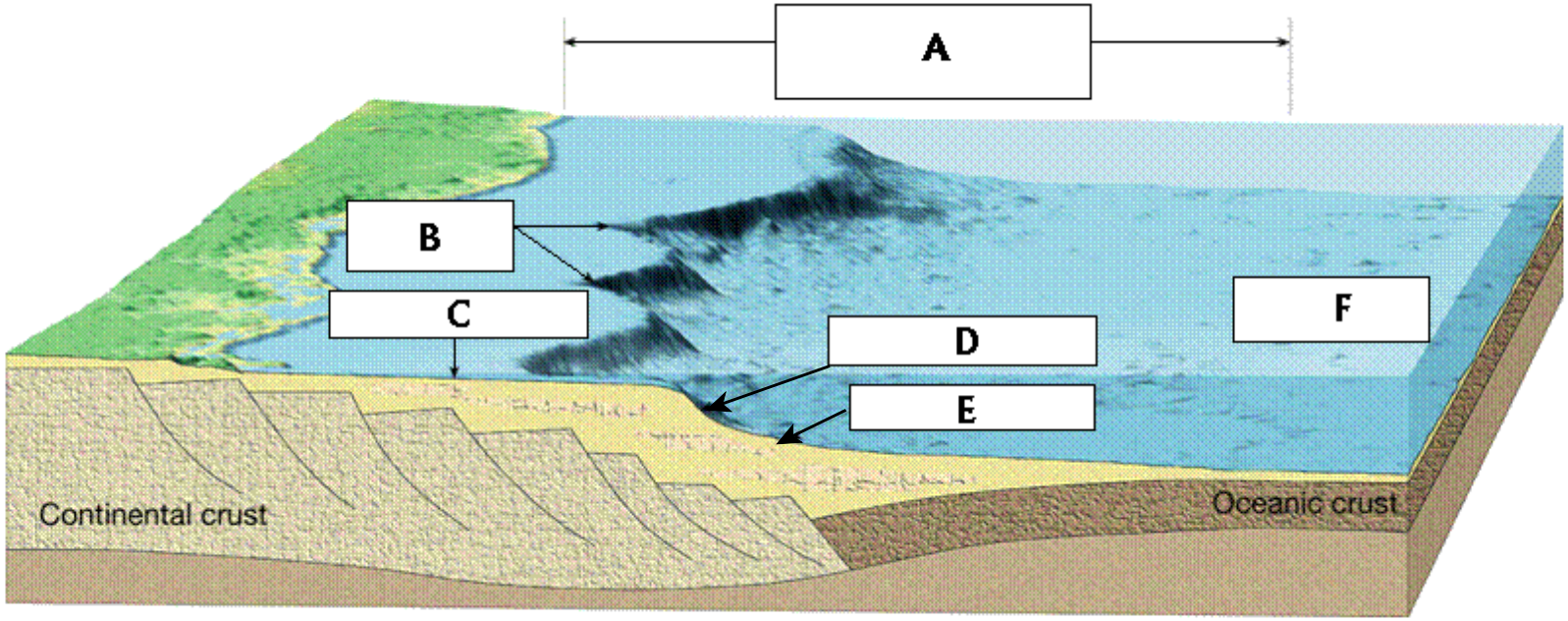
1. Label each of the four major oceans.
2. Which ocean is the deepest? _____
3. North America is between which two oceans ? _____
4. Which three continents border the Arctic Ocean? _____

   _____
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.



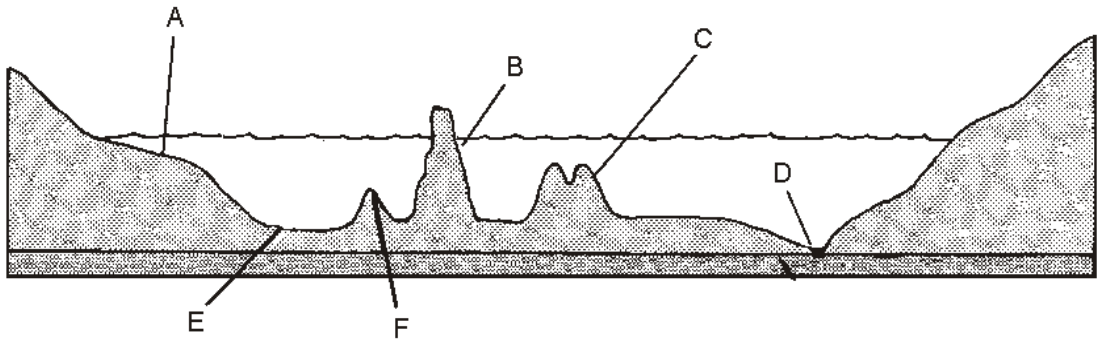
A. _____ D. _____

B._____ E. _____

C. _____ F. _____

Ocean Floor Topography Activity Sheet

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



A. _____

B. _____

C. _____

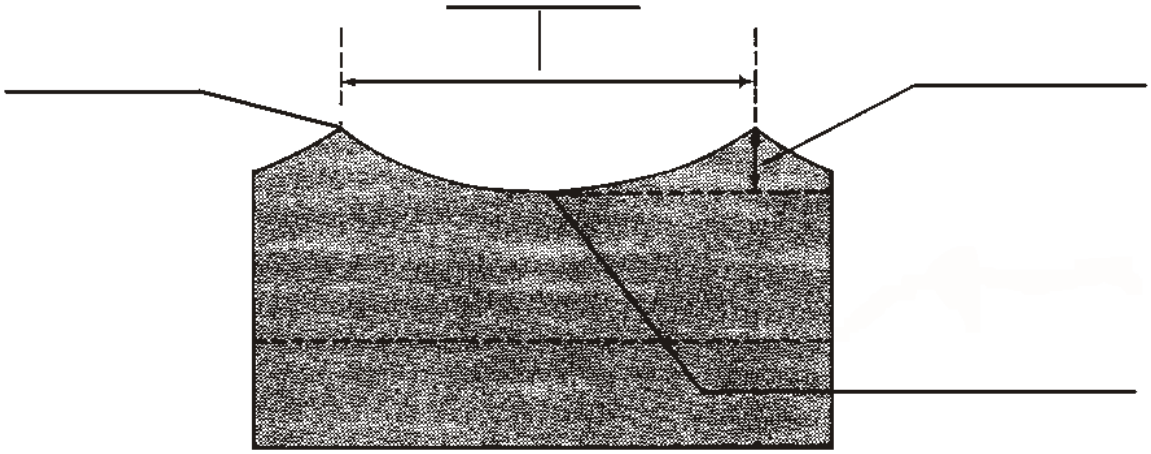
D. _____

E. _____

F. _____

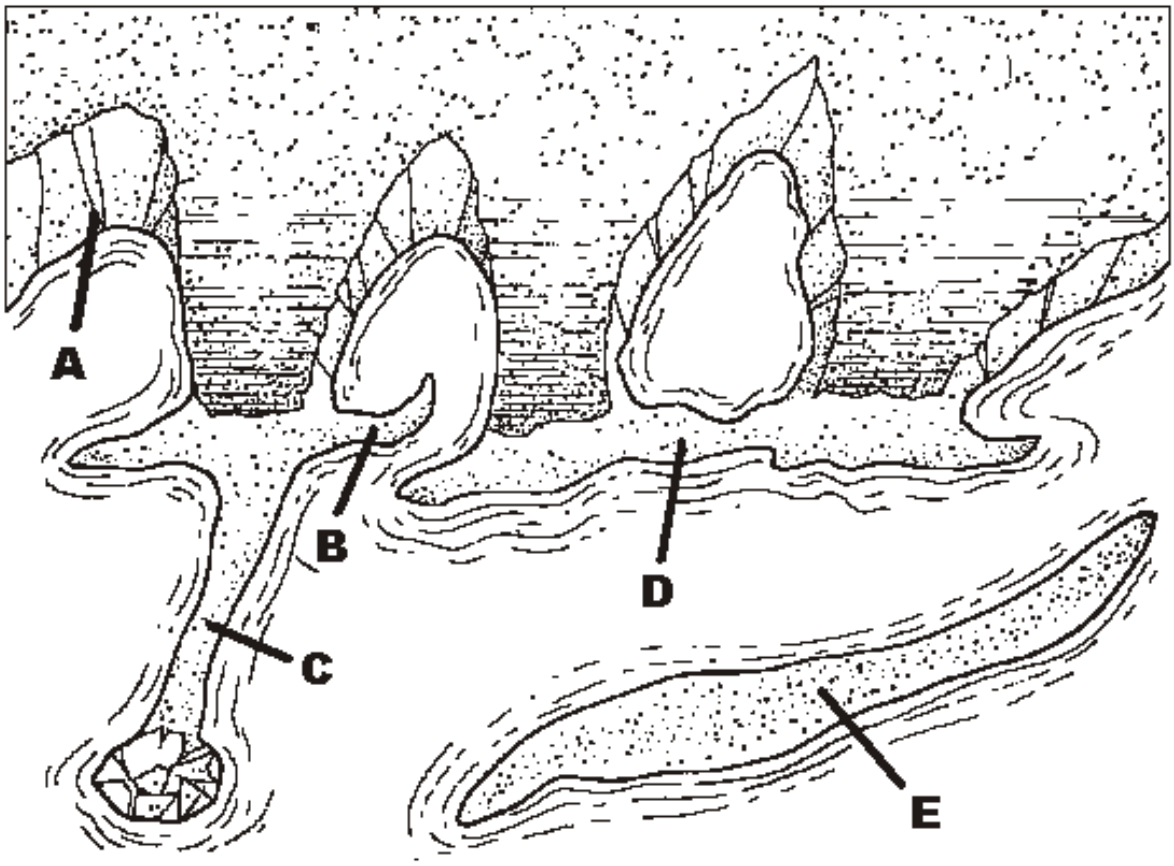
Wave Activity Sheet

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. _____

Answer Keys

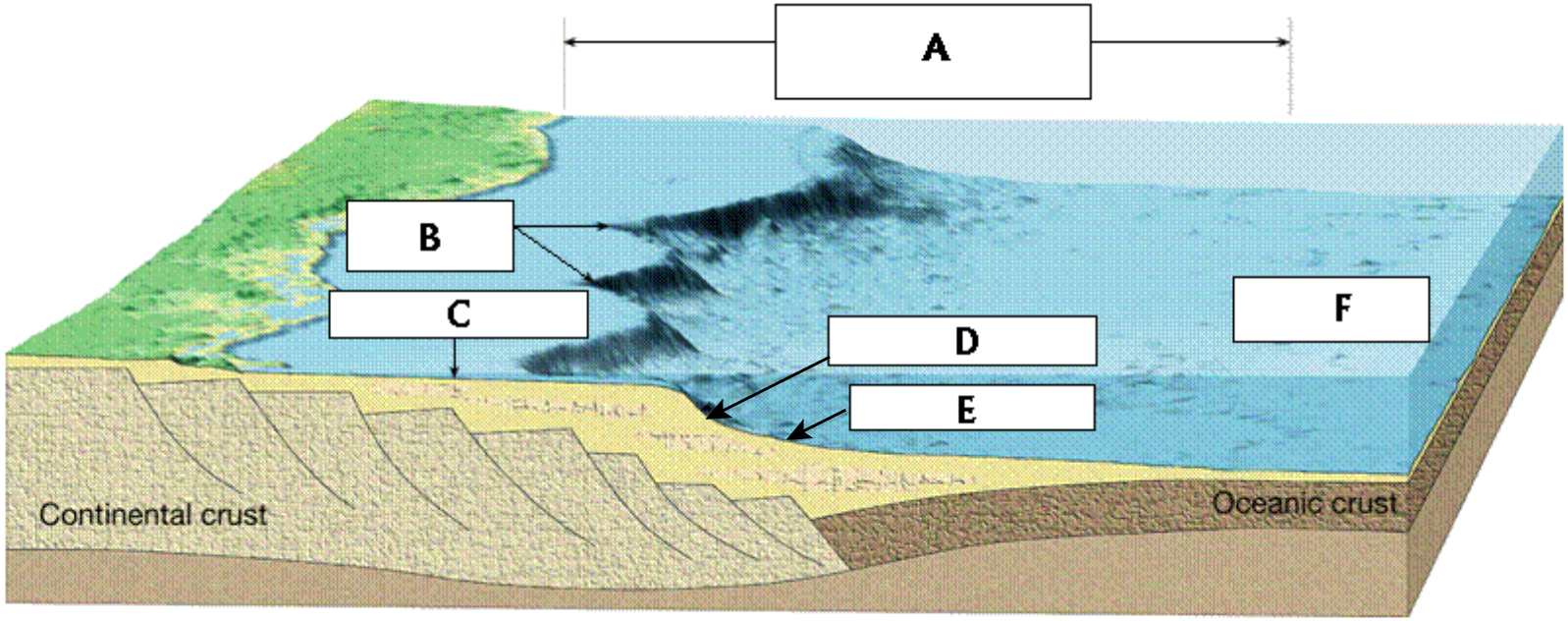
Earth's Oceans Activity Sheet ANSWER KEY

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? **Pacific**
3. North America is between which two oceans ? **Pacific and Atlantic**
4. Which three continents border the Arctic Ocean? **North America, Europe and Asia**
5. Which ocean is the largest? **Pacific**
6. In which hemisphere is the Indian Ocean found? **Southern hemisphere**
7. Draw a line that proves that all of Earth's oceans are connected

Atlantic Continental Margin Activity Sheet ANSWER KEY

Label the following regions found in the continental margin.



A. Continental margin

B. Submarine canyons

C. Continental shelf

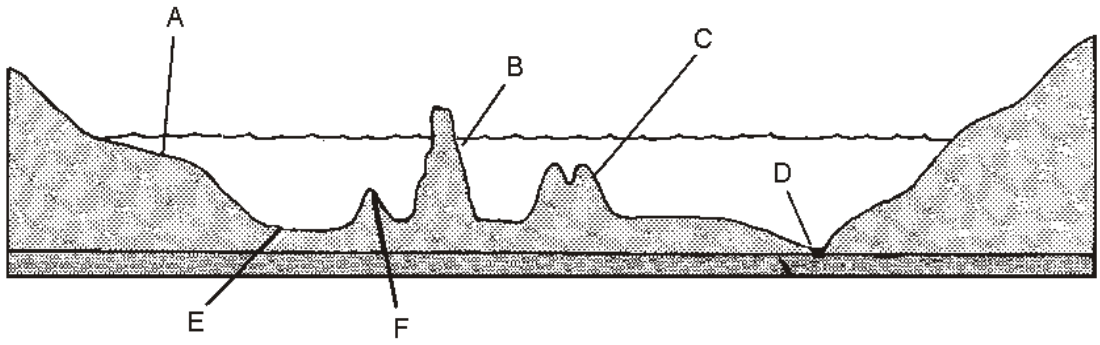
D. Continental slope

E. Continental rise

F. Abyssal plain

Ocean Floor Topography Activity Sheet ANSWER KEY

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



A. **Continental shelf**

B. **Island**

C. **Mid-ocean ridge**

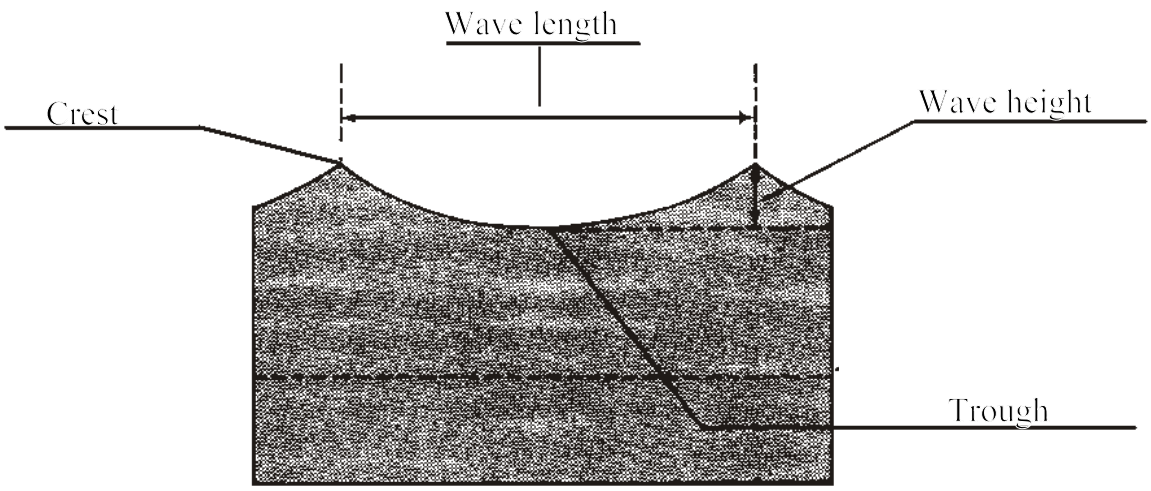
D. **Ocean trench**

E. **Abyssal plain**

F. **Seamount**

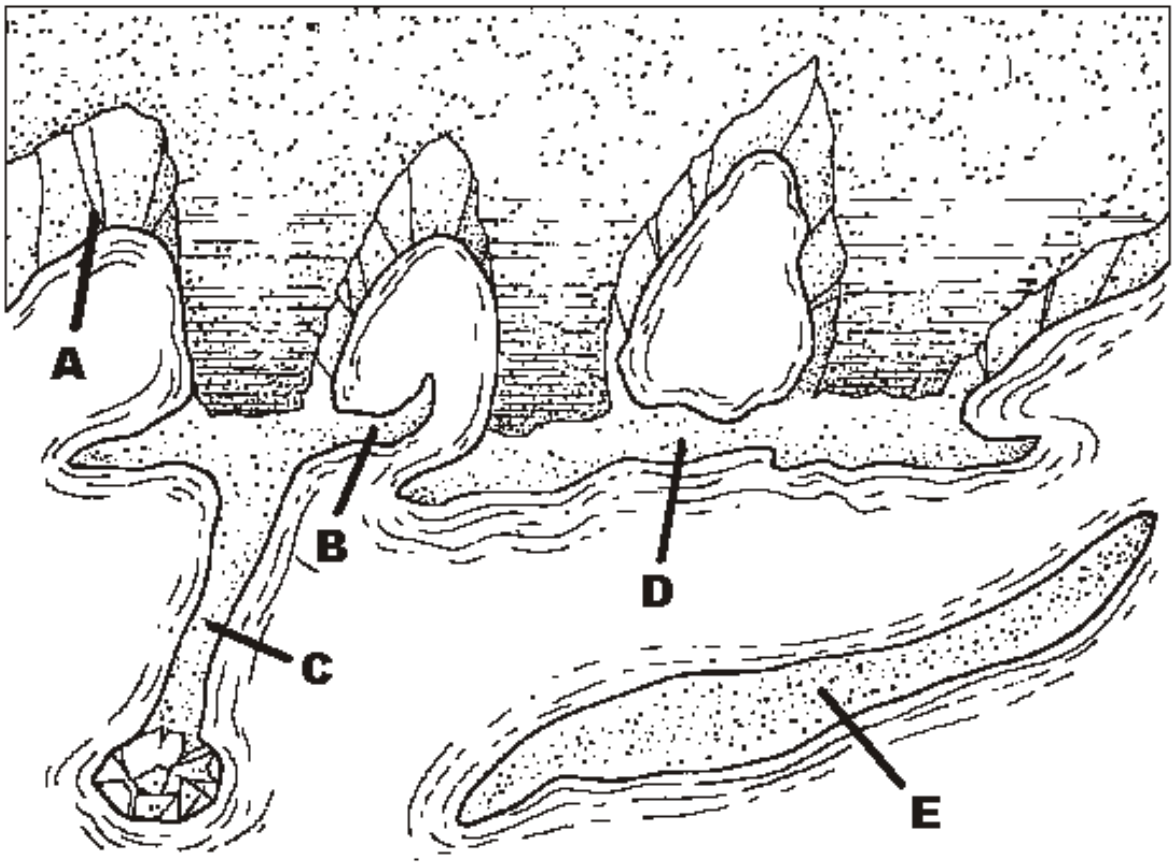
Wave Activity Sheet ANSWER KEY

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



Shoreline Features Activity Sheet ANSWER KEY

Label the shoreline features in the diagram below.



A. **Wave-cut cliff**

B. **Spit**

C. **Tombolo**

D. **Baymouth Bar**

E. **Barrier Island**

Appendix B
Assignments and 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 counter current 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.

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? _____

_____

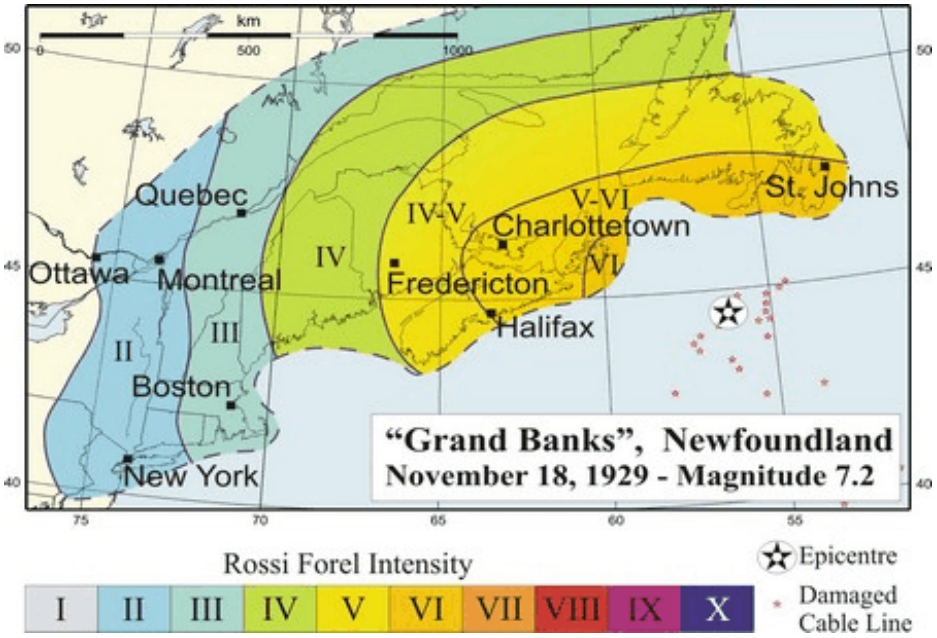
_____

_____

Assignment 2 - Grand Banks Earthquake and Tsunami

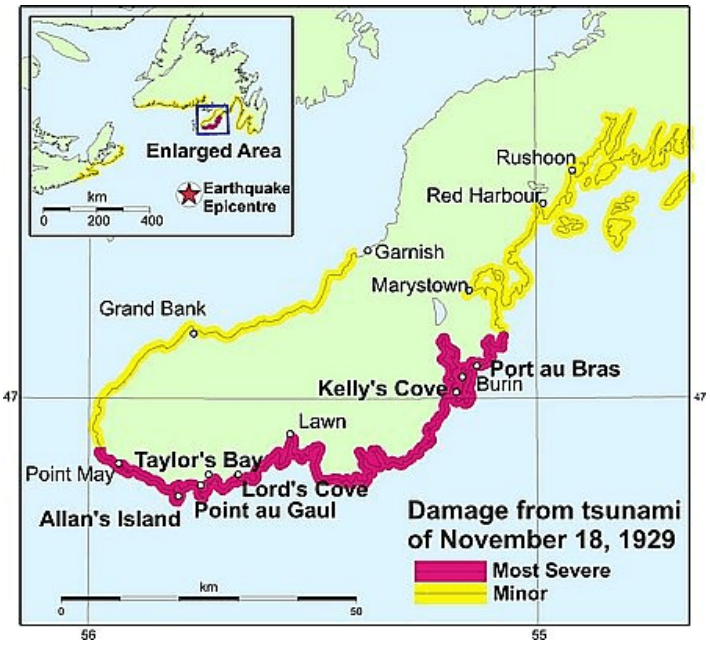
Directions: Read the following passage and answer the questions that follow.

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 shade 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 kilometres 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 1/2 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?

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 in 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.

   _____

   _____

Answer Keys

Assignment 1: Ocean Currents ANSWER KEY

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. **The Gulf Stream carries many North American species to the British Isles.**

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. **Currents expose the southern edge of Asia to African fauna.**

3. Would the temperature of the water off the west coast of the United States tend to be cold or warm? Explain. **Cold; the California Current brings cold water from the North Pacific.**

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

5. What causes currents in the Northern Hemisphere to rotate clockwise, while currents in the Southern Hemisphere rotate counterclockwise? **The Coriolis effect.**

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 thought 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? **Powerful winds.**

7. Winds blowing off the coast of South America skim the surface water and move it westward.

What happens to the cooler, deeper water? **It rises.**

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

industry in Peru. **The cold, rising water carries nutrients, causing plankton growth and large populations of smaller organisms, thus larger number of fish.**

9. Give two reasons to explain why the Peru Current is cold. **The current flows from the cold, southern tip of South America. The colder, upwelling water contributes to cooling the Peru Current.**

10. Why is the counter current warm? **It flows from the warm, equatorial region.**

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? **The Peru Current is cold. When it diminishes, the area is warmer.**

12. What happens to the cooler, deeper water as a result of the warming upper layers? **The cooler water does not rise.**

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.

Assignment 3: Tidal Ranges ANSWER KEY

Materials

graph paper
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13	1.3	0.3
14	1.4	0.3
15	1.4	0.3
16	1.4	0.3

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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
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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? **April 6 and 7**

2. What day(s) had the highest tidal range? **April 28**

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.)

   A new or full moon probably occurred on April 1 to2, 14 to 17, and 27 to 30 because tidal range was greatest at these times.

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.)

   First and third quarter moons probably occurred on April 6 to 7 and 21 to 23 when the tidal range was lowest.

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

   When high tides were highest, low tides were lowest. When high tides were lowest, low tides were usually highest. The graph shows great tidal range to small tidal range, to great, to small, to great.