

Water, Water Everywhere: Oceans

Grade Level or Special Area: 6th Grade

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Length of Unit: 8 lessons (10 days of 45 minute periods)

I. ABSTRACT

- A. The unit examines the ocean subsurface, movement and life it sustains. In cooperative and independent hands-on activities with strong math connections, students strengthen math skills while learning science concepts and improving reading/ writing skills. A culminating assessment project conducted in cooperative learning groups utilizes student technology skills. In this alternative assessment students develop interactive displays demonstrating knowledge of the ocean while teaching younger students concepts learned during the unit.

II. OVERVIEW

- A. Concept Objectives
1. Ocean is part of other inter-related biological and physical systems.
- B. Content from the *Core Knowledge Sequence*
1. Oceans cover 71% of the earth's surface. p.152
 2. Three subdivisions of ocean: Atlantic, Pacific and Indian Oceans p.152
 3. The ocean floor has topography like the earth's surface. p.152
 4. Describe where continental shelf, continental slope, continental rise, and abyssal plains, mid-ocean ridges and trenches, Mid-Atlantic Ridge, Mariana Trench can be found. P.152
 5. Plate tectonics work to create Mid-Atlantic Ridge and Mariana Trench p.152
 6. Seawater is composed of salts created by weathering, erosion and volcanic ash. P. 152
 7. Seawater's salinity is constant.
 8. Seawater contains many elements to sustain a wide variety of life. p.152
 9. The ocean moves in three ways, currents, tides and waves and they are important to life on earth. P.153
 10. Surface currents are caused by winds and the Coriolis effect. P.153
 11. The Gulf Stream and the Kuroshio Currents are two examples of currents. P.153
 12. Subsurface currents are caused by density currents and upwelling. P.153
 13. Currents are important for transportation, sustaining ocean life, and earth's climate. P.153
 14. Gravitational forces of the sun and moon cause tides. P.153
 15. There are two tides daily. P.153
 16. Waves are caused by the wind. P.153
 17. Water molecules move up and down in place and do not move with the wave. P.153
 18. Crest and trough, wave height and wavelength are similar to light and electromagnetic waves P.153
 19. Tsunamis are fast-moving waves caused by earthquakes. P.153
 20. Benthic zone is the bottom of the ocean where little light penetrates therefore there is very little life. P.153
 21. Pelagic zone is the open ocean. P.153
 22. Benthic, bottom living organisms such as kelp and mollusks P.153
 23. Nekton is the free swimming part of the ocean where fish and whales exist P.153

24. Small drifting plants and animals (plankton) are the dominant life and food source of the ocean and use photosynthesis to create food. P.153
 25. Most organisms in the ocean are plant life. P.153
 26. Most deepwater life depends on organic matter from above or chemosynthesis in order to exist. P.153
 27. Upwelling is a source of rich nutrients for some marine life. P.153
 28. Solutions for pollution of the ocean are necessary to protect the delicate balance of the food webs.
- C. Skill Objectives
1. Read for information and create concept maps
 2. Use graphs and charts to gather information and make inferences
 3. Compute elapsed time
 4. Calculate ratio and proportion
 5. Use strategies to problem solve
 6. Use longitude and latitude to find locations
 7. Plot points on a graph
 8. Use library and the Internet resources to research a given topic
 9. Use technology to create graphs
 10. Create proportional models
 11. Compute ratios

III. BACKGROUND KNOWLEDGE

- A. For Teachers
1. Definition, cause and effect of tides, waves and currents.
 2. Convection and density currents.
 3. Three levels of life in the ocean
- B. For Students
1. Grade K: Animals and their needs. Plants make their own food, but animals get food from eating plants or other living things. Earth is made of land and water. Location of the oceans
 2. Grade 1: Living things and their environments. Most of the earth is covered with water. Locate oceans. Oceans are salt water. Describe a coast, shore, waves and tides.
 3. Tides are high and low.
 4. The most important current for the U.S. is the Gulf Stream.
 5. The ocean floor has mountain peaks and valleys or trenches.
 6. The ocean contains organisms too small for the eye to giant whales
 7. Dangers to ocean life include over-fishing, pollution, and oil spills
 8. Grade 4: Earth is made up of many elements
 9. Grade 4: Earth and its Changes. Plate tectonics change the earth.
 10. Grade 5: Photosynthesis is an important life process that occurs in plant cells, but not animal's cells. Unlike animals plants make their own food, through photosynthesis.
 11. Grade 5: Role in photosynthesis of sunlight, chlorophyll, carbon dioxide and water.

IV. RESOURCES

- A. <http://worldatlas.com/aatlas/infopage/oceans.htm> and www.worldatlas.com/aatlas/world.htm
- B. www.tides.info

C. <http://mbgnet.mobot.org/salt/sandy/tide.htm>

V. LESSONS

Lesson One: Where are oceans and what are islands?

A. *Daily Objectives*

1. Concept Objective(s)
 1. Ocean is part of other inter-related biological and physical systems.
2. Lesson Content
 - a. Oceans cover 71% of the earth's surface
 - b. Three subdivisions of ocean: Atlantic, Pacific and Indian Oceans
 - c. The floor has topography like the earth's surface
3. Skill Objective(s)
 - a. Correctly locate oceans on a map

B. *Materials*

1. Blank World Map containing oceans of the world (one for each student)
2. Projection of map of ocean bottom from <http://worldatlas.com/aatlas/infopage/oceans.htm>
3. www.worldatlas.com/aatlas/world.htm

C. *Key Vocabulary*

1. **Islands** are small bodies of land surrounded by water
2. **Coral atolls** are ring shaped islands or string of islands consisting of coral reef surrounding a lagoon.

D. *Procedures/Activities*

1. Motivating students: Start unit by explaining to students that the lessons they learn during this unit will be used to teach younger students about the ocean in a giant bubble that they will design and build
2. Ask students to estimate the percentage of earth covered by ocean. Tell students oceans cover 71% of the earth.
3. In co-operative learning pairs have students locate on a blank map the three subdivisions of ocean. For special ed students pair with higher performing students.
4. Use <http://worldatlas.com/aatlas/infopage/oceans.htm> Examine/discuss a map of the subsurface of the ocean bottom. Use maps to show students many islands are the tops of mountain peaks. Identify with students the islands (Pacific islands, Aleutian islands) that consist of parts of submerged continents, volcanic peaks, and coral atolls.
5. Have students pretend they are one of the Pacific islands and write a short story or create a comic strip telling how they became an island. Student papers will reflect the plate tectonic theories of continent formation, volcanic activity as studied in previous Core Knowledge unit or coral deposits creating an atoll.

E. *Assessment/Evaluation*

1. Completion of blank work map
2. Stories or comic strips

Lesson Two: Bottoms Up: What does the bottom of the ocean look like?

A. *Daily Objectives*

1. Concept Objective(s)
 - a. Ocean is part of other inter-related biological and physical systems.
2. Lesson Content
 - a. Describe where continental shelf, continental slope, continental rise, and abyssal plains, mid-ocean ridges and trenches, Mid-Atlantic Ridge, Mariana Trench can be found.

- b. Plate tectonics work to create Mid-Atlantic Ridge and Mariana Trench
3. Skill Objective(s)

- a. Graph points on a chart
- b. Interpret data from a chart

B. *Materials*

- 1. http://go.hrw.com/atlas/norm_htm/natlantc.htm
- 2. Appendix A (one for each student)
- 3. Appendix B (one for each group)

C. *Key Vocabulary*

- 1. **Continental shelf** is located on the continent's edge that is beneath the ocean surface
- 2. **Continental slope** connects the continental shelf to the open-ocean floor
- 3. **Continental rise** is a section of ocean floor that rises to connect open-ocean floor to continental shelf.
- 4. **Abyssal plains** are large, flat region of the open ocean floor.
- 5. **Mid-ocean ridges** are mountain chains running through every major ocean
- 6. **Trenches** are an underwater ditch or canyon
- 7. **Plate tectonics** is the theory that earth is made up of many plates that move causing surface events.
- 8. **Mid-Atlantic Ridge** is mountain chain in the Atlantic Ocean
- 9. **Mariana Trench** is a large ditch running through the Pacific Ocean

D. *Procedures/Activities*

- 1. Ask students what they think the bottom of the ocean looks like? Entertain all answers.
Explain to students they are going to draw a profile of the ocean floor. Explain what a profile is and that sonar has enabled us to "see" what the ocean floor looks like. Distribute Appendix B. Students may work in pairs mixing the performance levels. Model on an overhead projector/chalkboard how to do first 5. Do the next 5 as a guided practice. Have students graph the rest independently.
- 2. Label continental shelf, continental slope and mid-range ridge according to what was read in Appendix B.

E. *Assessment/Evaluation*

- 1. Completed graphing of ocean floor profile Activity from Appendix B.

Lesson Three: What is in saltwater?

A. *Daily Objectives*

- 1. Concept Objective(s)
 - a. 1. Ocean is part of other inter-related biological and physical systems.
- 2. Lesson Content
 - a. Seawater is composed of salts created by weathering, erosion and volcanic ash
 - b. Seawater's salinity is constant
 - c. Seawater contains many elements to sustain life.
- 3. Skill Objective(s)
 - a. Use spreadsheet to record information and create a pie graph illustrating the elements contained in seawater.
 - b. Create a concept map
 - c. Correctly include all elements of a friendly letter

B. *Materials*

- 1. Appendix C: Composition of seawater (one for each student)
- 2. Seawater obtained from fish store

C. *Key Vocabulary*

- 1. **Weathering** is the erosion of rocks from the elements of weather

D. *Procedures/Activities*

1. Show students seawater in container with seawater. Ask them what is in seawater. Entertain all responses. Ask students if ocean is saltier now than 100 years ago and explain their answer. Entertain all answers.
2. Review elements in chemistry from 5th grade curriculum. Tell students that elements are contained in seawater. Once again ask what they think is in the seawater.
3. Read Appendix C explaining why salinity stays constant. Have students draw concept map showing the reasons for constancy of salinity.
4. View Appendix C: Composition of seawater and sediment together or independently. Ask students what percentage are the minerals in total? (100) What is best kind of graph to express this information? (pie)
5. Place the elements of seawater with corresponding percentages in spreadsheets. Use the graph maker to create a pie graph with the data.
Alternative assignment – make own pie graph using paper and colored pencils.

E. *Assessment/Evaluation*

1. Alternative assessment to questions in Appendix C. Have students pretend a younger friend has asked them if the ocean will become saltier. Students will write a letter to the friend giving them the answer.
2. Create concept map demonstrating why ocean is salty.

Lesson Four: Ocean Motion: What is a current?

A. *Daily Objectives*

1. Concept Objective(s)
 - a. Ocean is part of other inter-related biological and physical system.
2. Lesson Content
 - a. The ocean moves in three ways: currents, tides and waves and they are important to life o earth.
 - b. Surface currents are caused by winds and the Coriolis effect.
 - c. The Gulf Stream and the Kuroshio Currents are two examples of currents.
 - d. Subsurface currents are caused by density currents and upwelling.
 - e. Currents are important for transportation, sustaining ocean life, and earth's climate.
 - f. Seawater contains many elements to sustain a wide variety of life.
3. Skill Objective(s)
 - a. Correct use and articulation of steps in scientific methods.
 - b. Write cohesive paragraph on a topic

B. *Materials*

1. Appendix D (one for each student)
2. Wall map of North America

C. *Key Vocabulary*

1. **Surface currents** are large circular streams kept in motion by prevailing winds and rotation of the earth.
2. **Gulf Stream** is an example of a surface current in the North Atlantic
3. **Kuroshio** is an example of a surface current in the North Pacific
4. **Upwelling** is a current created near the shore due to convection. Causes nutrients from bottom of ocean to surface providing nourishment for many kinds of ocean life.
5. **Density currents** are created as denser water sinks to the bottom and less dense waters rises. Less dense warm water rises, cools, and falls creating a current

D. *Procedures/Activities*

1. Ask students if they have ever heard anyone dropping a bottle with a message into the ocean and the bottle is discovered hundreds of miles away. Ask students why this occurs.
2. Read Appendix D Ocean Currents together. Conduct pre-reading survey of the material focusing on title, boldface print, headings BEFORE reading Appendix D. As material is read together, show on a map where the Gulf Stream flows.
3. Have students write what they believe would happen if there were no currents on earth.

E. Assessment/Evaluation

1. Student paragraph on what they believe would happen if there were no currents on earth.

Lesson Five: Ocean Motion: What causes some currents?

A. Daily Objectives

1. Concept Objective(s)
 - a. Ocean is part of other inter-related biological and physical systems.
2. Lesson Content
 - a. The ocean moves in three ways, currents, tides and waves and they are important to life on earth.
 - b. Subsurface currents are caused by density currents and upwelling
 - c. Currents are important for transportation, sustaining ocean life, and earth's climate.
3. Skill Objective(s)
 - a. Use a formula to calculate density

B. Materials

(One of the following needed for each group)

1. Clear plastic container
2. Dish of ice
3. Beaker with warm water
4. Pipette
5. Food coloring
6. Appendix D (from previous lesson)
7. Appendix E (one for each group)
7. Calculators

C. Key Vocabulary

1. **Density currents** are large bodies of water flowing through the ocean caused as less dense warm water rises, cools and falls.

D. Procedures/Activities

1. Ask students what makes large bodies of water in the ocean move in the same direction. Entertain all responses.
2. Divide class into groups of 3 with mixed abilities. Review with students the directions from Appendix E that will demonstrate a density current. As students participate travel through groups asking them why the warm water rises (less dense), why is cold water more dense (molecules closer together with less space between molecules. Molecules move slower), where warm water comes from in the ocean (ocean ranges where steam comes from magma). After completing activity discuss what students observed, questions from Appendix E. Be sure to correct any misconceptions students may have. Review how to find a variable in an equation. Students use formula $D=M/V$ (Density equals mass divided by volume). Review how to use a formula and have students solve #5 from Appendix E. Give additional similar problems if needed for practice in using a formula.

- E. Review how sun's heat comes to surface of sun and how convection heats a room and how earth's heat travels through the magma. Discuss how these processes are similar.

E. *Assessment/Evaluation*

1. Student responses to Appendix E during activity
2. Student responses to Appendix D questions

Lesson Six: Ocean Motion: What causes tides?

A. *Daily Objectives*

1. Concept Objective(s)
 - a. Ocean is part of other inter-related biological and physical systems.
2. Lesson Content
 - a. The ocean moves in three ways, currents, tides and waves and they are important to life on earth.
 - b. Tides are caused by the gravitational forces of the sun and moon.
 - c. There are two tides daily.
3. Skill Objective(s)
 - a. Calculate elapsed time

B. *Materials*

1. Appendix F (one for each student)
2. Appendix G
3. Bill Nye: Moon and or <http://mbgnet.mobot.org/salt/sandy/tide.htm>
4. www.tides.info

C. *Key Vocabulary*

1. **High tide** – ocean level is high due largely to gravitational pull of the moon
2. **Low tide** - ocean level is low due to gravitational pull of the moon
3. **Neap** During the moon's quarter-phases the sun and moon work at right angles, causing the bulges to cancel each other. The result is a smaller difference between high and low tides and is known as a neap tide.

D. *Procedures/Activities*

1. Explain to students that the level of the ocean rises and falls each day. Ask them why they think this occurs. Read Appendix F: Tides
2. Show movie: Bill Nye: Moon section on tides and/or use <http://mbgnet.mobot.org/salt/sandy/tide.htm> or visual on placement of earth and sun to form high, low and neap tides. Explain that gravitational pull of the moon pulls water to one side and when sun and moon line up together the pull is greater. Explain when moon and sun are at right angles a neap tide is created.
3. Divide students into groups of 3 students each. The student representing the earth will have a large rope (3 foot diameter) around his waist. Students will simulate the creation of high and low tides.
Point out to students the moon's gravitational pull on Earth and on the bodies of water on it. The moon causes the water on the side of Earth nearest to it to rise up in a high tide. The water on the opposite side of Earth also rises up in a high tide as the solid Earth under it is pulled toward the moon. Low tides occur in between the placers as water flows toward the high tides. Point out there is a finite amount of water on earth; only the distribution changes.
4. Draw a diagram of positions of earth, moon, sun during high and low and neap tides.
5. Use Appendix H - Tide Math connection activity. Decide to have the students use the Internet or local newspapers to record high and low tide for seven days. OR Use www.tides.info to find a high and low tide chart for an area of the world most meaningful to your students. Print out page of high and low tides for one week. THEN Using computation skills of elapsed time calculate the elapsed time between high and low tides. (Students should see a pattern of 12 hours and 50 minutes between afternoon high tide on one day and afternoon high tide on the previous day. The same holds true for low tides)

E. *Assessment/Evaluation*

1. Labeled diagram
2. Calculations of high and low tides.

Lesson Seven: Ocean Motion: What are waves?

F. *Daily Objectives*

1. Concept Objective(s)
 - a. Ocean is part of other inter-related biological and physical systems.
2. Lesson Content
 - a. Waves are caused by the wind
 - b. Water molecules move up and down in place and do not move with the wave.
 - c. Crest and trough, wave height and wavelength are similar to light and electromagnetic waves.
 - d. Tsunamis are fast-moving waves caused by earthquakes.
3. Skill Objective(s)
 - a. Record and articulate findings from a scientific activity

G. *Materials*

1. Chalkboard
2. Child's pool or large container filled with water
3. Corks for each group
4. Appendix H: (One for each student)

H. *Key Vocabulary*

1. **Waves** are the up and down movement of the ocean's surface caused by wind.
2. **Crest** is the high part of the wave.
3. **Trough** is the low part of the wave
4. **Wave height** is the distance from bottom of trough to top of crest
5. **Wavelength** is the distance from top of crest to top of crest or top of trough to top of trough. Measured same way as electromagnetic waves are measured from previous units.
6. **Tsunamis** is the fast moving waves caused by earthquakes

I. *Procedures/Activities*

1. Have a child's pool filled with some water with LOTS of newspaper under the pool to absorb any splash. (Can do this outdoors if weather permits.)
2. Ask students what they know about waves. Have they ever been to the ocean? Draw out their experiences with waves at the shore.
3. Have one student agitate the water and then have several students drop corks into the water
4. Discuss what students are observing – water molecules tend to move up and down in place and not move with the wave. Identify what is meant by wave height, introduce or review crest and trough of a wave.
5. Read Appendix H. Have students conduct a pre-read survey reading title, headings and bold-faced words and questions BEFORE beginning to read.
6. Discuss that tsunamis are giant waves caused by earthquakes under the ocean. Recall the lessons on the Plate Tectonics Core Knowledge unit.
7. Assign Appendix H: Waves questions

J. *Assessment/Evaluation*

1. Student responses during activity discussion
2. Completed questions to Appendix H

Lesson Eight: Is There Anybody Down There?

A. *Daily Objectives*

1. Concept Objective(s)
 - a. Ocean is part of other inter-related biological and physical systems.
2. Lesson Content
 - a. Benthic zone is the bottom of the ocean where little light penetrates therefore there is very little life
 - b. Pelagic zone is the open ocean
 - c. Benthic, bottom living organisms such as kelp and mollusks
 - d. Nekton is the free-swimming part of the ocean where fish and whales exist.
 - e. Small drifting plants and animals (plankton) are the dominant life and food source of the ocean and use photosynthesis to create food.
 - f. Most organisms in the ocean are plant life.
 - g. Most deepwater life depends on organic matter from above or chemosynthesis in order to exist.
 - h. Upwelling is a source of rich nutrients for some marine life
 - i. Solutions for pollutions of the ocean are necessary to protect the delicate balance of food webs.
3. Skill Objective(s)
 - a. Read for specific information
 - b. Draw conclusions and make inferences
 - c. Use classroom, library and internet resources to research
 - d. Use ratio/proportion to create model for full size “Ocean Bubble” bubble

K. *Materials*

1. Appendix I Life in the Ocean (one for each student)
2. Appendix J: Create a Bubble (one for each student)

L. *Key Vocabulary*

1. **Benthic** are bottom living such as kelp and mollusks
2. **Nekton** are free swimming such as fish and whales
3. **Plankton** is small drifting plants and animals which are dominant life and food source of the ocean.
4. **Photosynthesis** is a plants ability to change light into food using chlorophyll
5. **Zooplankton** is animal plankton
6. **Food chain** is the sequence of the organisms in which each uses the next member for food.
7. **Food web** is the interacting of food chains

M. *Procedures/Activities*

1. Ask students where plants and animals get their food in the ocean. Place some of their responses on the board and try to develop a food chain or web.
2. Read Appendix I: Life in the Ocean
3. Assign: Assessment. Students use library and classroom and the Internet resources to find specific life from each classification. Must find picture. Draw or reproduce the plant or animal. Write on the back which classification with some interesting facts about size. Write down what it eats. Cut out and place in a container in the class until the culminating activity.
4. Take one life form of the ocean and draw a food chain and a food web using poster paper.

N. *Assessment/Evaluation*

1. Research one organism that lives in the life. Make a poster that shows: 1) if organism is from benthic, nekton, or plankton level 2) what does it eat 3) a food chain of which your organism is a part.

VI. CULMINATING ACTIVITY

- A. Students will be divided into groups of 2-3 students of mixed ability and given **Appendix J: Creating the Ocean Bubble Bubble**. Students will build a large plastic bubble inflated with a window fan at one end. Students will be divided into groups of 2-3, each with the task of creating an interactive way to illustrate to younger students in 3rd grade who are also studying oceans, one of the topics listed in **Appendix K: Topics for Project**. Only one group per topic. Inside of the bubble students will use permanent markers to show the different zones of the ocean. In conjunction with the 3rd grade students will place appropriate living things in each of the zones. Some 6th grade students will create a ticket with the number of interactive stations printed on a ticket with an appropriate graphic for Ocean Bubble. Outside of the bubble students will have on display the various topics. As groups of 5 younger students come through the 6th graders will give short presentations about their display. The 6th grade created tickets will be distributed to 3rd graders earlier in the day. These tickets will be punched with a hole punch as the groups of students visit each station.

VII. HANDOUTS/WORKSHEETS

1. Appendix A
2. Appendix B
3. Appendix C
4. Appendix D
5. Appendix E
6. Appendix F
7. Appendix G
8. Appendix H
9. Appendix I
10. Appendix J
11. Appendix K

VIII. BIBLIOGRAPHY

<http://www.the-cohens.com/marc/HMS-Crew/Tides.html> Lesson plans on tides

http://www.the-cohens.com/marc/HMS-Crew/wave_action.html Lesson plans on making waves

http://www.the-cohens.com/marc/HMS-Crew/nautical_calculation.html Math activities involving the ocean

<http://smithsonianeducation.org> student and teacher resources

<http://www.onr.navy.mil/focus/ocean/motion/waves3.htm> excellent diagrams of ocean motion

http://www.field-trips.org/tours/sci/oceank/_tourlaunch1.htm virtual reality tour of different aspects of ocean

<http://www.mccollam.com/fun/geoquiz/euroquiz.html> excellent interactive quiz that contains blank maps for students to test knowledge of ocean locations as well as other geographical areas of the world.

Hirsch, Jr. E.D. *What Your First Grader Needs to Know*. New York: Dell Publishing, 1991, ISBN 0-385-31026-9

Objectives: Differentiate the continental shelf from the continental slope.
Describe a mid-ocean ridge, an abyssal plain, and an ocean trench.

Vocabulary: continental shelf, continental slope, abyssal plain, mid-ocean ridge, trench

The ocean floor has mountains, valleys and plains just like the earth's surface. As you travel from the ocean shore you come to the **continental shelf**. The continental shelf slopes gradually from the edge of the continent into the ocean. The North American continental shelf in the Atlantic Ocean extends from 2 to more than 300 km into the Atlantic. In some places the ocean is 150 m deep.

The ocean floor drops sharply. This ocean surface feature is called the **continental slope**. Trenches, valleys, plains, and ridges are found beyond the continental slope. Where sediment has been deposited by ocean currents into deep valleys, abyssal plains are created. These plains are between four and six thousand km deep.

Where new ocean floor forms because of the earth's plates coming together is called the **mid-ocean ridge**. The mid-ocean ridge is an underwater mountain ridge. Volcanic eruptions force magma to seep between the cracks causing new crust to form along the ridge as the liquid magma becomes rock as it cools.

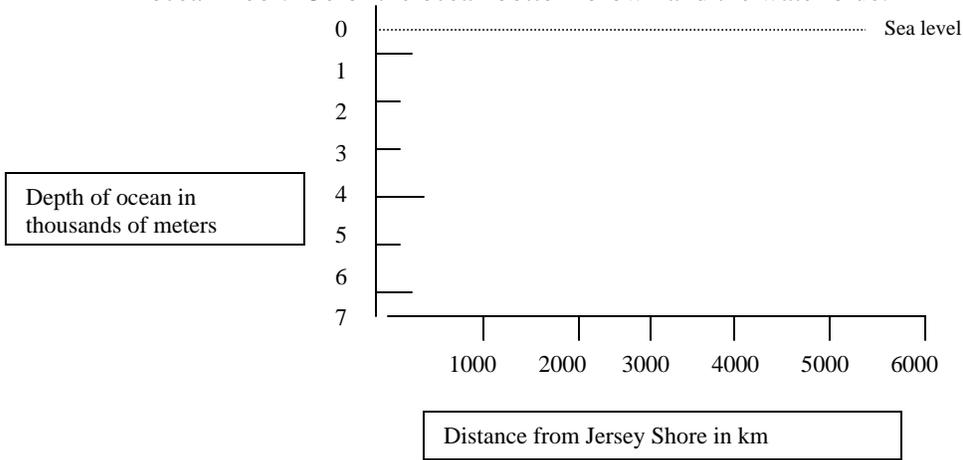
Some underwater volcanoes created enough crust to be seen above water. These are called volcanic islands as seen in Hawaii.

Also on the ocean floor are **trenches**. A trench is a long narrow, steep-sided depression in the ocean floor. These were formed as one plate was forced beneath another. The Pacific Ocean where most trenches are found contains the Marianas Trench, 11 km deep. If the Earth's tallest mountain, Everest, were set in the bottom of the Marianas Trench it would be covered with more than 2000 m of water. It is along trenches that earthquakes and volcanoes are active.

Appendix B

Purpose: To see a profile of the Atlantic Ocean at 34 degrees north latitude.

Directions: Using graph paper, plot the points from the chart. Connect the points to create a profile of the ocean floor. Color the ocean bottom brown and the water blue.



Set up your graph to look like the one above. Use the points below

Point	Distance from Jersey Shore (km)	Depth of water (meters)
1.	0	0
2.	150	200
3.	200	2000
4.	500	3500
5.	1000	5500
6.	1500	5000
7.	2000	5500
8.	2500	3500
9.	3000	45000
10.	3200	4000
11.	3500	2100
12.	3600	1300
13.	4000	0
14.	4100	2000
15.	4500	4000
16.	5000	5000
17.	5300	4200
18.	5500	2000
19.	5600	1000
20.	5650	200
21.	5700	0

Now label:

- Continental shelf
- Continental slope
- mid-ocean ridge

Appendix C
Composition of Seawater.

Oceans:

Objective Importance of the ocean

Reason ocean is salty and has a stable salinity.

In a group list the ways oceans affect your life, then make a list of the ways humans affect oceans.

Oceans make up 70 percent of the earth's surface.

When did oceans begin? Early earth had much volcanic activity. Volcanoes spewed lava, ash and *water vapor*. The water vapor accumulated in the earth's atmosphere and then began to fall and to collect in basins where oceans are now located.

These salts come from rivers and groundwater slowly dissolving elements such as calcium, magnesium, and sodium from rocks and minerals. Rivers transport these elements to the oceans. Erupting volcanoes add elements, such as sulfur and chlorine, to the atmosphere and oceans.

But why are oceans salty? As rivers flow to the oceans elements of calcium, magnesium, and sodium dissolve from the rocks and are carried to the ocean. When these elements reach the ocean they combine with sulfur and chlorine that were deposited by volcanoes during explosions. The combination of the elements carried by the river and the volcanic deposits in the ocean create sodium and chlorine, salts. This process occurred over millions of years and continues to occur.

Why doesn't the ocean get saltier? Why is its salinity, saltiness, been stable for hundreds of millions of years. Some of the elements just settle to the bottom of the ocean floor much the same way sand thrown into a swimming pool would settle to the bottom. Secondly, plants and animals living in the ocean use the calcium, silicon and other elements to build shells and skeletons.

Appendix C (p.2)

1. Draw a concept map showing how the ocean becomes salty and why its salinity does not change.

Use the following words:

Rivers, calcium and silicon, combine, sulfur and chlorine, form, salts, plants and animals, skeleton and shells.

2. Look at the composition for ocean water below. Add the parts water and the salts. What does it equal? Why?

3. Add all the parts that make up ocean salt. What does it equal? Why?

Composition of Ocean Water	
To 96.5 parts water	
Add 3.5 parts salts	
To make salts	
Mix 55 parts chloride	1.2 parts calcium
30.5 parts sodium	1.1 parts potassium
3.7 parts magnesium	0.7 parts silica
7.7 parts sulfate	and others

Appendix D: Currents

Objective:

Cause of surface currents.
Importance of surface currents.

Vocabulary:

Surface currents
Coriolis effect

The ocean moves in three ways – currents, tides and waves.

If you stir a cup of cocoa you have created a current. A current is a mass of water moving in one direction. An ocean current is like a river within the ocean. Surface currents are caused by the wind blowing across the surface of the ocean water. Surface currents are usually no more than 300-400 meters deep.

One of the most important currents for America is the Gulf Stream current that travels from the Florida area to England. This current is about 100 km wide and was important to the American colonies.

Surface currents are influenced by the Coriolis effect. The Coriolis effect is caused by the spinning of the earth. It causes currents in the northern hemisphere to flow right, and southern hemisphere currents to turn left. Look at a map that shows the Gulf Stream and you will see that it turns towards the right. Continents also affect the flow of currents. Pacific currents continue to move west until they hit Asia and Australia.

Why are surface currents important? Surface currents carry seeds and plants. This is one of the ways different species have been spread to different continents. Many ocean organisms rely to surface currents for transportation. Sailors have always used currents to travel.

Surface currents also influence climate. Warm water is from the equator are spread north and south of the equator. The heat from the equator is then transferred to other places on the earth. Iceland is warmed by the Gulf Stream that turns an area that should be very cold to one with a mild climate.

Appendix E

Density Currents

Wind-driven surface currents affect only the upper layers of Earth's oceans. Currents can also be caused by the differences in densities. Warm water is less dense than cold water. As the denser ocean water sinks, less dense water rises causing a density current.

Try the next activity to see how this occurs.

Materials: dish of ice

Beaker with warm water

Pipette

Food coloring

Procedures:

1. In a dish, melt ice to make ice water.
2. Fill a large beaker with warm water
3. Add a few drops of food coloring to the warm water
4. Use the pipette to carefully place the colored warm water on the bottom of the beaker containing the ice water.
5. Repeat using warm water in the beaker and colored ice water in the pipette.

Observe: In which experiment was a current created?

How does the density of the cold water create a current?

Appendix E (page 2)

Questions

1. How does the energy from wind affect surface currents?

2. How do density currents affect the circulation of water in deep parts of the oceans?

3. When marine animals such as eels, turtles, and whales migrate, they often use surface ocean currents. What would happen to animal migration without surface currents?

4. The latitudes of San Diego, California and Charleston, South Carolina are exactly the same. However, the average yearly water temperature in the ocean off Charleston is much higher than the water temperature off San Diego. Explain why.

5. *Math Connection:* If the density of a sample of seawater is 1.02716 g/mL, what would be the mass of 4 mL of the sample?

Appendix F: Tides

Vocabulary: tides

Objective: What causes tides? How are tides different from currents and waves?

Ocean Tides

The ocean moves in three ways: currents, waves and tides. Tides are the rising and lowering of the level of the sea. There are two high tides and two low tides each day. At high tide water is pushed further up on the coast or beach. During low tide the water recedes or pulls back from the beach.

What causes the tides? Tides are controlled by the gravitational pull of the sun and moon. Although the sun is larger and has more gravity, the moon is closer and so has twice the gravitational pull of the sun. The water in the oceans responds to this force, forming a bulge of ocean water on the side of Earth facing the moon. This is a high tide. Another bulge forms on the opposite side of the planet. The bulge on the side away from the moon also occurs because the water is thrown outward as Earth and the moon revolve around a common point. The water in the oceans tries to travel away from Earth's orbit, but Earth's gravity keeps water from flying off into space. This is similar to what happens if you spin a bucket of water around in a circle. The water in the bucket tries to travel in a straight line and is thrown outward toward the bottom of the bucket. The bottom of the bucket keeps the water. The areas between the bulges experience low tides.

When the sun and the moon are lined up on one side, the tides become very high because that side of the earth has the gravitational pull of the moon AND the sun. When the moon, sun and earth are lined up to form the points of a right angle, the bulges cancel each other out; there is equal pull by the sun and the moon and there is little difference between high and low tides. This is called a **neap tide**.

Appendix G: Activity

Collect the high and low tides for 7 days or use the chart your teacher will give you and answer the following questions:

1. How many low tides are there each day? _____
2. Write a general statement about the time between high tides on the same day.
3. How much later is the morning high tide on the third day from the morning high tide on second day?
4. How much later is the afternoon low tide on the fifth day than the afternoon low tide on the fourth day? _____

5. Who and why would need to know when high and low tides will occur?

Complete Chart for 7 days

Day	Time Between Low Tides	Time Between High Tides

Appendix H: Waves

Vocabulary: wave

Objective: What is a wave? What makes a wave? How is wave different from a current?

Ocean Waves

As explained in the last lesson, the ocean is constantly moving by currents, waves and tides. A **wave** is a movement of ocean water that makes the water rise and fall. The movement of waves transmits energy. Waves can have tremendous force.

But waves in the ocean transmit energy without actually moving the water very far. The particles of water move in a circular movement. If you were floating on a tube in the ocean, the wave passes under you. You don't really go anywhere. The tube moves back then up and forward.

Most of the circular movement of water particles is near the surface of the ocean because that's where most waves are. The energy from one water particle is transferred to the next particle and that particle transfers the energy to the next particle and so on. The *water particle* does not move forward; only energy is being transferred. It is similar to the energy passed as people do the wave at a football game. People are just standing and sitting but the movement gives the illusion that people are actually moving around the stadium.

What makes waves?

What makes waves in the ocean? Waves are all about the transfer of energy. Energy from the wind is transferred to the ocean water. As described above each particle transfers the energy to the next particle and so on. The transfer of energy forms waves.

Why do waves "break" when they get to shore? The energy in the wave is moving at a certain speed. As the wave comes to shallow water, the bottom of the wave comes in contact with the bottom of the ocean, but the top continues to move at the same speed until it crashes on the beach. Why? You remember learning about Newton's First Law and inertia. How do these breaking waves provide entertainment for beach goers?

The **crest** is the highest point of the wave. The **trough** is the lowest point. Wave height is the vertical distance between crest and trough. Wavelength is the horizontal distance between the crests or between the troughs of two successive waves

Appendix H (page 2)

1. How are waves similar and different from currents?

2. How are wavelengths similar to what we learned about electromagnetic and light wavelengths?

Appendix I Life in the Ocean

Organisms generally get their nutrients by photosynthesis, ingesting nutrients by filtering water, or moving through water hunting for food.

Plankton

Plankton is organism that gets their nutrients by photosynthesis. Plankton is small algae and animals that rely on photosynthesis for their nutrients. They travel the ocean by drifting on currents. Diatom, golden algae, is the most plentiful and important food source for animal plankton. The animal plankton made up of eggs, baby fish, jellyfish, crabs and others use the energy of the diatom to live.

Nekton

Nekton is animals that can move through the water to acquire their food. Shrimps, cod, squid, whales, swimming turtles and seals are all nekton. These animals do not rely on the currents to propel them through the ocean since they can swim. Some live in only one part of the ocean and others like whales travel throughout the ocean. Some live close to the surface where they eat plankton and others live in the dark bottom of the ocean. Others hunt and consume other nekton and benthos in order to live. Nekton can control the depth at which they are swimming by controlling their buoyancy with special organisms that fill with gas.

Benthos

Organisms that live on the seafloor are bottom dwellers, benthos. Since sunlight can penetrate up to 140 m into the water, many of these organisms dwell on the bottom of the continental shelf but some live deep on the ocean bottom. Bottom-dwellers may burrow or attach to the bottom while others swim.

Appendix K (page 2)

Benthos gets their food by preying upon other bottom-dwelling fish. Some eat the decomposing material on the ocean's bottom acting as a kind of vacuum cleaner. Others cannot move and so filter the water for nutrients. Organisms like coral are permanently attached to the ocean floor and sting its prey.

Questions:

1. Both the anglerfish and the viperfish live in the dark ocean. The anglerfish has a light that dangles over its head to attract food and the viperfish has a light inside of its mouth to attract small fish into its mouth. Explain how this is an adaptation to their environment.

2. Kelp is a bottom dweller of the continental shelf living in cool water. Kelp can grow up to 30 cm each day and reach lengths of 25 m. How long would it take for kelp to grow 25 m?

If you grew this fast, how tall would you be when you were 3 months old?

4. Draw the levels of life in the ocean and place at least 2 organisms at each level

Appendix I (page 3)

5. Complete this chart

Level	How they get food	Where they live	Organisms
Plankton			
Nekton			
benthos			

6. Blue whales consume more than 8 metric tons of krill a day. How many grams of krill does a blue whale eat? (1 million grams = 1 metric ton)

How many kg does a blue whale consume?

7. Blue whales are 26 m long and weigh 137 metric tons. How many kg does a blue whale weight? _____ How many g? _____

How many of you would equal the length of a blue whale?

Appendix J

Create a closed three-dimensional enclosure that has the greatest floor space possible. The actual figure will use four 25' x25' (4 mil thickness) plastic pieces and duct tape for the seams.

Sketch your idea first then use graph paper to create a three-dimensional model.

Requirements:

- Must be at least 6 feet tall but no higher than 8 feet tall
- Have an opening of 3-4 feet at one end.
- The model can use only three 25 units x 25 units pieces of graph paper
- Must have the greatest floor area possible
- Must have least amount of seams possible.

Calculate:

Floor area _____

Volume _____

Express Ratio of model:actual _____

Express Volume of model:actual _____

Appendix K: Topics for Project

Each activity must include:

- A display or demonstration. The display can be 2 or 3 dimensional .
- An interactive component where the student shows he understands the concept at your station.
- Sign that includes the number of your station and the topic in letters at least 5 inches high

Possible topics:

1. Ocean food web including
2. Importance of photosynthesis in ocean food chain
3. Chemosynthesis
4. Locating the oceans of the world

5. Desalination of the ocean

Describe and illustrate some of the ways salt water is desalinated.

Design a method to remove salt from seawater. Draw and label these drawings. Display them on the walls surrounding Ocean Bubble

6. Water cycle

7. Density currents

8. Topic: Density Currents (Using Models)

Have a large fish tank, a long pipette and some very warm (not hot) colored water so younger students can put the warm water in the pipette and release into the bottom of the cold water thereby creating a density current. Students could then draw what they observed on a paper that has the title density currents.

6th graders would have on display world maps (created by them) of the major currents throughout the world

and/or

This same experiment can be done by substituting colored salt water for the very warm water as explained above.

9. What makes surface currents?
10. Three ways oceans move – currents, waves, and tides
11. Reading tide charts
12. Explaining high and low tides
13. Why are tides important?
14. How are waves created?

15. Features of the ocean basin (continental shelf, continental slope, mid-ocean ridge, abyssal plain and ocean trench)
16. Why and why is the sea floor mined?
17. Size of blue whales or other ocean organism
18. Kelp
19. Plankton, Nekton, and Benthic Levels of the ocean
20. An interesting organism in the ocean, its place in a food chain or food web
21. Global warming and its affect on the ocean
22. Parts of a wave – crest and trough and how to measure the height of a wave.