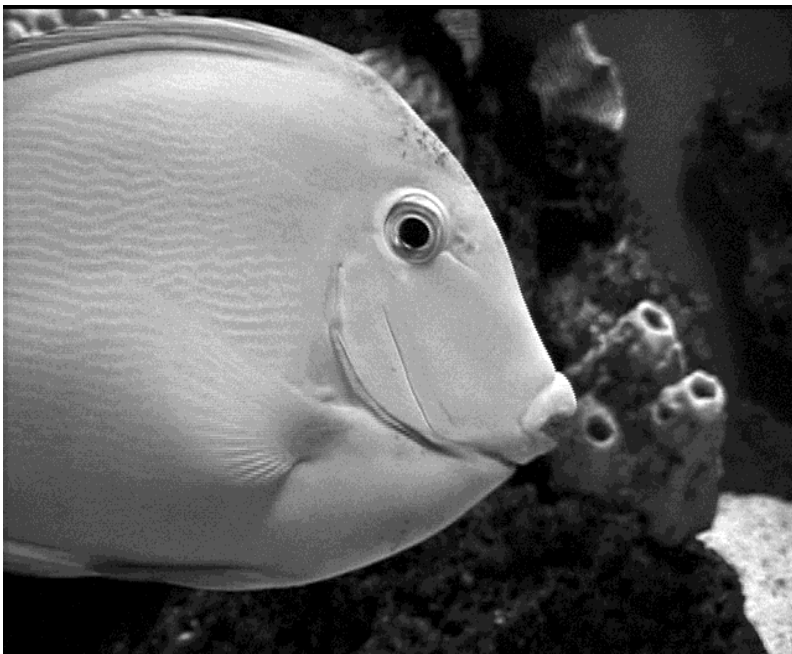


# Oceanography

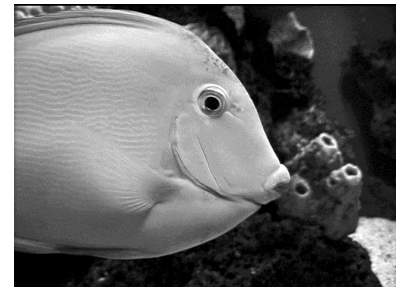
## Teacher's Guide Middle School



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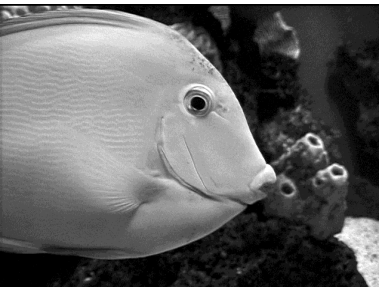
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ISBN 1-59234-052-0



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# Viewing Clearances

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**Discounts** may be granted to institutions interested in purchasing programs in large quantities. These discounts may be negotiated with the *Visual Learning Company*.



# **A Message from our Company ...**

Dear Educator:

Thank you for your interest in the educational videos produced by the *Visual Learning Company*. We are a Vermont-based, family owned and operated business specializing in the production of quality educational science videos and materials.

We have a long family tradition of education. Our grandmothers graduated from normal school in the 1920's to become teachers. Brian's mother was an elementary teacher and guidance counselor, and his father was a high school teacher and superintendent. This family tradition inspired Brian to become a science teacher, and to earn a Ph.D. in education, and lead Stephanie to work on science educational programs at NASA.

In developing this video, accompanying teacher's guide, and student activities, our goal is to provide educators with the highest quality materials, thus enabling students to be successful. In this era of more demanding standards and assessment requirements, supplementary materials need to be curricular and standards based - this is what we do!

Our videos and accompanying materials focus on the key concepts and vocabulary required by national and state standards and goals. It is our mission to help students meet these goals and standards, while experiencing the joy and thrill of science.

Sincerely,

Brian and Stephanie Jerome



# Standards Correlations

## National Science Education Standards

(Content Standards: 5-8, National Academy of Sciences, c. 1996)

Science as Inquiry - Content Standard A:

As a result of activities in grades 5-8, all students should develop:

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Earth Science - Content Standard D:

As a result of their activities in grades 5-8, all students should develop an understanding that:

- Water is a solvent. As it passes through the water cycle it dissolves minerals and gases and carries them to the oceans.
- Global patterns of atmospheric movement influence local weather. Oceans have a major effect on climate, because water in the oceans holds a large amount of heat.

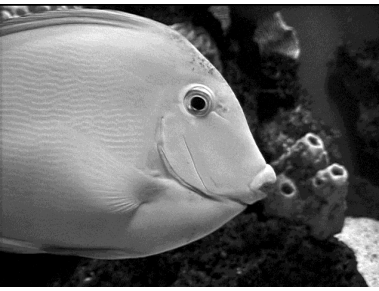
## Benchmarks for Science Literacy

(Project 2061 - AAAS, c. 1993)

The Physical Setting - The Earth (4B)

By the end of eighth grade, students should know that:

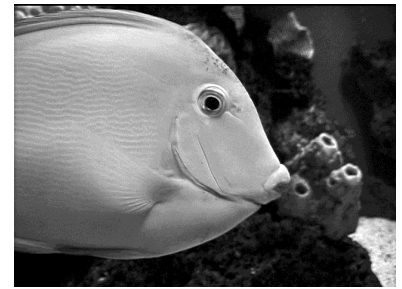
- Heat energy carried by ocean currents has a strong influence on climate around the world.



# Student Learning Objectives

Upon viewing the video and completing the enclosed student activities, students should be able to do the following:

- List and locate the major oceans on Earth;
- Define the term **salinity**, and describe why the oceans are salty;
- State how ocean temperature, pressure, and density vary with depth;
- Explain that the thermocline is a zone that separates warmer water from colder water;
- Understand how water pressure increases with depth;
- List some of the factors that affect wave size;
- Differentiate between surface currents and deep currents;
- Locate the general position of the Gulf Stream, and describe how it brings warmer water to higher latitudes; and
- Describe some of the features of the ocean floor, including continental shelf, continental slope, submarine canyons, seamounts, and deep sea trenches.



# **Assessment**

## **Preliminary Test:**

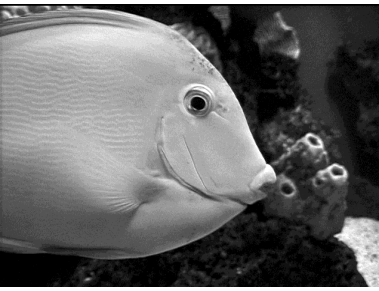
The Preliminary Test, provided in the Student Masters section, is an assessment tool designed to gain an understanding of student preexisting knowledge. It can also be used as a benchmark upon which to assess student progress based on the objectives stated on the previous pages.

## **Video Review:**

The Video Review, provided in the Student Masters section, can be used as an assessment tool or as a student activity. There are two main parts. The first part contains questions titled “You Decide” that can be answered during the video. The second series of ten questions consists of a video quiz to be answered at the conclusion of the video.

## **Post-Test:**

The Post-Test, provided in the Student Masters section, can be utilized as an assessment tool following student completion of the video and student activities. The results of the Post-Test can be compared against the results of the Preliminary Test to assess student progress.



# Introducing the Video

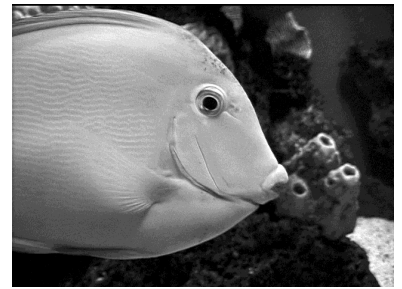
Before viewing the video, ask students if they have ever been swimming in the ocean. Ask them to describe the taste of seawater. Next ask them why seawater tastes salty, but water in lakes does not taste salty. Ask the class to describe other things they may observed on their visit to the ocean. They may mention things such as waves, currents, or specific types of animals. Tell students to pay close attention to the video to learn more about the oceans.

## Video Viewing Suggestions

The Student Master “Video Review” is provided for distribution to students. You may choose to have your students complete this Master while viewing the program or to do so upon its conclusion.

The program is approximately 20-minutes in length and includes a ten-question video quiz. Answers are not provided to the Video Quiz on the video, but are included in this teacher’s guide. You may choose to grade student quizzes as an assessment tool or to review the answers in class.

The video is content-rich with numerous vocabulary words. For this reason you may want to periodically stop the video to review and discuss new terminology and concepts.



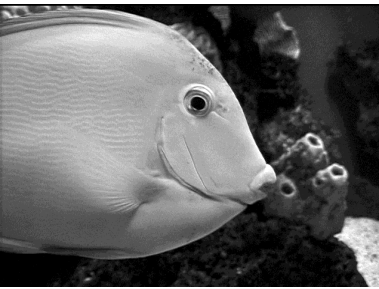
# Student Assessments and Activities

## Assessment Masters:

- Preliminary Test
- Video Review
- Post-Test

## Student Activity Masters:

- Properties of Seawater
- Making Waves
- Exploring the Ocean
- Creatures of the Dark
- Vocabulary of *Oceanography*

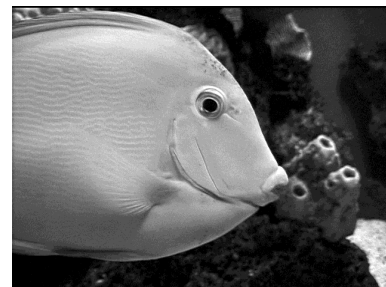


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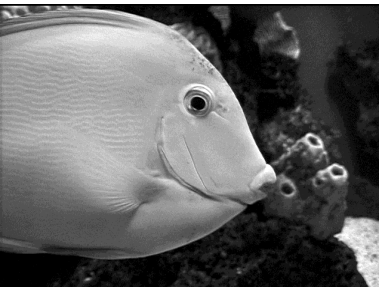
# Video Script: *Oceanography*

1. What do the following things have in common:...
2. ...these gannets resting on this sea cliff,...
3. ...this lobsterman pulling up his trap,...
4. ...these sea lions,...
5. ...these barnacles filtering water,...
6. ...and this fish?
7. If you haven't guessed yet, all of these living things live close to the ocean and obtain their food from the oceans.
8. Throughout the history of the earth, the oceans have played a vital role in providing food and habitat for tens of thousands of different kinds of living organisms.
9. What do the oceans consist of?
10. What makes up seawater, and why are the oceans salty?
11. What forces are responsible for currents, tides, and waves?
12. And what does the ocean floor look like?
13. Oceanography is the study of the oceans . . .
14. . . and oceanographers are scientists who work at studying the oceans, and answering many of the these questions.
15. During the next few minutes, we are going to explore these questions as we take a look at the earth's oceans.
- 16. Graphic Transition – Geography of Oceans**
17. This view of earth from space shows a planet that is mostly blue in color.
18. This is because the oceans cover over 70% of the earth's surface.
19. Even though all of the ocean waters on earth are connected, certain regions are identified by different names.
- 20. You Decide!** How many oceans are there?
21. There are four oceans on earth.
22. The Arctic Ocean is located at the North Pole.
23. The Pacific Ocean is the largest and deepest ocean.
24. The Atlantic Ocean is the second largest ocean, bordering North America, Europe, South America and Africa.
25. The Indian Ocean is one of the smaller oceans.
26. Smaller bodies of saltwater that are nearly enclosed by land are called seas.
27. Seas are also connected to the oceans.
28. For example, the Mediterranean Sea is connected to the Atlantic Ocean.
- 29. Graphic Transition – Why is the Ocean Salty?**
30. If you have ever taken a gulp of water while swimming or surfing in the ocean, you certainly know that ocean water tastes salty.
31. But why is ocean water salty? Ninety-six percent of water in the ocean is pure water. But a small percentage of it is made of chemicals, including salt.
32. Sodium chloride, or common table salt, is the most common salt found in seawater.

# Script (cont.)



33. Salinity is the term used to describe the amount of salt in water.
34. The salinity of ocean water is between 3.3% and 3.7%.
35. Salinity varies in the oceans depending on location.
36. Due to abundant rainfall, ocean waters in the tropics tend to have a lower salinity.
37. But at the poles, ocean water tends to have a higher salinity.
38. Where do salts found in the ocean come from?
39. The ocean serves as a collecting basin for material washed from the land.
40. Rocks and soils from the land contain salts, which are washed into the oceans by rivers and streams.
41. When ocean water evaporates, the salts are left behind.
42. Over thousands of years, this process has resulted in the levels of salinity that exist today.
43. Although salt is one of the dominant elements, there are many other elements found in ocean water.
44. In fact, over 90 different elements are known to exist in seawater.
45. For example, oxygen is one of the many gasses dissolved in seawater.
- 46. You Decide!**
47. What body part enables fish to breathe underwater?
48. Fish and many other sea animals possess structures called gills, which enable them to extract oxygen from seawater.
49. Other than oxygen, nitrogen and carbon dioxide are also important gasses found in the ocean.
- 50. Graphic Transition – Temperature, Pressure, and Density**
51. The ocean water, here on the coast of Maine, is so cold that it can cause your muscles to cramp in minutes.
52. But the temperature of the water here in South Florida is as warm as bath water.
53. Why is the water temperature different in these two locations?
54. The main factor accounting for this difference in ocean water temperature is the amount of solar energy received from the sun.
55. Ocean water near the equator receives more overall solar energy throughout the year...
56. ...than oceans near the poles.
57. Temperature also varies with depth.
58. The surface of the ocean receives more sunlight than deeper water and is therefore warmer.
59. Wind and wave action mix water in the upper 100 to 400 meters, transferring heat downwards.
60. Below this depth, water temperature decreases.
61. The thermocline is a zone that separates warmer water from colder water.
62. The thermocline also represents a division between water of different densities.
63. Warmer, less dense water rides above colder, denser water.
- 64. You Decide!**
65. Where is pressure greatest in the oceans?
66. That's right! Pressure is greatest at the bottom.
67. To demonstrate this, try stacking a couple of books on your hand. Place your other hand on top of this stack and continue stacking by having someone place more books on your second hand.
68. Where is the pressure greatest? It is greatest on the bottom hand because more books are pressing down on it.



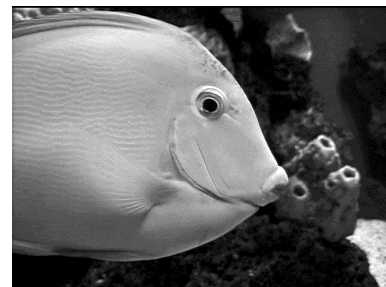
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# Script (cont.)

69. Similarly, in the oceans, as depth increases, more water from above is pushing downward, causing the pressure to increase.
70. At deep depths the pressure is so great it is capable of crushing the human body.
71. But even in this world of darkness and intense pressure, animal life such as these giant tube worms can thrive.
- 72. Graphic Transition – Waves**
73. When most people think of the beach, they often think of waves.
74. While some waves are quite small,...
75. ...the largest wave ever recorded was over 34 meters, or over 100 feet, high.
76. Have you ever wondered why waves are bigger on a windy day?
77. That is because wind is the major force responsible for the creation of waves.
78. The speed of wind, the length of time it blows, and the distance it blows over, all affect the size of the wave.
79. In the open ocean, smaller waves often become long, wide waves called swells.
80. Swells are created by rhythmic patterns of waves that are generally the same distance apart.
81. As waves approach shallow water, their speed decreases, causing them to become closer together and to increase in height.
82. The area where a wave breaks and crashes on the shore is called the surf.
83. When water retreats from the shore, it may rush back to sea, forming a strong current called an undertow.
84. An undertow can be dangerous to swimmers, pulling them out to sea.
85. While most waves are created by wind, another type of wave is created by disturbance in the ocean floor.
86. Tsunamis are large movements of water most commonly created by earthquakes in the ocean floor.
87. In Alaska in 1964, a tsunami generated by an earthquake inundated the coastline with a large mass of water hurling debris . . .
88. . . . and boats far inland, causing loss of property and human life.
- 89. Graphic Transition – Surface Currents**
90. While it is easy to see the motion of waves on the ocean surface, it is not as easy to see currents.
91. A current is like a river of moving water within the ocean.
92. There are different kinds of ocean currents. Surface currents move water horizontally – parallel to the surface of the earth.
93. Most surface currents move water in the upper few hundred meters of the ocean.
94. Wind is the primary force responsible for the creation of surface currents.
95. As the wind blows, friction is created along the water surface, forcing the water to flow.
96. This map of the earth shows the general surface current movement in the oceans.
97. Notice how circular patterns, called gyres, are found in many areas.
98. One of the more well know surface currents is the Gulf Stream. The Gulf Stream shown in this satellite image flows along the east coast of North America.
99. For hundreds of years, sailors have used the 100 kilometer wide Gulf Stream to speed their passage to Europe.
100. The Gulf Stream brings warm water and warm weather to northern countries like Ireland and England, . . .

---

# Script (cont.)



101. . . . and greatly moderates their climate in spite of their northern location.

## **102. Graphic Transition – Deep Currents**

103. While surface currents flow along the upper portion of the ocean,...

104. . . . deeper currents flow along the bottom of the ocean.

105. Deep currents are generated by differences in density of water.

106. For example, at the poles, the ocean water is very cold and salty. Cold, salty water is dense.

107. This can be illustrated in this tank where the cold, blue, dense water rides along the bottom . . .

108. . . . and the warmer, less dense water rides over the top.

109. In the oceans, cold, dense water from the poles sinks downward to the deep ocean, and continues to flow slowly toward the equator.

## **110. Graphic Transition – The Ocean Floor**

111. When you look across the surface of the ocean, it looks relatively flat.

112. But in many places the ocean floor is as mountainous as this scene.

113. Most of the ocean floor is unexplored.

114. In fact, we probably know more about the surface of the moon than the floor of the ocean.

115. Fortunately, enough of the ocean floor has been explored to develop a basic understanding of its features.

116. The place where ocean water meets the land is called the shoreline.

117. While it may appear that continents end at the shoreline, the edge of a continent actually extends into the ocean.

118. The region where the edge of a continent meets the ocean floor is called the continental margin.

119. Extending from the shoreline is a relatively flat area called the continental shelf. A continental shelf has a gentle, relatively flat slope.

120. Some, like the Atlantic coast of North America, may extend hundreds of kilometers into the ocean.

121. Certain areas of the continental shelf provide excellent fishing grounds and . . .

122. . . . provide habitat for sea life, such as whales.

123. At the edge of the continental shelf, a steep incline called the continental slope drops to the ocean floor.

124. In some areas, deep submarine canyons cut into the continental shelf and slope.

125. Beneath the waters here in Monterey Bay, California lies a very deep submarine canyon, . . .

126. . . . which is deeper than the Grand Canyon, seen here.

127. The large flat areas of the ocean floor are called abyssal plains.

128. Abyssal plains are similar to deserts in that life is sparse.

129. Along the ocean floor are scattered underwater mountains called seamounts.

130. Seamounts are volcanic mountains which rise sharply from the ocean floor.

131. In some cases, as in Hawaii, seamounts reach above the ocean surface and become islands.

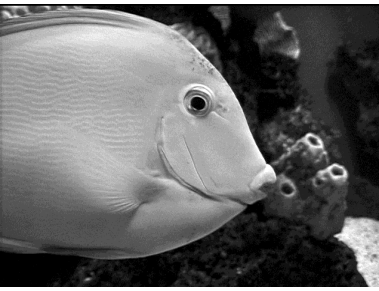
132. The island of Hawaii rises over 9,600 meters from the ocean floor, making it the highest mountain on earth.

133. Along the edges of the ocean floor lie deep trenches – the deepest areas of the ocean.

## **134. Graphic Transition - Summing Up**

135. During the past few minutes, we have explored some of the characteristics of the oceans.

136. We also studied some of the factors which contribute to the salinity of ocean water.



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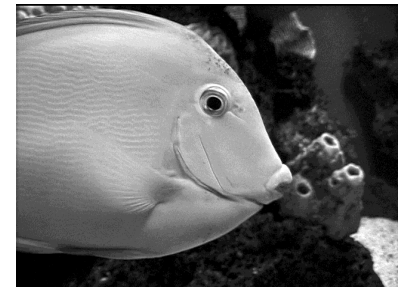
# Script (cont.)

137. We also took a look at some of the other characteristics of ocean water, including temperature, pressure, and density.
138. And we discussed some of the factors involved in the creation of ocean waves, . . .
139. . . as well as ocean currents, including surface...
140. . . and deep currents.
141. We also took a look at some of the fascinating features found on the floor of the ocean.
142. So the next time you take a swim in the ocean,...
143. . . or sail a boat in the ocean,
144. . . think about some of the things we discussed.
145. You might just look at the oceans a little differently.

## **Video Quiz**

Fill in the correct word when you hear this tone. Good luck and let's get started.

1. The \_\_\_\_\_ Ocean is the largest ocean.
2. \_\_\_\_\_ is a measure of salt in seawater.
3. Ocean water near the \_\_\_\_\_ is warmer.
4. The \_\_\_\_\_ separates water of different temperature.
5. As depth increases, \_\_\_\_\_ increases.
6. \_\_\_\_\_ is the major force responsible for the creation of waves.
7. A \_\_\_\_\_ is like a river moving in the ocean.
8. Tsunamis tend to be triggered by underwater \_\_\_\_\_.
9. Large, flat areas of the ocean floor are \_\_\_\_\_ plains.
10. \_\_\_\_\_ are volcanic mountains rising from the ocean floor.



# Answers to Student Assessments

## Preliminary Test

1. oceanographers
2. sea
3. depth
4. thermocline
5. swells
6. surf
7. current
8. abyssal
9. seamount
10. trenches
11. false
12. true
13. false
14. true
15. true
16. false
17. false
18. true
19. true
20. false

## Video Review

### **You Decide:**

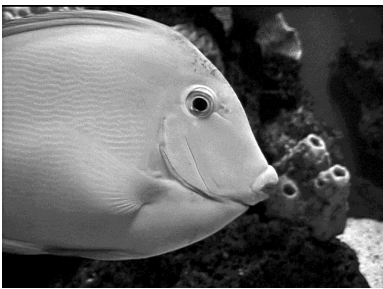
1. There are four major oceans on the earth.
2. Gills enable fish to breathe underwater.
3. Pressure in the oceans is greatest at the bottom.

## Video Quiz:

1. Pacific
2. salinity
3. equator
4. thermocline
5. pressure or density
6. wind
7. current
8. earthquakes
9. abyssal
10. seamounts

## Post Test

1. true
2. false
3. true
4. true
5. false
6. true
7. false
8. false
9. false
10. true
11. thermocline
12. trenches
13. sea
14. depth
15. swells
16. current
17. abyssal
18. oceanographers
19. surf
20. seamount



# Answers to Student Activities

## Properties of Seawater

### **Pressure:**

Students should be able to feel more pressure on their hand in deeper water.

### **Salinity and Density:**

The wooden block should float higher in the saltwater than in freshwater. This is because salt water is denser than freshwater.

### **Temperature and Density:**

The cold, colored water should migrate along the bottom with the warmer water riding over the top. This is because cold water is denser than warm water

## Making Waves

1. The largest wave is produced in the longer pan because the wind and wave travelled over a larger distance.
2. A larger wave is produced by a strong and steady wind current.
3. The largest wave should have been produced in the larger pan, with continuous stable wind and the fastest speed setting.

## Exploring the Oceans

Diagrams will vary.

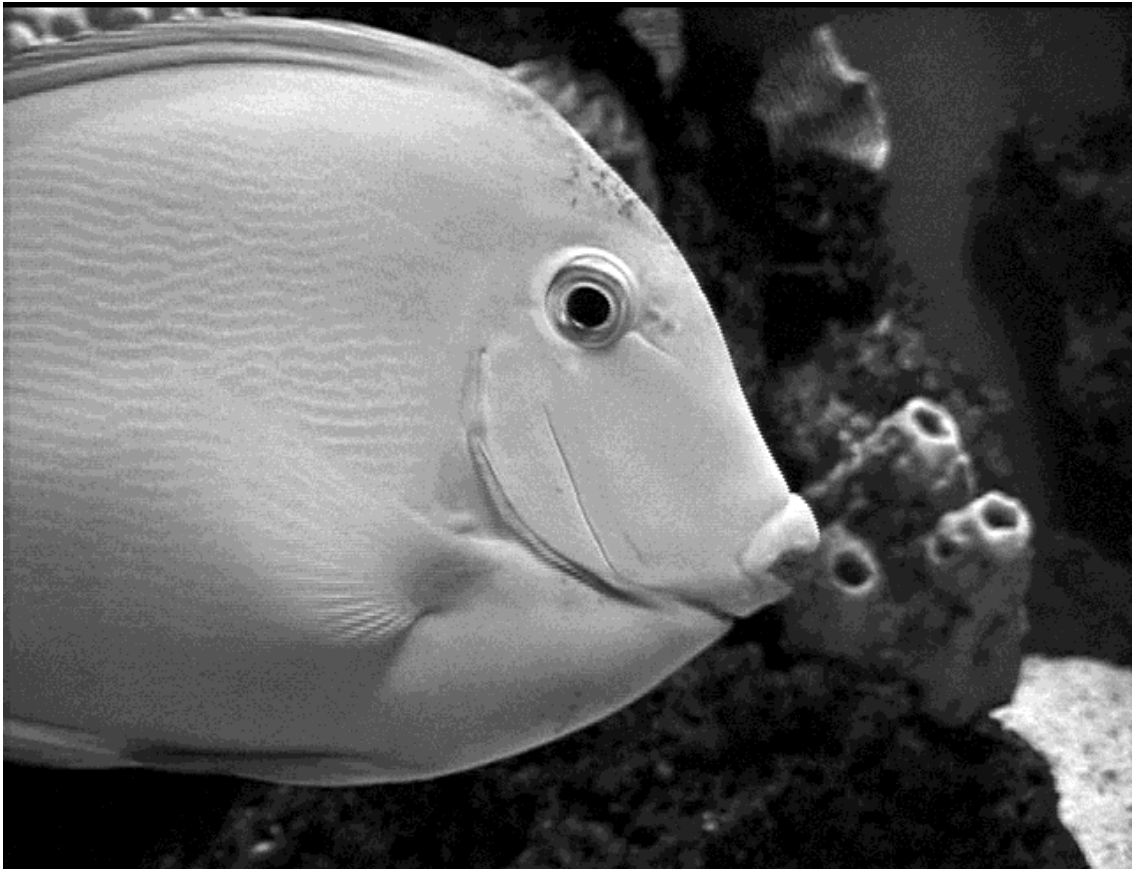
## Creatures of the Dark

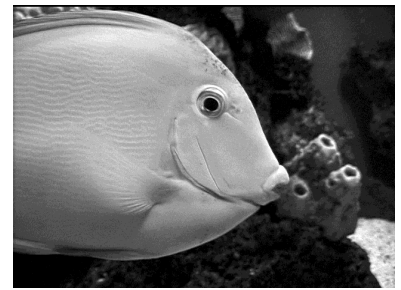
1. C
2. D
3. D
4. C
5. Hydrothermal vents are formed in places where the sea floor separates. Seawater seeps into the cracks and encounters hot magma. The water becomes super heated, rises, and bursts through holes in the sea floor.
6. Hydrothermal vent creatures tend to thrive on hydrogen sulfide, a chemical that is toxic to creatures found close to the surface. Or they consume other animals who derive their energy from synthesizing hydrogen sulfide.
7. Hydrothermal vent animals ingest bacteria, which are responsible for converting hydrogen sulfide to energy.
8. Bacteria have a symbiotic relationship with other animals in hydrothermal vents, meaning that both the bacteria and animals benefit from the relationship.

## Vocabulary

1. thermocline, b
2. swells, c
3. sea, a
4. current, c
5. seamount, f
6. abyssal, e
7. Pacific, h
8. trench, g
9. salinity, j
10. oceanography, i

# **Assessment and Student Activity Masters**



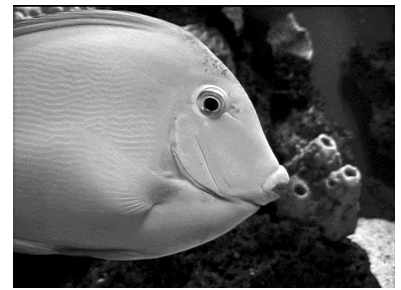


# Preliminary Test

**Directions:** Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

1. \_\_\_\_\_ are scientists who study the oceans.
2. A \_\_\_\_\_ is a body of saltwater enclosed partially by land.
3. Temperature varies with \_\_\_\_\_.
4. The zone that separates warmer water from colder water is called the \_\_\_\_\_.
5. Small waves in the open ocean that become long, wide waves are called \_\_\_\_\_.
6. The \_\_\_\_\_ is the area of an ocean where waves break and crash on shore.
7. The Gulf Stream is an example of a surface \_\_\_\_\_.
8. \_\_\_\_\_ plains are large, flat areas of the ocean floor.
9. The island of Hawaii was once an underwater mountain called a \_\_\_\_\_.
10. \_\_\_\_\_ are the deepest areas of the ocean.

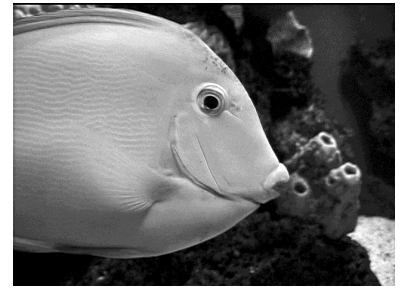
depth	wave
trenches	sea
ocean	current
swells	seamount
oceanographers	thermocline
abyssal	surf



# Preliminary Test

**Directions:** Decide whether the answer is True (T) or False (F).

- 11. The Atlantic Ocean is the largest ocean. T F
- 12. Fish use gills to extract oxygen from the water. T F
- 13. There are twelve major oceans. T F
- 14. Wind is the primary source of wave creation. T F
- 15. The Gulf Stream is an example of a surface current. T F
- 16. Salinity is a measure of seawater temperature. T F
- 17. The deep sea is warm and dark. T F
- 18. Oceanography is the study of the oceans. T F
- 19. Oceans cover more of the earth's surface than does land. T F
- 20. Water pressure is greatest in the upper layer of the ocean. T F



# Video Review

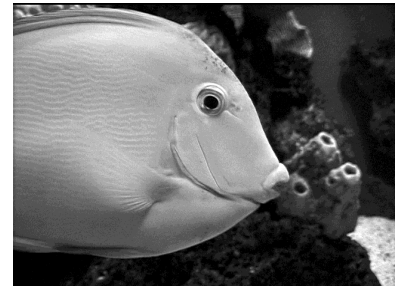
**Directions:** During the course of the program, answer the “You Decide” questions as they are presented in the video. Answer the Video Quiz questions at the end of the video.

**You Decide:**

- A. How many oceans are there? Answer \_\_\_\_\_
  
- B. What body part enable fish to breathe underwater? Answer \_\_\_\_\_
  
- C. Where is pressure greatest in the oceans? Answer \_\_\_\_\_

**Video Quiz:**

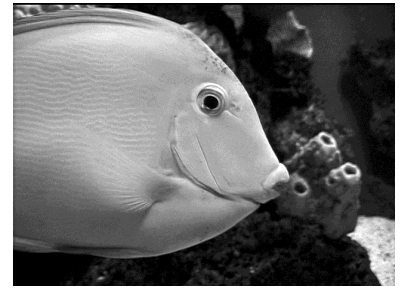
1. The \_\_\_\_\_ Ocean is the largest ocean.
2. \_\_\_\_\_ is a measure of salt in seawater.
3. Ocean water near the \_\_\_\_\_ is warmer.
4. The \_\_\_\_\_ separates water of different temperature.
5. As depth increases, \_\_\_\_\_ increases.
6. \_\_\_\_\_ is the major force responsible for the creation of waves.
7. A \_\_\_\_\_ is like a river moving in the ocean.
8. Tsunamis tend to be triggered by underwater \_\_\_\_\_.
9. Large, flat areas of the ocean floor are \_\_\_\_\_ plains.
10. \_\_\_\_\_ are volcanic mountains rising from the ocean floor.



# Post Test

**Directions:** Decide whether the answer is True (T) or False (F).

1. Oceans cover more of the earth's surface than does land.      T      F
2. Water pressure is greatest in the upper layer of the ocean.      T      F
3. Wind is the primary source of wave creation.      T      F
4. Fish use gills to extract oxygen from the water.      T      F
5. There are twelve major oceans.      T      F
6. The Gulf Stream is an example of a surface current.      T      F
7. Salinity is a measure of seawater temperature.      T      F
8. The deep sea is warm and dark.      T      F
9. The Atlantic Ocean is the largest ocean.      T      F
10. Oceanography is the study of the oceans.      T      F

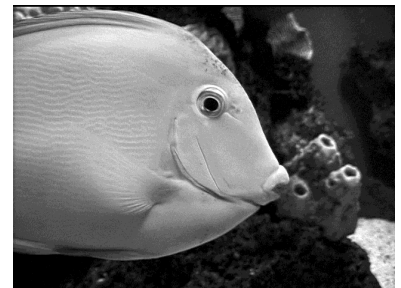


# Post Test

**Directions:** Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

11. The zone that separates warmer water from colder water is called the \_\_\_\_\_.
12. \_\_\_\_\_ are the deepest areas of the ocean.
13. A \_\_\_\_\_ is a body of saltwater enclosed partially by land.
14. Temperature varies with \_\_\_\_\_.
15. Small waves in the open ocean that become long, wide waves are called \_\_\_\_\_.
16. The Gulf Stream is an example of a surface \_\_\_\_\_.
17. \_\_\_\_\_ plains are large, flat areas of the ocean floor.
18. \_\_\_\_\_ are scientists who study the oceans.
19. The \_\_\_\_\_ is the area of an ocean where waves break and crash on shore.
20. The island of Hawaii was once an underwater mountain called a \_\_\_\_\_.

depth	wave
trenches	sea
ocean	current
swells	seamount
oceanographers	thermocline
abyssal	surf



# Properties of Seawater

**Objective:** In this activity, students will learn about some of the interesting characteristics of seawater.

**Background:** Seawater in the ocean possesses some important physical and chemical properties, which have a big impact on the plants, animals, and people that live in and near the sea. The three general properties we will investigate include pressure, salinity, and density.

## **Materials:**

faucet water	salt	thermometer
aquarium or plastic container	food coloring	plastic bag
wooden block	pencil	ice cubes

## **Procedure:**

### **Pressure:**

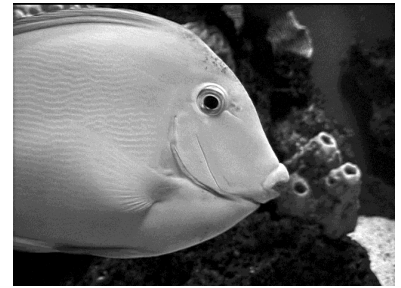
- Fill an aquarium or a deep sink with 5 centimeters of water. Place your hand at the bottom and note how your hand feels.
- Then fill the aquarium or sink to the top. Now place your hand at the bottom. Note any difference in the feeling of your hand.
- Decide whether you feel more pressure on your hand in deep or shallow water.

### **Salinity and Density:**

- Mix 250 ml. of water with 50 ml. of salt. Pour this in a sink or aquarium. Repeat this 5 to 7 times.
- Take a small wooden block and place it in the salty water. With a pencil, place a mark on the side of the block at the water mark.
- Repeat step b, except do not add salt water.
- Compare the position of the different marks on the same block.

### **Temperature and Density:**

- Fill an aquarium half way with warm water that is approximately 70 degrees C.
- Fill a plastic bag with a few ice cubes, cold water, and a few drops of food coloring.
- Place a few small holes in the bag, and gently lower it to the bottom of the tank.
- Explain why the colored water migrates across the bottom.



# Making Waves

**Objective:** In this lab, students will learn how waves of varying sizes are formed.

**Background:** As anyone who has been to the ocean knows, waves exist in many different sizes. Some waves are very small and look like ripples in the water. But some waves, known as tsunamis, are so large that they can submerge coast lines, causing devastation to the people who live in coastal towns. What determines how large or small a wave will be? The main factor is wind. The speed of wind, the length of time it blows, and the distance over which it blows affects the size of waves. The faster the wind and the longer and further it blows, the larger the wave. If the conditions are right, waves can reach great heights, with the record wave reaching over 100 feet!

## Materials:

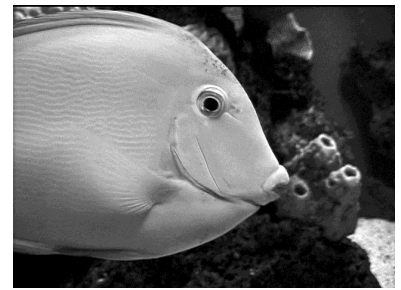
2 pans of varying length  
water  
oscillating fan

## Procedure:

1. Fill each pan with water.
2. Beginning with the short pan, adjust the speed of the fan and determine which speed produces the largest wave.
3. Next, oscillate the fan to determine whether a larger wave is produced when the fan is oscillating, or when it is directly blowing on the water.
4. Repeat steps 2 and 3 using the larger pan.
5. Experiment with the location, speed, and settings of the fan to determine which combination produces the larger waves.

## Discussion:

1. In which pan was the largest wave produced? Why?
2. Is a larger wave produced when the fan is oscillating, or producing a continuous flow of air when aligned with the pan?
3. Which combination produces the largest wave?

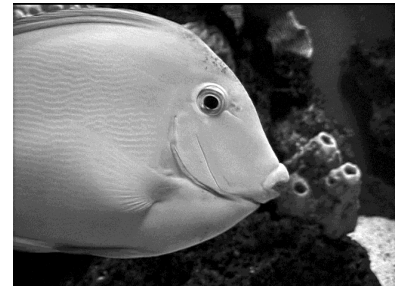


# Exploring the Ocean

**Objective:** In this lab, students will learn to identify the different regions of the ocean floor, and gain an understanding of the changes in ocean temperature and pressure.

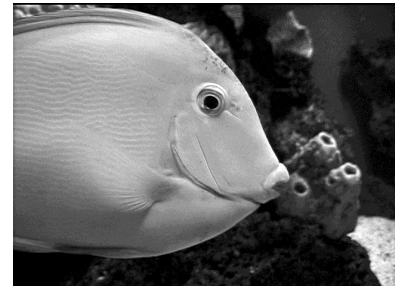
**Background:** Much like the landscape of the surface of the earth, the ocean floor is made of many different features. The feature you are probably most familiar with is the **shoreline**, the place where the ocean water meets the land. Although it appears as though the continent ends at the shoreline, it actually extends into the ocean. The **continental margin** refers to the region where the edge of the continent meets the ocean floor. Extending from the shoreline is a relatively flat area called the **continental shelf**, which has a very gradual slope. Where the continental shelf ends, there is a relatively steep drop-off to the ocean floor. This region is called the **continental slope**. In some regions of the continental shelf, there are **submarine canyons**, similar to the canyons we see on land. **Abyssal plains** are large, flat regions of the ocean floor, similar to desert regions. However, the ocean floor is not one continuous flat region. Abyssal plains are broken up by underwater mountains called **seamounts**. Seamounts are volcanic mountains, some of which are so large that they rise above the ocean's surface to form islands. In some places deep **ocean trenches** cut into the ocean floor, some plunging over 11,000 feet!

Now that we can identify the different features of the ocean floor, it is important to understand some of the properties of the ocean water. Temperature varies with location. This is largely due to the amount of solar energy received from the sun. Water near the equator receives more solar energy than water at the poles, and is therefore warmer. Temperature also varies with depth. Water near the surface receives more sunlight than deeper water, causing the surface water to be warmer. The **thermocline** is the zone that separates warmer water from colder water, and changes with season and location. The thermocline also represents the division between waters of different densities. Warmer, less dense water rides above colder, denser water. The third property is pressure. Pressure increases with depth because as depth increases, more water from above is pushing downward, causing the pressure to increase. Pressure can be so great that it can crush a human body!



# Exploring the Ocean (cont.)

**Directions:** Using the information provided on the previous page, draw a diagram of the ocean floor, as well as a cross-section profile of the ocean. Be sure to label the following regions of the ocean floor: continental shelf, continental slope, submarine canyon, abyssal plain, seamount, and trench. Also indicate areas of high and low water pressure, high and low intensity of light, temperature differences, thermocline, and regions of higher and lower density.



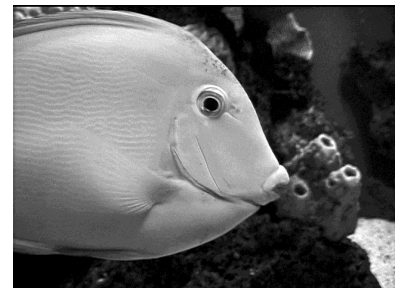
# Creatures of the Dark

**Directions:** Read the text below and answer the questions on the following page.

Until the late 1970s, scientists thought that life could not exist on the dark floor of the deep ocean, where sunlight cannot reach. But in 1977, scientists proved themselves wrong. While exploring the ocean floor, a group of scientists discovered a wide variety of strange creatures surviving in this harsh environment.

Scientists discovered deep-sea creatures living near hydrothermal vents. Hydrothermal vents are geysers found in the deep ocean floor. They exist in all oceans, generally around a depth of 2225 meters. The water they release contains rich minerals, and reaches temperatures of 403 degrees Celsius, (757 degrees Fahrenheit). Vents are formed in places where the sea floor separates. Seawater seeps into the cracks, where it encounters hot magma. The water becomes superheated, rises, and bursts through holes in the ocean floor, forming these extremely hot geysers.

Due to extreme temperatures and complete lack of sunlight, scientists thought living creatures could not survive in this harsh environment. However, in 1977, scientists found a large colony of tube worms living at a vent near the Galapagos Islands. These tube worms were unlike anything they had seen before. The tail ends of tube worms are securely planted in the ocean floor, while the opposite ends sway freely in the water. They can grow to be over 4 feet tall, and grow more than 33 inches per year. These giant tube worms are only found in the Pacific Ocean, but over 300 other species have been found throughout the ocean. Other organisms include mussels, crabs, clams and shrimp. These creatures are very different from those we eat. In fact, the chemicals present in hydrothermal vents are poisonous and would kill most creatures that exist on or near the earth's surface. It is these very chemicals that the vent creatures survive on in a process called chemosynthesis. Hydrogen sulfide, the most common chemical, is the main energy source in the hydrothermal vent communities. It is the sunlight substitute in the deep sea. Bacteria in the vents convert hydrogen sulfide to energy, and other vent animals consume the bacteria. In some cases, the bacteria live in the animal's tissue, forming a symbiotic relationship from which both the bacteria and animal benefit. Because of this, many vent creatures do not have a mouth or digestive tract!



# Creatures of the Dark (cont.)

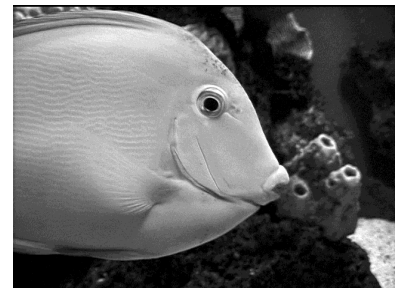
**Directions:** Answer the following questions.

## Part I: Multiple Choice

1. When were hydrothermal vents discovered?  
A. 1902                      C. 1977  
B. 1953                      D. 2001
2. What is the average depth of most hydrothermal vents?  
A. 1000 feet                C. 2225 feet  
B. 1000 meters            D. 2225 meters
3. Which of the following creatures are found in hydrothermal vents?  
A. clams                      C. shrimp  
B. mussels                 D. all of the above
4. What is the most common chemical in deep sea vents?  
A. oxygen                    C. hydrogen sulfide  
B. sulfur                      D. sunlight

## Part II. Short Answer

5. How are hydrothermal vents formed?
6. How are hydrothermal vent creatures, such as shrimp, different from those found closer to the ocean's surface?
7. Explain the process by which some hydrothermal vent animals obtain energy from hydrogen sulfide
8. Explain the relationship that bacteria have with some other animals in the deep sea vents.



# Vocabulary of Oceanography

\_\_\_\_\_ 1. htmoercline \_\_\_\_\_

\_\_\_\_\_ 2. wellss \_\_\_\_\_

\_\_\_\_\_ 3. eas \_\_\_\_\_

\_\_\_\_\_ 4. urcrent \_\_\_\_\_

\_\_\_\_\_ 5. tunomeas \_\_\_\_\_

\_\_\_\_\_ 6. lassaby laipns \_\_\_\_\_

\_\_\_\_\_ 7. icfpcai \_\_\_\_\_

\_\_\_\_\_ 8. chrent \_\_\_\_\_

\_\_\_\_\_ 9. tyisalni \_\_\_\_\_

\_\_\_\_\_ 10. phygraceoano \_\_\_\_\_

a. large area of water partially enclosed by land

b. zone of separation of warmer and colder water

c. long, wide waves in the open ocean

d. river-like stream in the open ocean

e. wide plains on the ocean floor

f. volcanic formation rising to the surface from the sea floor

g. deepest area of the oceans

h. the largest ocean

i. the study of oceans

j. the measurement of salt levels in water