Teacher's Masters

California Education and the Environment Initiative

Earth Science Standard E.5.d.

Ocean Currents and Natural Systems

California Education and the Environment Initiative

Approved by the California State Board of Education, 2010

The Education and the Environment Curriculum is a cooperative endeavor of the following entities:

California Environmental Protection Agency
California Natural Resources Agency
Office of the Secretary of Education
California State Board of Education
California Department of Education
California Integrated Waste Management Board

Key Leadership for the Education and Environment Initiative:

Linda Adams, Secretary, California Environmental Protection Agency
Patty Zwarts, Deputy Secretary for Policy and Legislation, California Environmental Protection Agency
Andrea Lewis, Assistant Secretary for Education and Quality Programs, California Environmental Protection Agency
Mark Leary, Executive Director, California Integrated Waste Management Board
Mindy Fox, Director, Office of Education and the Environment, California Integrated Waste Management Board

Key Partners:

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Office of Education and the Environment
1001 I Street • Sacramento, California 95812 • (916) 341-6769
http://www.calepa.ca.gov/Education/EEI/

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Lesson 1 Rise and Fall of the California Sardine Industry

None required for this lesson.

Lesson 2 Ocean Water's Influence on the Distribution of Organisms

None required for this lesson.

Lesson 3 Ocean Currents' Influences on Coastal and Marine Organisms

None required for this lesson.

Lesson 4 Human Connections to Ocean Processes

None required for this lesson.

Lesson 5 Marine Organism Distribution and Human Economies

Perspectives on the Kelp Harvest Ban 2

Lesson 6 Management of California's Sardine Industry

None required for this lesson.

Assessments

Properties of Ocean Water—Traditional Unit Assessment Master 3

Monterey Bay NMS Concept Map—Alternative Unit Assessment Master 7

Abalone Farmers

Background: Abalone is a shellfish that is considered a highly-desirable food by many. In California, 13 abalone farms raise these mollusks, feeding them harvested kelp from the ocean.

Perspective: Abalone farmers would like greater access to harvesting kelp to support their farming industry. The kelp is an important economic resource for them. In harvesting kelp beds, they cut the top portion off the kelp, rather than stripping the beds bare. Abalone farmers see kelp beds as a sustainable resource that is renewed each year.

Defenders of Wildlife

Background: The organization, Defenders of Wildlife, is a national conservation group. They work to protect native plants and animals in their natural communities.

Perspective: Environmentalists, like the Defenders of Wildlife, want to protect kelp forests as a habitat for sea otters. Sea otters use kelp beds as nurseries and foraging grounds. Environmentalists oppose the harvesting of underwater forests, since they believe it destroys the sea otters' habitat.

Cannery Row Business Association

Background: Cannery Row is a waterfront street in Monterey, California. This area once housed the sardine industry. Now it is a tourist attraction filled with restaurants, hotels, and shops. The Cannery Row Business Association was an organization that supported the interests of businesses in Cannery Row. (In 2004, this organization was reconfigured as the Cannery Row Business Improvement District.)

Perspective: Sea otters are one of the main tourist attractions in Monterey. Sea otters use kelp forests as nurseries and foraging grounds. The tourism industry is opposed to harvesting kelp forests. They are concerned that harvesting kelp forests will reduce the sea otter population. This in turn will have a negative economic impact on the community, since tourists will no longer come to Cannery Row to see the sea otters.

Name: _____

Part 1

Instructions: Use the words in the Word Bank to complete the sentences below. Some words may be used more than once, and some may not be used at all. (2 points each)

Word Bank

California Current	cold	erosion
longshore currents	nutrients	photosynthesis
phytoplankton	primary producers	salinity
temperature	upwelling	warm
thermocline	gyre	

1. Sardines thrive in environments that contain high concentrations of _____.
2. Scientists think the California's sardine population may have been influenced by changes in _____, as well as overfishing.
3. Both phytoplankton and kelp are examples of _____.
4. Inorganic nutrients, such as nitrogen and phosphates, are necessary for _____.
5. Cold waters are carried down the coast of California by the _____.
6. In Monterey Bay, a process called _____ brings deep, nutrient-rich waters to the surface.
7. _____ water sinks because it is more dense than _____ water.
8. In addition to temperature, another variable that influences the density of water is _____.

Name: _____

9. Because there is a consistent amount of solar energy year-round in the tropics, a permanent _____ forms in the ocean waters.

10. A _____ is a large-scale ocean circulation system.

11. Thermoclines trap _____ in deep, _____ water.

12. Building jetties and breakwaters can disrupt _____, which can change the way sediments move and can cause _____.

Part 2

Instructions: Select the best answer and circle the correct letter. (2 points each)

13. Off California's coast, a thermocline _____.
- a. remains constant all year round
- b. disappears during the summer
- c. forms during the summer, as the California Current brings warm water to form an upper layer
- d. forms during the summer, as increased sunlight heats the upper layers of the water

14. In polar regions, _____.
- a. phytoplankton thrive during the summer, when sunlight increases
- b. there is a permanent thermocline that traps nutrients below the surface waters
- c. cold temperatures prevent phytoplankton from surviving
- d. phytoplankton thrive all year round, because nutrients are always plentiful

15. In tropical regions, phytoplankton _____.
- a. thrive all year round, because there is a constant supply of solar energy
- b. thrive in the summer when waters warm up
- c. get trapped in deep water beneath a permanent thermocline
- d. have a consistent and plentiful supply of nutrients, since the upper and lower layers of water mix all year round

16. Which of the following is not a feature of the ocean that affects vertical layering?
- a. density
- b. phytoplankton
- c. temperature
- d. salinity

Name: _____

17. Which of the following do primary producers need to survive?
   a. cool temperatures
   b. warm temperatures
   c. nitrogen and phosphates
   d. permanent thermoclines

18. Jetties and breakwaters _____.
   a. cause erosion
   b. cause sediments to be deposited in new places
   c. disrupt local currents
   d. All of the above.

19. Jetties and breakwaters _____.
   a. have little effect on ecosystems
   b. may form habitats for marine organisms
   c. may cause the destruction of habitats for some organisms
   d. b and c

20. Which group would support increased kelp harvesting in Monterey Bay?
   a. tourism industry
   b. manufacturers who use alginate
   c. environmentalists
   d. sardine canneries

Part 3

Instructions: Answer the following questions in the spaces provided. (5 points each)

21. How does a thermocline affect the distribution of marine organisms?

Name: _____

22. What physical properties are important to supporting the sardine population off the coast of California? Why?

23. What scientific evidence has been used to develop management policies for the sardine industry in California. Give one example.

Name: _____

Instructions: Use the **Monterey Bay NMS Background Information** (Student Edition, pages 10–13) to complete the concept map below. (5 points per box)

How are these organisms important to human lives and communities?

What properties of the ocean affect where these organisms live?

When currents and seasons change, the distribution of phytoplankton changes. How does this affect other organisms in the ecosystem?

Coastal and marine organisms in Monterey Bay NMS

Examples:

How do people make decisions about management of this ecosystem?

How do ocean layers and currents influence where these organisms live?

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