NATIONAL GEOGRAPHIC

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UNIT

# Marine Ecology, Human Impacts, & Conservation

This project-based learning experience culminates with students using their new knowledge about marine ecology and human impacts on the ocean to create and propose a management plan for a Marine Protected Area.

**GRADES**

9 - 12+

**SUBJECTS**

*Biology, Ecology, Conservation, Earth Science, Oceanography, English Language Arts, Geography, Human Geography, Physical Geography, Mathematics*

**CONTENTS**

9 Lesson plans

For the complete unit with media resources, visit:
http://www.nationalgeographic.org/unit/marine-ecology-human-impacts-conservation/

## UNIT OVERVIEW

As part of National Geographic Society's Ocean Initiative, National Geographic Education is working to help teachers like you educate your students about the importance of ocean health and the establishment and management of Marine Protected Areas (MPAs).

National Geographic Education has developed a series of teacher-tested classroom activities for you to use in your science courses, specifically to incorporate within your high school biology curriculum to teach students about marine ecology, human impacts on the ocean, and ocean conservation.

This collection of activities invites you to use current classroom technologies, videos, photo galleries, and maps to give students a clear view of the health and importance of the ocean. These activities provide you with tools that help students take effective notes, use graphic

organizers, and formulate opinions about ocean-related environmental issues. This project-based learning experience culminates with students using their new knowledge about marine ecology and human impacts on the ocean to create and propose a management plan for a Marine Protected Area.

This unit was originally developed for the National Teacher Leadership Academy (NTLA) 2010 Summer Geography Institute.

## LESSON 1: THE WORLD OCEAN | 2 HRS 45 MINS

Students investigate the interconnectedness of the ocean and Earth's physical and human systems through videos, discussions, writing, and mapping. They make personal connections to their own lives and are introduced to the concept of Marine Protected Areas (MPAs).

## LESSON 2: MARINE ECOSYSTEMS AND BIODIVERSITY | 2 HRS 35 MINS

Students explore major marine ecosystems by locating them on maps. Students use marine examples to learn about energy transfer through food chains and food webs. They discuss how food webs can illustrate the health and resilience of an ecosystem.

## LESSON 3: SYMBIOTIC RELATIONSHIPS IN MARINE ECOSYSTEMS | 3 HRS 40 MINS

Students analyze videos to make observations about species, populations, and communities of organisms and discuss their symbiotic relationships. Then they create a hypothetical marine ecosystem and describe the adaptive, trophic, and symbiotic relationships between the biotic and abiotic components of the ecosystem.

# LESSON 4: HUMAN IMPACTS ON THE WORLD OCEAN | 1 HR 40 MINS

Students are introduced to the idea that humans have enormous impacts on marine ecosystems and resources, and explore the stakeholders involved.

# LESSON 5: HUMAN IMPACTS ON MARINE SPECIES | 7 HRS 10 MINS

Students learn about three examples of human impacts on marine life: migration patterns and shipping, algal blooms and water chemistry, and marine debris. Some of these impacts are due to human activity in the ocean, and some impacts on the ocean are due to human activity on land.

# LESSON 6: ECOSYSTEM IMBALANCE IN THE WORLD | 1 HR 50 MINS

Students build on their knowledge of individual impacts on the ocean to see how the whole system can react to threats and changes. They examine ways in which human actions throw marine ecosystems out of balance, explore the concept of how impacts can build, and review their understandings of ecosystem dynamics.

# LESSON 7: FISHERIES | 4 HRS 30 MINS

Students explore issues related to fisheries sustainability and simulate fish monitoring methods commonly used by scientists and resource managers.

# LESSON 8: MARINE PROTECTED AREAS EXPLORATION | 4 HRS 45 MINS

Students explore Marine Protected Areas on an interactive map and compare and contrast three case studies. They learn how the MPA classification system works in the United States, apply that system to example scenarios, and create case studies of their own.

# LESSON 9: MARINE PROTECTED AREAS MANAGEMENT | 12 HRS

Students read a case study and debate the pros and cons of a Marine Protected Area (MPA) in the region. Then they select a Marine Protected Area and develop and present a management plan for it.

# BACKGROUND & VOCABULARY

## Vocabulary

| Term | Part of Speech | Definition |
|---|---|---|
| **abiotic** | *adjective* | lacking or absent of life. |
| **adaptation** | *noun* | a modification of an organism or its parts that makes it more fit for existence. An adaptation is passed from generation to generation. |
| **anthropogenic disturbance** | *noun* | changes to the natural environment caused by human activity. |
| **apex predator** | *noun* | species at the top of the food chain, with no predators of its own. Also called an alpha predator or top predator. |
| **aphotic zone** | *noun* | the deepest ocean zone, below 914 meters (3,000 feet). Also known as the midnight or bathypelagic zone. |
| **atmosphere** | *noun* | layers of gases surrounding a planet or other celestial body. |

| Term | Part of Speech | Definition |
|---|---|---|
| **autotroph** | *noun* | organism that can produce its own food and nutrients from chemicals in the atmosphere, usually through photosynthesis or chemosynthesis. |
| **biodiversity** | *noun* | all the different kinds of living organisms within a given area. |
| **biogeography** | *noun* | study of the distribution of species and ecosystems in space and time. |
| **biomagnification** | *noun* | process in which the concentration of a substance increases as it passes up the food chain. |
| **biomass** | *noun* | living organisms, and the energy contained within them. |
| **bioprospecting** | *noun* | process by which pharmaceutical companies buy or claim genetic resources from native species of a developing country. |
| **biotic factor** | *noun* | effect or impact of an organism on its environment. |
| **bycatch** | *noun* | fish or any other organisms accidentally caught in fishing gear. |
| **case study** | *noun* | form of problem-based learning, where the teacher presents a situation that needs a resolution. The learner is given details about the situation, often in a historical context. The stakeholders are introduced. Objectives and challenges are outlined. This is followed by specific examples and data, which the learner then uses to analyze the situation, determine what happened, and make recommendations. |
| **choropleth map** | *noun* | representation of statistical data, such as population, over a specific area using colors or patterns to represent types or intensity of data. |
| **collapsed fishery** | *noun* | fishing industry where the number of fish has been severely reduced or depleted. Also called a depleted fishery. |
| **commensalism** | *noun* | relationship between organisms where one organism benefits from the association while not harming the other. |
| **common name** | *noun* | non-scientific name of a species, or what the organism is usually called. |
| **coral reef** | *noun* | rocky ocean feature made up of millions of coral skeletons. |
| **current** | *noun* | steady, predictable flow of fluid within a larger body of that fluid. |
| **dead zone** | *noun* | area of low oxygen in a body of water. |
| **decomposer** | *noun* | organism that breaks down dead organic material; also sometimes referred to as detritivores |
| **decomposition** | *noun* | separation of a chemical compound into elements or simpler compounds. |

| Term | Part of Speech | Definition |
|---|---|---|
| **detritivore** | *noun* | organism that consumes dead plant material. |
| **ecological succession** | *noun* | gradual, predictable changes to an ecosystem or habitat. |
| **ecosystem** | *noun* | community and interactions of living and nonliving things in an area. |
| **eutrophication** | *noun* | build-up of sediment and organic matter in bodies of water, which may cause a change in the productivity of the ecosystem. |
| **fishery** | *noun* | industry or occupation of harvesting fish, either in the wild or through aquaculture. |
| **food chain** | *noun* | group of organisms linked in order of the food they eat, from producers to consumers, and from prey, predators, scavengers, and decomposers. |
| **food pyramid** | *noun* | diagram of a healthy diet that shows the number of servings of each food group a person should eat every day. |
| **food web** | *noun* | all related food chains in an ecosystem. Also called a food cycle. |
| **Great Pacific Garbage Patch** | *noun* | area of the North Pacific Ocean where currents have trapped huge amounts of debris, mostly plastics. |
| **habitat** | *noun* | environment where an organism lives throughout the year or for shorter periods of time. |
| **harmful algal bloom (HAB)** | *noun* | rapid growth of algae, bacteria, or other plankton that can threaten an aquatic environment by reducing the amount of oxygen in the water, blocking sunlight, or releasing toxic chemicals. |
| **heterotroph** | *noun* | organism that cannot make its own nutrients and must rely on other organisms for food. |
| **hydrosphere** | *noun* | all the Earth's water in the ground, on the surface, and in the air. |
| **hydrothermal vent** | *noun* | opening on the seafloor that emits hot, mineral-rich solutions. |
| **hypoxia** | *noun* | condition of not having enough oxygen in a substance, such as water or blood. |
| **kelp forest** | *noun* | underwater habitat filled with tall seaweeds known as kelp. |
| **marine debris** | *noun* | garbage, refuse, or other objects that enter the coastal or ocean environment. |
| **marine ecosystem** | *noun* | community of living and nonliving things in the ocean. |

| Term | Part of Speech | Definition |
|---|---|---|
| **Marine Life Protection Act (MLPA)** | *noun* | (1999) California law passed to create a network of marine protected areas (MPAs) along the California coast. |
| **marine park** | *noun* | part of the ocean protected by the government to preserve a threatened ecosystem or habitat. Marine parks are often recreational areas. |
| **marine protected area (MPA)** | *noun* | area of the ocean where a government has placed limits on human activity. |
| **marine reserve** | *noun* | part of the ocean where no fishing, hunting, drilling, or other development is allowed. |
| **marine sanctuary** | *noun* | part of the ocean protected by the government to preserve its natural and cultural features while allowing people to use and enjoy it in a sustainable way. |
| **mark-recapture method** | *noun* | way of monitoring animal population. A random group of animals is captured, marked with a tag or band, and released before another random group from the same population is captured. Some of the animals from the second group may have been tagged previously. Also called sight-resight, band recovery, and capture-mark-recapture. |
| **microbe** | *noun* | tiny organism, usually a bacterium. |
| **migration** | *noun* | movement of a group of people or animals from one place to another. |
| **mutualism** | *noun* | relationship between organisms of different species, in which both organisms benefit from the association. |
| **niche** | *noun* | role and space of a species within an ecosystem. |
| **no-take zone** | *noun* | area set aside by the government where all extractive activity, including fishing, mining, and drilling, is not allowed. |
| **nutrient** | *noun* | substance an organism needs for energy, growth, and life. |
| **ocean** | *noun* | large body of salt water that covers most of the Earth. |
| **ocean basin** | *noun* | depression in the Earth's surface located entirely beneath the ocean. |
| **ocean circulation** | *noun* | worldwide movement of water (currents) in the ocean. |
| **oceanographer** | *noun* | person who studies the ocean. |
| **open ocean** | *noun* | area of the ocean that does not border land. |

| Term | Part of Speech | Definition |
|---|---|---|
| **overfish** | *verb* | to harvest aquatic life to the point where species become rare in the area. |
| **oxygen** | *noun* | chemical element with the symbol O, whose gas form is 21% of the Earth's atmosphere. |
| **parasitism** | *noun* | relationship between organisms where one organism (a parasite) lives or feeds on the other, usually causing harm. |
| **photosynthesis** | *noun* | process by which plants turn water, sunlight, and carbon dioxide into water, oxygen, and simple sugars. |
| **phytoplankton** | *noun* | microscopic organism that lives in the ocean and can convert light energy to chemical energy through photosynthesis. |
| **predator** | *noun* | animal that hunts other animals for food. |
| **prey** | *noun* | animal that is hunted and eaten by other animals. |
| **producer** | *noun* | organism on the food chain that can produce its own energy and nutrients. Also called an autotroph. |
| **recovering fishery** | *noun* | fishing industry where catches are increasing after having been reduced or depleted. |
| **reservoir** | *noun* | natural or man-made lake. |
| **salinity** | *noun* | saltiness. |
| **scientific name** | *noun* | the name, usually in Latin, of an organism's genus and species. |
| **shifting baseline** | *noun* | slow changes in the standard characteristics of an ecosystem, which cause the standards to be adjusted, such as overfishing leading to a lower "baseline" estimate of the fish population. Also called a sliding baseline. |
| **spillover effect** | *noun* | process by which fish are protected within a no-take zone, then produce more offspring and eventually migrate into nearby, unprotected areas. |
| **stakeholder** | *noun* | person or organization that has an interest or investment in a place, situation, or company. |
| **substrate** | *noun* | base of hard material on which a non-moving organism grows. Also called substratum. |
| **sustainability** | *noun* | use of resources in such a manner that they will never be exhausted. |
| **sustainable fishery** | *noun* | industry of harvesting fish or shellfish that can be maintained without damaging the ecosystem or fish population. |

| Term | Part of Speech | Definition |
| --- | --- | --- |
| **sustainable seafood** | *noun* | fish, shellfish, and other aquatic organisms harvested from fish farms or fisheries that can be maintained without damaging the ecosystem. |
| **symbiosis** | *noun* | two or more distinct organisms living together for the benefit of one or both. |
| **temperature** | *noun* | degree of hotness or coldness measured by a thermometer with a numerical scale. |
| **tide** | *noun* | rise and fall of the ocean's waters, caused by the gravitational pull of the moon and sun. |
| **toxic phytoplankton** | *noun* | aquatic organism that produces chemicals that, in large amounts, can be deadly to plants and animals. |
| **trophic level** | *noun* | one of three positions on the food chain: autotrophs (first), herbivores (second), and carnivores and omnivores (third). |
| **upwelling** | *noun* | process in which cold, nutrient-rich water from the bottom of an ocean basin or lake is brought to the surface due to atmospheric effects such as the Coriolis force or wind. |
| **wave** | *noun* | moving swell on the surface of water. |

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