Family Guide

Contents

NATIONAL GEOGRAPHIC

ENCOUNTER

OCEAN ODYSSEY

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About National Geographic Encounter: Ocean Odyssey

National Geographic Encounter is a first-of-its-kind, truly immersive experience that opens with Ocean Odyssey. Using technology, children embark on a virtual underwater journey across the Pacific Ocean, exploring some of the ocean's greatest wonders and mightiest creatures. Created in a 60,000-square-foot space in Times Square, children can walk across an ocean floor and investigate a variety of ecosystems that come to life through groundbreaking technology. Video mapping, 8K photographic animation, mega-projection screens, sound, and interactive, real-time tracking bring students face-to-face with sea life—from great white sharks and humpback whales to Humboldt squids and sea lions.

At the completion of the transect, children resurface to learn more about the creatures and habitats they encountered. They engage further with more interactive technologies—such as holograms and touch screens—that highlight important ocean conservation and scientific research themes.

Visit *National Geographic Encounter* for more information on how your children can have the ultimate undersea experience without getting wet!

To the Family: Using the Family Guide

This Family Guide provides resources to support children's engagement and learning as they interact with *National Geographic Encounter: Ocean Odyssey*. The guide includes optional pre-experience and post-experience discussion questions and activities that can be used individually to address specific topics, or together as a unit. The pre-experience resources are intended to motivate children's engagement and facilitate construction of new understandings before and during the experience, while the post-experience resources facilitate the application of children's new learning. The guide also includes background vocabulary, common misconceptions, and additional resources for further investigation.

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Introduction to Oceans

Oceans span 71 percent of Earth's surface, from the shallow shores of the Solomon Islands, to the furthest depths of the Mariana Trench (~11,030 meters, ~36,200 feet). Differences in temperature, depth, and nutrient availability give rise to a variety of oceanic habitats, including coral reefs, kelp forests, and deep-sea habitats such as hydrothermal vents. Nearly 200,000 identified species call these habitats home, from enormous humpback whales to the tiniest of bioluminescent plankton, with more species being discovered all the time. These species demonstrate a variety of adaptations to their niches, including camouflage, defense mechanisms, and tolerance to low light or oxygen.

Oceans not only nurture life underwater, but they are also instrumental to life on land. Oceans store solar radiation, which allows Earth to retain heat. Circulating ocean currents then distribute heat across the globe, which influences weather patterns, a key part of the water cycle. Oceans represent the largest carbon sink worldwide, and oceanic photosynthetic organisms are responsible for producing more than half of the oxygen we breathe.

Many nations' food security and economies are tied to the oceans, too. Oceans provide the primary source of protein for more than 3 billion people worldwide. Billions of people also depend on the oceans for their livelihoods through tourism, fishing, transportation, and renewable wave, tidal, and wind energy.

Did You Know:
Coral bleaching occurs when corals become stressed and expel the symbiotic algae (zooxanthellae) living in their tissues. Since algae give corals their color and provide the majority of their food, bleached corals turn white and may die. The leading cause of coral bleaching is increased ocean temperature due to climate change.

Human activities on land and in the water impact ocean water quality and biodiversity. Sea levels are rising, ocean temperatures are warming, and the water is becoming more acidic due to increasing carbon dioxide concentrations. As a result of these changes, coral reefs are experiencing large-scale coral bleaching events. Compounding the matter, approximately 8 million tons of plastic is dumped into our oceans each year. These plastics break down over time, becoming microplastics, and may accumulate in large gyres of marine debris like the Great Pacific Garbage Patch. Marine debris can directly entangle and drown marine mammals, or be mistaken for food and ingested. Consuming plastics and microplastics can lead to death for some organisms such as turtles and albatrosses.

Did You Know:
While the term "garbage patch" might imply there is an island of visible trash floating in the ocean, most gyres of marine debris are almost entirely made of microplastics that may not be visible to the naked eye.

Degrading plastics can also release chemicals, such as bisphenol A (BPA), which can accumulate up the food chain through biomagnification, meaning that top predators accumulate the most chemicals.

Around the world, individuals, communities, and governments work every day to address the impacts of human activity on oceans, but successfully conserving our oceans will require everyone's help.

Age Level

For use with ages 10–14

Guiding Question

How can we work to conserve the water quality and biodiversity of our oceans?

Learning Goals

Your child's journey through National Geographic Encounter will be an engaging and interactive experience, and an opportunity for deep and meaningful learning about ocean ecology and conservation. Together, you can discuss your impact on the oceans and how you can work together to encourage conservation. The goals of this guide are to encourage thoughtful conversations and to engage in activities that are both fun and educational together.

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Guiding Your Child's Learning

Before

Before going to the experience, have a discussion with your children to share their existing conceptions and knowledge of oceans in order to build interest in the topic and identify any misconceptions to be addressed. Draw on past experiences such as visits to an ocean or movies watched involving oceans. A list of pre-experience discussion questions is included in this guide, which can be used to elicit background information related to biological oceanography, ocean resource use, and marine debris. After the introductory discussion, family members can choose to delve deeper into an ocean-related topic by engaging your children in one of the pre-experience activities.

During

While journeying through *National Geographic Encounter: Ocean Odyssey*, ask your children to describe unique features of the organisms and connect previous discussions and activities with their current experiences. Encourage the children to fully engage with the interactive experience!

After

Upon return, family members should help children reflect on their personal journey through *National Geographic Encounter*. Family members can ask their children about their experience to elicit any conflicts between preconceptions and what they learned or noticed, and then work to dispel existing misconceptions. A list of post-experience discussion and activities included in this guide can be used to help children place their new learning in the context of biological oceanography and to begin understanding their own impact on oceans. Once children are introduced to human impacts on oceans, family members can extend the learning further by challenging children to consider how their life at home may impact oceans and to propose solutions to these impacts.

Any of the discussion questions or activities can be tailored so as to be more personally or geographically relevant to children, or modified for older or younger children.

Before National Geographic Encounter: Ocean Odyssey

These discussion questions and activities are designed to motivate engagement with *National Geographic Encounter*.

Discussion Questions

- Oceans stretch between continents and can reach depths of approximately 11,030 meters (~36,200 feet). What are some factors that might influence the distribution of species across and within the ocean?
- Coastal and coral reef habitats provide cracks and crevices that small fish can use to hide from predators. What are some ways small fish living in the open ocean might protect themselves from predators (*bait balls*)? How are these behaviors similar to or different from terrestrial animals living in open habitats?

- Humans depend on resources provided by the environment in order to survive. What services do oceans provide for humans? Draw on examples from trips your family has taken to the ocean and any ocean-related activities you have done together.
- How are oceans impacted by human activity? Does the location of where you live on Earth influence the types of impacts you have on the ocean? For instance, does an individual living near the ocean in California have a different impact than a person living in Kansas? Why or why not?
- Non-biodegradable materials are accumulating in our oceans each day, which scientists refer to as marine debris. What items do you use or throw away that might accidentally end up in the ocean? What are some ways these items might reach the ocean? What makes these items harmful to the ocean and ocean animals?

Activities

- Have children think about ocean habitats and animal adaptations to introduce the variety of habitats that exist within the ocean and the many adaptations animals have developed to survive within them. Explore the three broad ocean habitats within the open ocean and along the ocean floor; then research the types of marine organisms living within each habitat and the adaptations that make them suited to live within the respective environments. Extend the learning by proposing the types of relationships (*predator-prey, competition*) that may exist between animals and acting out these relationships together.
- Have children investigate bioluminescence, an adaptation used by many organisms in coral reef habitats. Introduce this topic using a photo gallery of bioluminescent species. Have your children predict how bioluminescence might benefit organisms living among coral reefs. Your children can then compare their predictions

with the known uses of bioluminescence described in the encyclopedic entry and explain how these uses represent adaptations. Connect bioluminescence to the children's immediate environments by having them brainstorm local terrestrial or freshwater organisms that use colors to attract mates, lure prey, distract predators, or camouflage themselves. Then have your children research the causes and effects of coral bleaching. Work with your children to select a bioluminescent coral reef organism (*moray eel, swell shark, warty frogfish, blackbelly dwarfgoby*) and determine how coral bleaching might impact it in the future. To extend learning, challenge your children to consider how coral bleaching and the loss of bioluminescent reef organisms might impact the economy (*decreased ecotourism*).

. Next, discuss biofluorescence, which is the emission of light by an organism or substance that has absorbed light or other electromagnetic radiation. Have children research what species are biofluorescent. One organism that fluoresces is coral. Scientists, such as National Geographic Emerging Explorer David Gruber, are still trying to determine exactly why corals fluoresce. Have children take on the role of the explorer and ask if they can come up with any theories as to why they think corals fluoresce. Ask them, how might biofluorescence be an advantage or a disadvantage for a species?

Did You Know:
Bioluminescence is produced by a chemical reaction within living organisms, such as some species of fish, bacteria, and jellies. Though some corals may glow, they are not bioluminescent. Instead, these corals are fluorescent, meaning they absorb a stimulating light and re-emit it without the use of chemical reactions.

- Have your children investigate the perils of plastic within our oceans. Explain that marine debris can collect in ocean gyres, like the Great Pacific Garbage Patch, and have your children predict what types of materials may become

marine debris. Your children will then categorize and quantify their recyclable trash or your family's recyclable trash for a week and use the information to revise their predictions of what may become marine debris. Children can compare the trash they have accumulated to the information in the encyclopedic entry. Demonstrate that not all trash is easily visible by highlighting the presence of microplastics, which can enter the environment directly or when larger plastics degrade into smaller and smaller pieces. Have your children calculate how much trash they or your family produce in a month and year, and then discuss how some of this trash might end up in oceans. Use a map to trace routes from the local environment to the nearest ocean, noting that trash can also be moved by the wind. Children can research how marine debris, especially microplastics, might harm wildlife. Then prompt your children to consider how proximity to the ocean might increase one's impact, and have your children debate who is responsible (*which individuals, communities, or governments*) for addressing the issue of marine debris.

Nature Picture Library / Alamy Stock Photo

Did You Know:
Not all marine debris floats at the surface of the ocean. Some debris can sink several meters below the surface, and scientists have discovered that about 70 percent sinks to the bottom of the ocean.

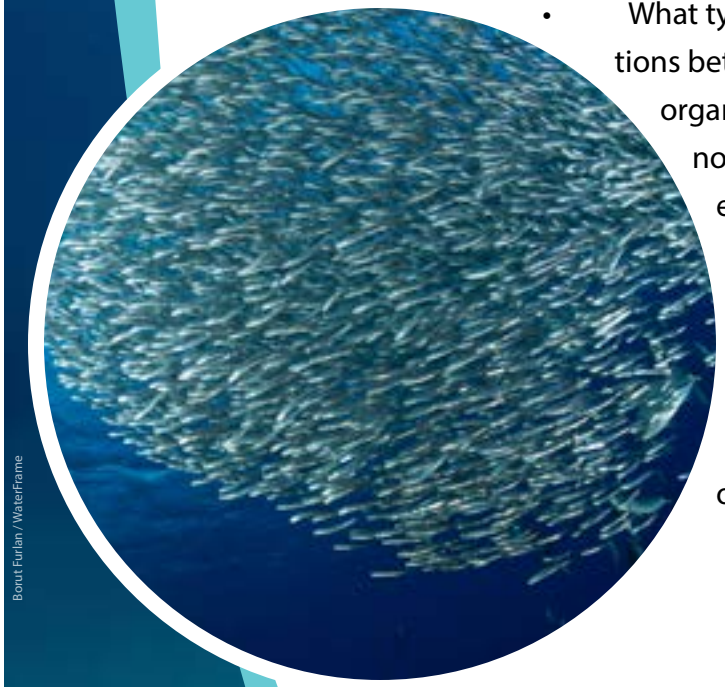
After National Geographic Encounter: Ocean Odyssey

Use these discussion questions and activities to prompt reflection and facilitate the application of experiences from *National Geographic Encounter*.

Discussion Questions:

- How was the experience similar to or different from what you expected the ocean to be like? How did the experience relate to what you learned about beforehand?
- Marine organisms often have adaptations in the form of unique characteristics or differences in shape, size, and color. What characteristics or adaptations did you notice during the experience?

- Some small fish species, such as Pacific sardines, gather in a tight ball-like formation to defend against predators. These bait balls expose the fewest number of fish to potential predators. How did the predators in the experience attempt to overcome the bait ball in order to feed? How have other predators adapted to counter bait balls in order to still feed on the small fish? Given these predator adaptations, are bait balls a successful defense for small fish species? Why or why not?



Bonut Furlan / WaterFrame

- What types of interactions between marine organisms did you notice during the experience? What other interactions exist between marine organisms in the ocean? What implications do these interactions have for the conservation of individual species?
- How did the experience compare to your prior thoughts about the health and biodiversity of our oceans? As humans, are we responsible for conserving the health and biodiversity of our oceans? Why or why not? What might influence an individual's feelings of responsibility?
- Governmental boundaries between countries and international waters do not prevent water, organisms, or debris from moving throughout the ocean. This means that debris produced in one country may end up on the shores of another, or in shared waters. How should countries divide responsibility for maintaining the health and biodiversity of our oceans? How should we account for differences in the level of development and wealth between countries when assigning responsibility?
- Conserving the health and biodiversity of our oceans will require participation from people all across the world. How can we inspire

people to conserve our oceans? What inspires you to conserve our oceans?

- How can you have a positive impact on our oceans? Why is it important to have a positive impact on our local waterways, in addition to oceans?

Activities

1. Have children design their own undiscovered marine species. Begin by reviewing animal adaptations in the ocean and recalling the various adaptations of species from the experience. Nearly 200,000 ocean species have already been identified, and scientists estimate around 2 million species might actually live in the ocean but have yet to be discovered. Challenge your children to design and describe one of the undiscovered species. Encourage children to think critically about how the species is adapted to the ocean habitat of their choice and to predict how it would interact with other species in that habitat. Have children share their designs and explanations with other children or family members.

Nicole Duplaix

> Share your child's marine species with @NatGeoEncounter using #OceanOdysseyUndiscovered.
>
> Make sure you have received permission prior to posting on social media.

2. Have children elect the next marine animal to symbolically represent an organization focused on ocean conservation. With your children, research various ocean conservation organizations (Oceana, Ocean Conservancy, Surfrider, WCS, Nature Conservancy, WWF, National Geographic) to familiarize yourselves with the

different solutions for maintaining healthy oceans. Together, recall the species of marine organisms you interacted with during the experience. Have children select and research a marine species candidate for representative. Children can design a campaign platform that provides background information about the organism (*physical description and development, feeding habits, territory*) and explains why this species is an appropriate representative for an ocean conservation organization. Have children create a leaflet or poster for their candidate and share it with other family members or members of your community in a mock campaign. An election can be held if more than one candidate is proposed by the child, or more than one child proposes a candidate.

Share your child's poster with @NatGeoEncounter using #OceanOdysseyConservation.

Make sure you have received permission prior to posting on social media.

3. Have children design a solution that will prevent plastics from entering into oceans. Begin by recalling the types and sizes of marine debris found in the ocean gyres and discuss the behavior of the Great Pacific Garbage Patch (where it moves and how fast). Have your children brainstorm and discuss any considerations that should be taken into account while designing (*unintended harm to wildlife, cost-benefit analysis, disposal of collected debris*). Then work with your children to design a process or device that can efficiently prevent plastics from reaching the ocean without endangering marine organisms. Use recycled materials to build a prototype of the solution and test the device in a bathtub or kitchen sink.

Share your child's solution with @NatGeoEncounter using #OceanOdysseyRecycling.

Make sure you have received permission prior to posting on social media.

4. Have children propose a conservation plan to tackle one of the issues impacting oceans.

   For an example of a current conservation initiative, visit: https://www.billionoyster-project.org/.

   Begin by working with your children as they research organizations focused on ocean conservation (Oceana, Ocean Conservancy, Surfrider, WCS, Nature Conservancy, WWF, National Geographic) to better understand the issues and possible solutions. Explain that many conservation organizations often have a limited amount of money, which means that they must choose what to prioritize (*habitat restoration, restocking fish populations, reducing pollution, cleaning up marine debris, developing marine conservation zone*). Then, challenge children to evaluate the different issues facing oceans and determine how to prioritize spending of the organization's $1 million budget.

   For an example of specific conservation strategies, visit: https://www.wcs.org/our-work/regions/new-york-seascape.

   Work with your children to evaluate their budgetary decisions. Connect this activity to children's immediate environment by having them determine if their conservation priorities are relevant to the nearest bodies of water.

5. Have children read more about the Pristine Seas Project led by National Geographic Explorer-in-Residence Enric Sala. Ask them to summarize the project and highlight the impacts the team has made so far in protecting the ocean. Direct them to the interactive globe featuring past and ongoing expeditions and areas they

have succeeded in protecting and let them investigate each one. Ask children, what are the common characteristics of the areas the team is trying to protect? Which area(s) that the Pristine Seas Project is involved in would you most like to visit?

6. Have children brainstorm a message of marine conservation that should be shared with other people. Is it the importance of keeping our oceans clean? Is it saving endangered marine species? Whatever it is, how can your children inspire others to take action in marine conservation? National Geographic 2014 Emerging Explorer Asher Jay shares her message of ocean conservation through her Message in a Bottle project. Have your children create their own message in a bottle that speaks to the ocean conservation message they want to relay to others. Have your children decorate a recycled plastic bottle to illustrate their marine conservation message.

For more information on Message in a Bottle and examples of Asher's work visit: http://www.seaspeaksphere.com/ripples-of-reform/message-in-a-bottle/.

Share pictures of your child's completed message in a bottle with @NatGeoEncounter using #CleanOceanOdyssey.

Make sure you have received permission prior to posting on social media.

Appendix

Vocabulary

biodiversity - all the different kinds of living organisms within a given area

biofluorescence - emission of light by an organism or substance that has absorbed light or other electromagnetic radiation

biological oceanography - study of the life histories and population dynamics of marine organisms, and how they interact with their environment

bioluminescence - light emitted by living things through chemical reactions in their bodies

carbon sequestration - process of capturing carbon emissions and storing them underground

conservation - management of a natural resource to prevent exploitation, destruction, or neglect

coral bleaching - loss of symbiotic algae (zooxanthellae) in corals, leading to a loss of pigmentation

Great Pacific Garbage Patch - area of the North Pacific Ocean where currents have trapped huge amounts of debris, mostly plastics

marine conservation zone - area of the ocean set aside for protection of aquatic ecosystems

marine debris - garbage, refuse, or other objects that enter the coastal or ocean environment

marine ecosystem - community of living and nonliving things in the ocean

marine sanctuary - 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

microplastic - piece of plastic between 0.3 and 5 millimeters in diameter

National Oceanic and Atmospheric Administration (NOAA) - U.S. Department of Commerce agency whose mission is to "understand and predict changes in climate, weather, oceans, and coasts; to share that knowledge and information with others;

and to conserve and manage coastal and marine ecosystems and resources."

ocean gyre - an area of ocean that slowly rotates in an enormous circle

Pacific Ocean - one of Earth's four oceans, bordered by North America, South America, Australia, Asia, and Antarctica

sustainability - use of resources in such a manner that they will never be exhausted

water pollution - introduction of harmful materials into a body of water

For Further Exploration

Billion Oyster Project
https://www.billionoysterproject.org/

Blue York: A WCS Campaign
https://blueyork.org/

National Geographic Education: Great Pacific Garbage Patch – Encyclopedic Entry
https://www.nationalgeographic.org/encyclopedia/great-pacific-garbage-patch/

National Geographic Education: Biomagnification – Picture of Practice Video
https://www.nationalgeographic.org/media/biomagnification/

National Geographic Magazine Infographic – The Gulf of Mexico: Layers of Life
https://www.nationalgeographic.org/hires/gulf-mexico-layers-life/

Nature Conservancy: Protecting Oceans and Coasts
https://www.nature.org/ourinitiatives/habitats/oceanscoasts/index.htm

Nature Conservancy of New York: Oceans and Coasts
https://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/newyork/oceans-coasts/index.htm

New York Seascape: A WCS Program
https://www.wcs.org/our-work/regions/new-york-seascape

NOAA: Hudson Canyon Cruise 2002
http://oceanexplorer.noaa.gov/explorations/02hudson/logs/sep08/sep08.html

NOAA: Hudson Canyon National Marine Sanctuary Nomination
http://www.nominate.noaa.gov/nominations/hudson-canyon.pdf

NOAA Fisheries: Marine Mammals
http://www.nmfs.noaa.gov/pr/species/mammals/

Ocean Conservancy
https://oceanconservancy.org/trash-free-seas/

Oceana
http://oceana.org/

Pacific Ocean Conservation
http://www.pewtrusts.org/en/projects/pacific-ocean-conservation

Pristine Seas
https://www.nationalgeographic.org/projects/pristine-seas/

Pristine Seas: Marine Invasive Species
http://ocean.nationalgeographic.com/ocean/explore/pristine-seas/critical-issues-marine-invasive-species/

Pristine Seas: Marine Pollution
http://ocean.nationalgeographic.com/ocean/explore/pristine-seas/critical-issues-marine-pollution/

Pristine Seas: Ocean Acidification
http://ocean.nationalgeographic.com/ocean/explore/pristine-seas/critical-issues-ocean-acidification/

Pristine Seas: Overfishing
http://ocean.nationalgeographic.com/ocean/explore/pristine-seas/critical-issues-overfishing/

Pristine Seas: Sea Temperature Rise
http://ocean.nationalgeographic.com/ocean/explore/pristine-seas/critical-issues-sea-temperature-rise/

Surfrider Foundation
https://www.surfrider.org/

Wildlife Conservation Society: Oceans
https://www.wcs.org/get-involved/oceans

WWF: Oceans
https://www.worldwildlife.org/initiatives/oceans

Credits

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