




Teacher's Guide Sustainable Ocean

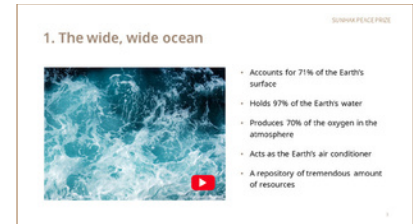
Introduction 1

- **Take a moment to look around you:** What do you see? Smartphones, toys and ballpoint pens – there is one thing in common among the household items you see. They are made of plastic. Plastic was first created in the process of finding an alternative substance/material to replace expensive African elephant ivory in making billiard balls. The first natural resin, plastic celluloid, appeared in 1869, and in 1933, polyethylene (PE), which is the most widely used form of plastic, was developed. Polyethylene is used to make plastic bags and plastic bottles. In 1937, nylon, a synthetic fiber rated as “a miracle thread thinner than spider webs and stronger than steel,” was developed. Plastic ~ convenience and seemed as if it would only benefit humankind, but ~ counterattack of plastic began.
- **Discovery of a giant plastic island:** In the summer of 1997, Captain Charles Moore was passing through the middle of the North Pacific Gyre when he encountered a stretch of plastic debris surrounding the ship. For a week straight, he sailed between the pieces of plastic, all of which were plastic waste that came from land. This area that Captain Moore passed through was about the size of a 1,600-kilometer- wide circle, and the amount of trash floating in it was equivalent to two years’ worth of garbage that is dumped into the largest landfill in the United States, Puente Hills Landfill. In terms of weight, it is equivalent to 6.7 million tons. This plastic island came to be known/referred to as the Great Pacific garbage patch.



1. The wide, wide ocean

- **Watch the video "I'm the ocean":**
 <https://youtu.be/rM6txLtoaoc>
- **71% of the Earth's surface:** The Earth glows blue when seen from space. This is because most of the Earth's surface is covered by the ocean. In fact, about 71% of the Earth's surface area is covered with water, which is equivalent to about 362 million square kilometers.
- **97% of the Earth's water is found in the ocean:** Freshwater coming from glaciers, lakes, and rivers accounts for only about 3% of the total volume of water on Earth. Of the 3%, much less is accessible as drinking water for humans. Accordingly, technology to convert the abundant seawater into freshwater is actively being researched, developed and applied.
- **Produces 70% of the oxygen in the atmosphere:** The ocean supplies oxygen, which is essential for sustaining life. Marine algae and other ocean phytoplankton produce about 70 percent of the oxygen in the Earth's atmosphere. The amount of oxygen supplied by the ocean is far greater than double the amount that is supplied by the Amazon rainforest.
- **Acts as the Earth's air conditioner:** One of the functions the ocean performs is to control the Earth's weather. The ocean current circulates energy by moving the heat near the equator to high latitudes with less heat. The ocean acts similar to an air conditioner for the Earth. If the ocean currents do not perform this function, the tropics will get hotter and polar regions will get even colder.
- **A repository of tremendous amount of resources:** The ocean has a wide range of creatures living in it and a vast array of mineral and energy resources are buried within it. The ocean has infinite potential for development. About 17,000 species of plants and about 152,000 species of animals live in the ocean, which account for 80 percent of the Earth's species. The ocean also has a vast amount of energy resources such as oil and natural gas. As of 2024, approximately 30 percent of the world's oil came from offshore oil fields. In addition, energy is being produced from the ocean using the ocean tides, currents, waves, and temperature differences.



- + The magazine Nature estimates the total annual value of land ecosystems at \$10.6 trillion and the total annual value of marine ecosystems at \$22.6 trillion, which is more than double the land ecosystem value. It also estimates the available use period of mineral deposits on land to be 40 to 110 years, but 200 to 10,000 years in the ocean.

2. Our ocean is dying

- Marine pollution refers to the deterioration of water quality and other adverse effects to the ocean caused by chemicals and trash produced by human activities entering the ocean. Most pollutants produced on land will eventually reach the ocean.
- **High concentrations of pollutants found in the body of marine creatures:** Among the substances that enter the ocean, pollutants with high degree of residuality remain in the ocean and form high concentrations in the environment or inside the body of marine creatures, causing serious problems.
- **Difficult and costly marine cleanup:** Because the ocean is more difficult to access than land, it is more challenging to clean up the ocean and costs much more. Therefore, it is very important to prevent marine pollution in advance.



2. Our ocean is dying

- **The ocean is getting hot:** Global warming is having a huge impact on the ocean as well as on land. For the past 100 years, the average temperature of the ocean surface has risen 0.1 °C every 10 years, and the temperature of the deep sea is rising faster than that of the shallow sea. Even if humankind were to stop greenhouse gas emissions right now, the temperature of the deep sea is expected to rise steadily until 2050.
- **Oceanwater nutrient pollution:** Nutrient pollution refers to the gradual increase of phosphorus, nitrogen and other plant nutrients causing excessive algae growth, which reduces the amount of oxygen in the water. This in turn hinders the breathing of fish and other marine life. When nutrient pollution intensifies, the blue color of the water changes to red and fish die in droves.



- Marine creatures are losing their habitat: Marine life habitats where spawning, breeding, and growing occur are being destroyed by industrial development, pollutants, and climate change. Between 1980 and 2010, 40% of marine life habitats such as coastal wetlands, mangrove forests, sea forests, coral reefs, and mudflats disappeared or were destroyed.
- Marine life extinction: According to the 2024 Global Assessment Report on Biodiversity and Ecosystem Services, 60% of the world's marine regions are adversely affected by humans and 267 species of marine life are on the verge of disappearing.

3. What is causing the ocean to die? (Pollutants from land)

- **Massive debris that flow into the ocean:** About 80 percent of marine debris comes from land. Much of it is land-based garbage that enter the rivers during typhoons, rainy seasons, and bad weather and flow into the sea. The largest proportion of marine debris is plastic (60 to 80%). Up to 12.7 million tons of plastic waste is dumped in the sea every year. More than 90% of the debris floating in the sea is plastic, and 70% of it slowly sinks below the sea surface. Marine creatures can swallow the plastic pieces and suffocate to death (plastics were found in the stomach of 90% of dolphins caught in nets). Floating plastic pieces are also broken into tiny pieces called microplastics and are swallowed by fish. Microplastics stay inside the bodies of fish for a long time spewing out various harmful substances, and humans who "consume such fish as food cannot be free from the damage.
- **Harmful materials that flow into the ocean (Pesticides, heavy metals, radioactive materials):**
 - ① Pesticides: Since the 20th century, humankind has used various kinds of pesticides to increase agricultural productivity. Pesticides were used extensively because they were cheap and easy to spray, and these substances were absorbed by the soil and eventually flowed into rivers and seas, contaminating the ocean.



② Heavy metals: Heavy metals from plating process and the production of pulp and paper, petrochemicals, oil refining, fertilizer, automobiles, airplanes, cement, glass, etc. flow into the rivers through sewage and wastewater, which in turn flows into the sea. In addition, when it rains, these materials can seep into the ground or move through the wind in the atmosphere into the sea.

③ Radioactive materials: Many dangerous nuclear wastes are dumped in the sea. Many countries have dumped nuclear waste produced during nuclear power generation into the sea. Despite the signing of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972, which bans dumping of marine waste, maritime dumping of nuclear waste has continued especially by the powerful and developed countries.

- **Oceanwater acidification caused by carbon dioxide:** The amount of carbon dioxide in the atmosphere rapidly increased after the Industrial Revolution, and more than a quarter of it was absorbed into the ocean. As a result, the acidity of oceanwater increased by about 30%. As oceanwater acidity increases, many chemical reactions occur, destroying the marine ecosystem and negatively affecting the bone growth of marine creatures.

3. What is causing the ocean to die? (Pollutants from within the ocean)

- **Oil from ships that leak into the ocean:** Oil leakage from ships occur naturally, during ship operation, and ship accidents. Oil spills from ship collisions, which tend to get a lot of attention from the media, account for only 14 percent of the total amount of oil that leaks into the ocean. The other 86% of oil leaks happen unknowingly. Once oil spills or leaks into the sea, it is difficult to restore to its original state with human power. Even if a large amount of money and human resources are invested in cleaning up, only about 20% of the leaked oil can be recovered, and the oil that remains in the ocean reduces the overall population of marine creatures and the oil residue affects the marine ecosystem for a long time.



- **Underwater noise and light that hinder the growth of fish:** Underwater noise caused by underwater construction in coastal areas, sailing of ships, etc. that exceeds a certain level adversely affect the growth and reproduction of noise-sensitive marine creatures. In addition, excessive artificial light emitted at night by man-made facilities installed on the coast or seashore adversely affects the growth, reproduction and behavior of marine creatures that are exposed to it.

3. What is causing the ocean to die? (Overfishing)

- **Overfishing:** Overfishing is when fish are caught at a rate faster than at which the species can replenish. The reality is that young fish as well as fish with eggs inside are indiscriminately caught using a tight net. At least two-thirds of large fish have disappeared from the ocean due to overfishing. Since 1950, one in three fish has disappeared.
- **Illegal, unreported and unregulated fishing (IUU fishing):** IUU fishing is the illegal capture of fish from the ocean without permission from the relevant countries or international fisheries organizations as well as not reporting or misreporting of fishing to the countries or international fisheries organizations. Such indiscriminate fishing causes fatal damage to fish resource management and regeneration.
- The ocean is not the Earth's trash bin



(Emphasizing the problem)

- **80% of marine pollution comes from land:** The majority of the Earth's pollutants eventually reach the ocean, and about 80% of marine pollution comes from land. According to the United Nations, 8 million tons of trash are dumped in the ocean each year, and more than 100,000 marine creatures are killed. Straws, nets, vinyl, and plastic floating in the ocean pose a great threat to marine creatures because these materials can be swallowed or entangle their bodies. The harmful substances absorbed by their bodies come back to humans as well.
- What is the most common type of trash thrown away by people at the beach?



- (Based on the Ocean Conservancy's 2020 International Coastal Cleanup analysis)
- 1st: Cigarette butts (2.4 million, was the most common for 3 3 years)
- 2nd: Food packaging (1.7 million)
- 3rd: Plastic bottle (1.6 million)
- 4th: Plastic bottle caps (1.1 million)
- 5th: plastic bag (750,000)

4. Why is ocean sustainability important?

- **Decrease in seafood supplies:** The demand for seafood soared as the demand for protein increased over the past century due to global population growth, which has led to overfishing and illegal fishing. As a result, many marine species have become either endangered or completely extinct. Consequently, the food crisis is expected to worsen.
- **Loss of ability to regulate climate:** Due to global warming, many problems are occurring as sea-level rises and ocean currents change. The most representative problem is stronger typhoons. As the temperature of the ocean rises, the amount of vapor evaporating increases, and when it meets the cold air at higher altitudes, it creates a stronger typhoon. The damages from typhoons that have been occurring annually around the world recently is expected to worsen.
- **Reduction of oxygen supply by 40%:** Phytoplankton and algae produce 70% of the Earth's total oxygen through photosynthesis, and more than 40% of the phytoplankton that has been producing oxygen since the 1950s have disappeared. This leads to a decrease in global oxygen supply and could further exacerbate global warming and climate change related problems.
- **Accumulation of heavy metals in our bodies:** Many chemicals from land, heavy metals, oil from ships, etc. do not decompose in their natural state, and even a small amount can build up in the body of marine creatures and rise up the food chain. The harmful substances found in the ocean can also spread through rain whose water droplets come from evaporated oceanwater, and the ultimate victim is humanity. The fatal damage caused by chemicals and



heavy metals to health varies and includes genetic damage, diseases caused by cell transformation, and birth defects

5. How can we protect the ocean's future? (Goal #14 of the 17 United Nations Sustainable Development Goals)

- **Conserve and sustainably use the oceans, seas and marine resources for sustainable development:** The key to UN SDG 14 is to create an environment in which the ocean can fully exercise its self-purification and regenerative capabilities.
- Let's preserve the marine environment! (SDG 14 Targets):
 - ① By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.
 - ② By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans.
 - ③ Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels.
 - ④ By 2020, conserve at least 10 per cent of coastal and marine areas, including through enhanced scientific cooperation at all levels.
- **Let's use marine resources sustainably! (SDG 14 Targets):** By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics.
 - ① By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that



appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation.

② By 2030, increase the economic benefits to small island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism.

③ Provide access for small-scale artisanal fishers to marine resources and markets.

6. Efforts for sustainable marine ecosystem (Commitment from the international society)

- **International convention:** The causes of marine pollution and collapse of marine ecosystem are very complex and diverse, and the scope of causes span the entire global community. This means that it is important for all countries to work together to come up with and implement solutions. Accordingly, various international agreements have been signed.
- **Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter (1972, London Convention):** Convention to regulate dumping of waste from airplanes and ships
- **Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (1995, GPA):** The GPA was created as an intergovernmental mechanism to counter land-based pollution and its impacts on the marine environment through detailed action plans.
- **Stockholm Convention on Persistent Organic Pollutants (2001):** This international environmental treaty aims to eliminate or restrict the production and use of persistent organic pollutants that do not decompose in the natural environment and accumulate in plants and animals up the food chain causing disturbance of the immune system and damage to the central nervous system.
- **Honolulu Strategy (2011) of the International Marine Debris Conference:** The Honolulu Strategy is a global framework to reduce the amount of marine debris



produced worldwide and manage and reduce the amount and impacts of existing marine debris.

6. Efforts for sustainable marine ecosystem (NGOs)

- Ocean Conservancy:** This environmental organization conducts ocean purification activities on the largest scale globally. More than 100 countries worldwide participate in its activities and through its years of experience, the organization has accumulated excellent know-hows. Whenever there is an international marine pollution incident, it contributes as a guardian of the ocean. It began the International Coastal Cleanup (held third Saturday of September every year) to remove trash from the world's beaches and waterways. It also plays an important role in the movement to ban overfishing and preparation of related laws to protect endangered marine life.
- Marine Stewardship Council (MSC):** The Marine Management Council is an international non-profit organization that establishes international standards for sustainable fishing and encourages the introduction of ecolabels to ensure a stable future supply of seafood. Starting in 1999, the MSC ecolabel is applied to wild fish or seafood from fisheries that have passed sustainable fishing standards, with 187 fishery companies from 66 countries, including the United States, the United Kingdom and Japan, participating. As of 2020, about 16% of the world's fisheries products are MSC-certified. Public confidence in MSC is very high and the United Nations and Food and Agricultural Organization also recommend fisheries producers to receive the MSC certification.



6. Efforts for sustainable marine ecosystem (National efforts)

- Designation of marine protected areas:** If the state designates marine protected areas, expected results include protection of marine habitats, sustainable management of marine resources, and tourism revenue from the preserved natural scenery.
- Support for development of plastic alternatives:** Nanocarbon, which is a lightweight, strong, non-

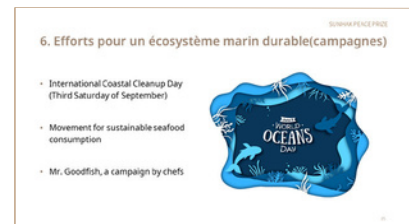


contaminating substance; toothpaste made from natural material that has 2.4 times the polishing effect of microplastics; cells from fruits that can be used as additives in beauty products; plastic made from plant sources that are biodegradable and harmless to human body; and various other alternatives to plastic are being developed.

- **Encouragement and operation of marine resources certification system:** The state should support and encourage fishing companies and workers to secure seafood supplies in a sustainable manner without overfishing and illegal fishing. Furthermore, responsible and healthy consumption by consumers should be encouraged by expanding the market for seafood supplies produced in a sustainable manner.

6. Efforts for sustainable marine ecosystem (Campaigns)

- **International Coastal Cleanup Day (Third Saturday of September):** The International Coastal Cleanup first began in 1986, in Texas, and continues to be carried out globally. About 500,000 people from more than 100 countries participate in activities such as coastal trash collection and inspection of marine protected areas around the third Saturday of September every year. Through the cleanup, participants can experience the importance of the marine and coastal environment and urge others to take interest in the issue of marine pollution. Over 9 million volunteers removed more than 66,000 tons of coastal trash over the past 30 years.
- **Movement for sustainable seafood consumption:** This movement is aimed at maintaining sustainable seafood supplies by consuming local seafood caught by small-scale fishing, rather than consuming seafood species at risk of extinction from overfishing such as tuna, Atlantic cod, groupers, and sharks. The Marine Stewardship Council (MSC) evaluates fish species, fishing methods, and distribution channels to certify sustainable seafood. The certified seafood is sold at a slightly higher price than regular seafood at wholesale, retail, large discount stores, and restaurants with environment-friendly signs.
- **Mr. Goodfish, a campaign by chefs:** Mr. Goodfish is a



campaign on the sustainable consumption of seafood products launched by three aquariums located in France, Italy, and Spain. The central idea is that it is important to choose the right fish to be able to continue consuming fish in the future. Member restaurateurs exclude from their menu fish such as tuna and Atlantic cod whose populations have declined and develop and distribute recipes using fish that are relatively abundant such as mackerel. Star chefs, including French chef Alain Ducasse whose restaurants hold Michelin starts, also participate in Mr. Goodfish's programs.

7. What can we do to save the polluted ocean?

- **Reduce the use of plastic:** Not only do plastic trash that end up in oceans harm marine life, it also poses a threat to our tables. Using reusable water bottle instead of disposable water bottle and using reusable shopping bags or baskets instead of plastic bags can make a positive difference to making our oceans healthy again.
- **Participate in marine protection activities:** Greenpeace, Ocean Conservancy, and many other environmental groups are working hard to protect our oceans. Participating in or sponsoring marine cleanup activities hosted by good NGOs dedicated to protecting marine habitats and wildlife can also be a way to create a healthy ocean.
- **Consume sustainable seafood:** Some companies supply seafood in a sustainable way, while others do not. When purchasing seafood, purchase products from companies that practice sustainable fishing when possible to help protect the ocean.



Save the Ocean!

- (Reemphasizing awareness and urgency)
- **Now is the critical time to save the ocean!:** The wide, wide ocean accounts for 71% of the Earth's surface area. The ocean, which has been supporting human life for a long time, is losing its vitality day by day due to pollution. Humans have let too many pollutants into the ocean to the verge of the ocean losing its ability to self-purify. Experts warn that if the current condition continues, more plastic



SUNHAK PEACE PRIZE

will fill the ocean than fish by 2050. The critical time to restore the ocean to its healthy state is now.

- **Time to act for the ocean:** Marine pollution is an issue that is directly related not only to marine life but also to human life. Humans are responsible for the serious problems facing the ocean now. We need to clearly understand the situation and its seriousness and act now to not let this critical time pass. Let's work together to make the ocean healthy again!