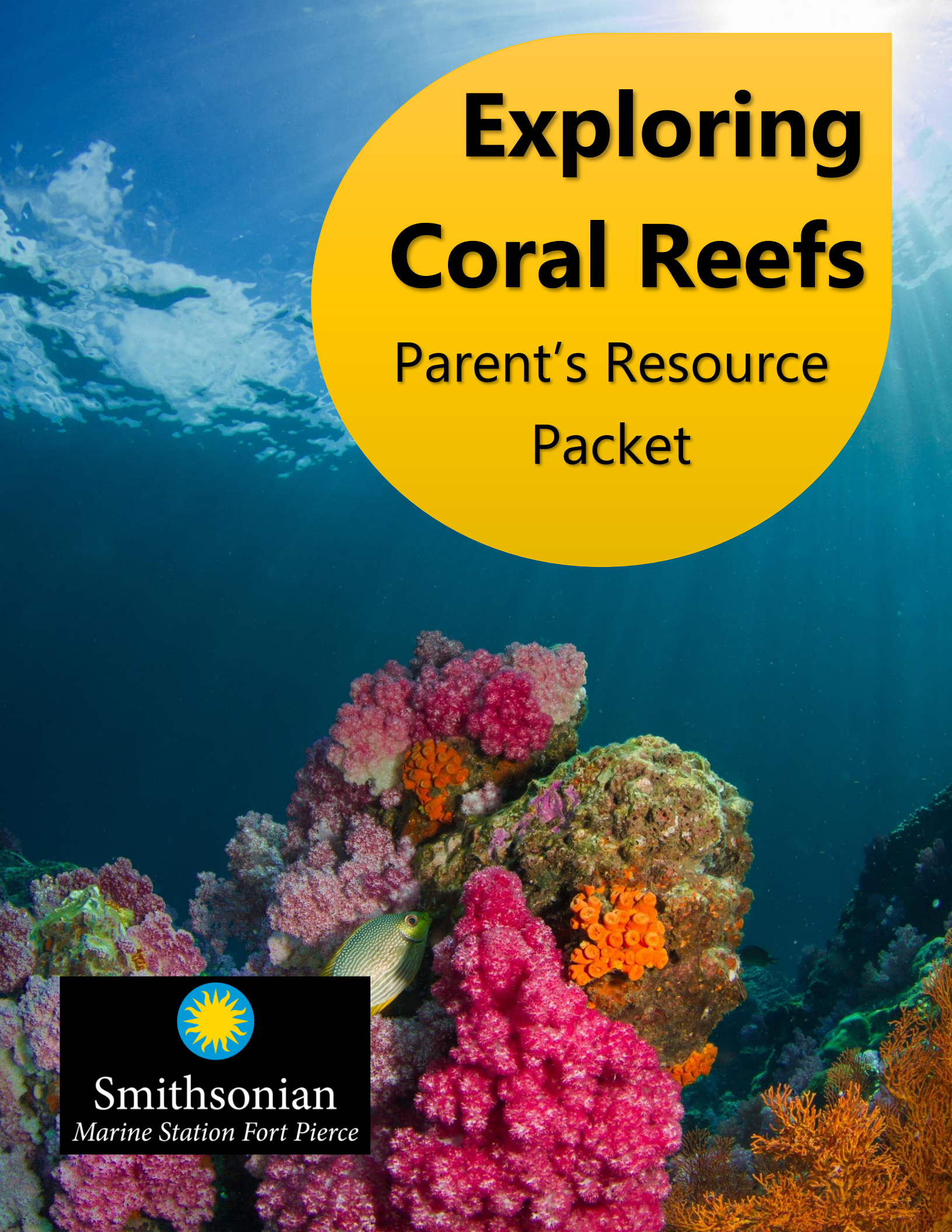


Exploring Coral Reefs

Parent's Resource Packet

Smithsonian
Marine Station Fort Pierce

Exploring Coral Reefs

Overview of Coral Reefs

Adapted from the Smithsonian Institution's Ocean Portal Coral Reef Introduction

Introduction

Coral reefs are the most diverse of all marine ecosystems. They teem with life, with perhaps one-quarter of all ocean species depending on coral reefs for food and shelter. This is a remarkable statistic when you consider that coral reefs cover just a tiny fraction of the earth's surface and about one percent of the ocean bottom. Because they are so diverse, coral reefs are often called the rainforests of the sea.

Coral reefs are also very important to people. The value of coral reefs has been estimated at 30 billion U.S. dollars and perhaps as much as 172 billion U.S. dollars each year, providing food, protection of shorelines, jobs based on tourism, and even medicines.

Unfortunately, people also pose the greatest threat to coral reefs. Overfishing and destructive fishing, pollution, global warming, changing ocean chemistry, and invasive species are all taking a huge toll. In some places, reefs have been entirely destroyed, and in many places today's coral reefs are a pale shadow of what they once were.

What are corals?

Corals are related to sea anemones, and they all share the same simple structure, the polyp. The polyp is like a aluminum can open at just one end: the open end has a mouth surrounded by a ring of tentacles. The tentacles have stinging cells, called nematocysts, that allow the coral polyp to capture small organisms that swim too close. Inside the body of the polyp are digestive and reproductive tissues. Reef building and hard corals differ from sea anemones in their production of a mineral skeleton.

Shallow water corals that live in warm water receive up to 90% of their food from zooxanthellae (pronounced zo-o-zan-THELL-ee). These single-celled symbiotic algae live in the coral's tissues and photosynthesize, passing some of the food they make from the sun's energy to their hosts. Corals provide nutrients, which are waste byproducts from the coral and in exchange, zooxanthellae produce and provide energy to the corals. It is this relationship that allows shallow water corals to grow fast enough to build the enormous structures we call reefs.

Where are reefs found?

Corals are found across the world's ocean, in both shallow and deep water, but reef-building corals are only found in clear, shallow (100 feet or less) tropical and subtropical waters. This is because the algae found in their tissues need light for photosynthesis and they prefer water temperatures between 70-85°F (22-29°C).

There are also deep-sea corals that thrive in cold, dark water at depths of up to 20,000 feet (6,000 m). Both stony corals and soft corals can be found in the deep sea. Deep-sea corals do not have the same algae and do not need sunlight or warm water to survive, but they also grow very slowly and have to capture plankton out of the water in order to eat. One place to find them is on underwater peaks called seamounts.

Continued on next page

Exploring Coral Reefs

Overview of Coral Reefs

Coral Reefs are the Cities of the Sea

Reefs are the big cities of the sea. They exist because the growth of corals matches or exceeds the death of corals – think of it as a race between the construction cranes (new coral skeleton) and the wrecking balls (the organisms that kill coral and chew their skeletons into sand).

When corals are babies floating in the plankton, they can be eaten by many animals. Once they settle down and secrete a skeleton, some fish, worms, snails and sea stars will prey on adult corals. Crown-of-thorns sea stars are particularly voracious predators in many parts of the Pacific Ocean. Population explosions of these predators can result in a reef being covered with tens of thousands of these sea stars, and most of the coral is killed in less than a year.

Corals also have to worry about competitors. They use the same nematocysts that catch their food to sting other encroaching corals and keep them at bay. Some seaweeds and algae are a particularly dangerous competitor, as they typically grow much faster than corals, and can block the sunlight needed by corals. It can also be abrasive for soft corals swaying in the current and coming into contact with seaweed or algae.

Corals do not have to only rely on themselves for their defenses because mutualisms (beneficial relationships) abound on coral reefs. Some coral colonies have animals that live within their branches and defend their home against coral predators. Parrotfish, in their quest to find seaweed, will often bite off chunks of coral skeleton and will later excrete the digested remains as sand.

Protecting Coral Reefs

There is much that we can do locally to protect coral reefs, by making sure there is a healthy fish community and that the water surrounding the reefs is clean. Well-protected reefs today typically have much healthier coral populations and are more resilient (better able to recover from natural disasters such as typhoons and hurricanes).

Fish play important roles on coral reefs, particularly the fish that eat seaweeds and keep them from smothering corals, which grow more slowly than the seaweeds. Marine protected areas (MPAs) are an important tool for keeping reefs healthy. Large MPAs protect the Great Barrier Reef and the Northwestern Hawaiian Islands, for example, and in June 2012, Australia created the largest marine reserve network in the world. Smaller ones, managed by local communities, have been very successful in developing countries. By protecting these areas from fishing or sport diving, fishes can thrive.

Clean water is also important. Erosion on land causes rivers to dump sediment on reefs, smothering and killing corals. Seawater with too many nutrients speeds up the growth of seaweeds and increases the food for predators of corals (like the crown of thorns sea stars) when they are developing as larvae in the plankton. Clean water depends on careful use of the land, avoiding too many fertilizers and erosion caused by deforestation and certain coastal construction practices. In the long run, however, the future of coral reefs will depend on reducing carbon dioxide in the atmosphere, which is increasing rapidly due to burning of fossil fuels. Carbon dioxide is both warming the ocean, resulting in coral bleaching, and changing the chemistry of the ocean, causing ocean acidification. Both making it harder for corals to build their skeletons.

Exploring Coral Reefs

Activities & Short Overview

Introduction to Oceans

The ocean supports a great diversity of life and ecosystems. Ocean life ranges in size from the smallest virus to the largest animal that has lived on Earth, the blue whale. Some major groups are found exclusively in the ocean. The diversity of major groups of organisms is much greater in the ocean than on land.

Marine biology provides many unique examples of life cycles, adaptations and important relationships among organisms (symbiosis, predator-prey dynamics and energy transfer) that do not occur on land. The ocean is three-dimensional, offering vast living space and diverse habitats from the surface through the water column to the seafloor. Most of the living space on Earth is in the ocean.

The ocean and humans are inextricably interconnected. The ocean is a source of inspiration, recreation, rejuvenation and discovery. It is also an important element in the heritage of many cultures. **Much of the world's population lives in** coastal areas.

Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution and physical modifications (changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.

Adapted from Ocean Literacy Principles

Videos

How Corals Spawn
Smithsonian Magazine
https://www.youtube.com/watch?v=nVAVACeEGLE

Surveying Marine Life on Coral Reefs
Smithsonian MarineGEO (Panama)
https://www.youtube.com/watch?v=gqgcMUkQMBY

Coral Conservator: Smithsonian Scientist Mary Hagedorn
SmithsonianScience
https://www.youtube.com/watch?v=VUZMKLo-VoE

Smithsonian Institution Featured Coral Researchers:

Nancy Knowlton
Sant Chair for Marine Science
http://invertebrates.si.edu/knowlton.htm

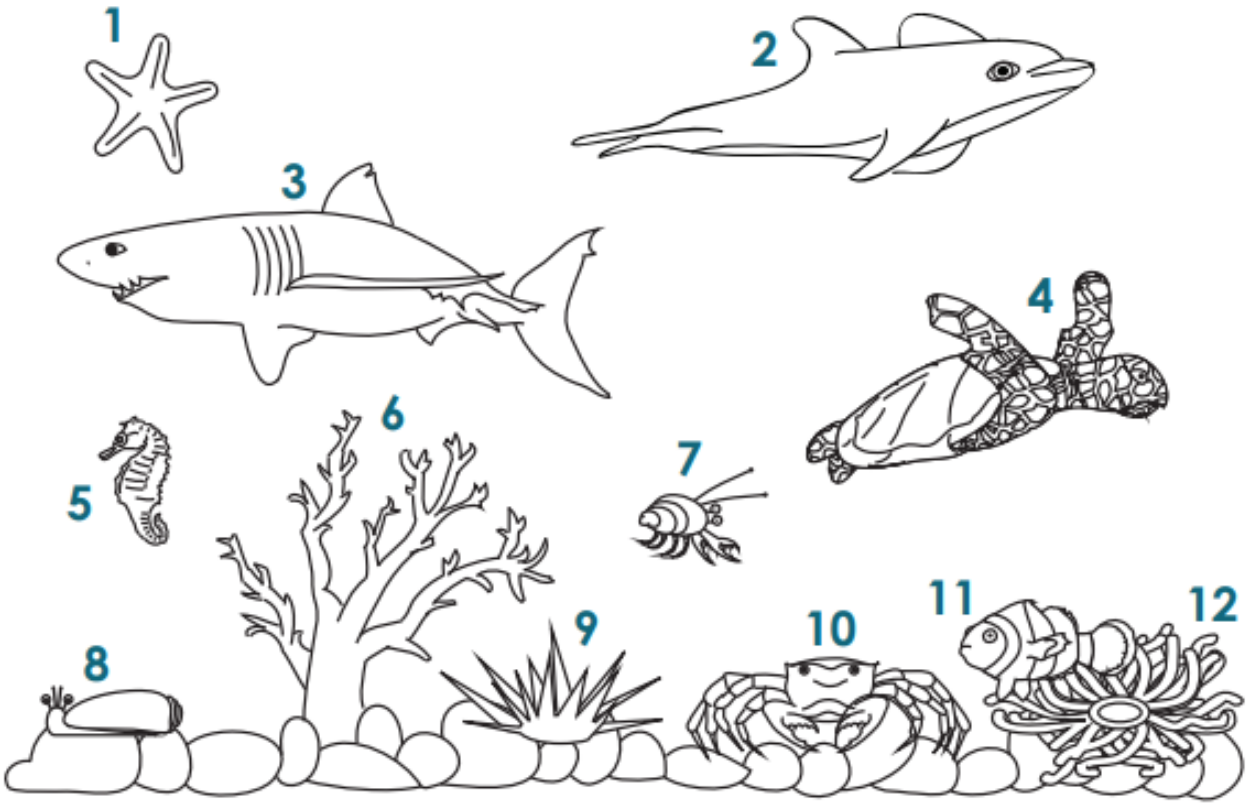
Stephen D. Cairns
Research Zoologist, Emeritus
http://invertebrates.si.edu/staff/cairns.cfm

Life in the Reef

Directions: Match the numbers in the picture to the names in the word bank. Label and color each coral reef organism. Be sure to check your spelling and write neatly.

Cone snail	**Spinner dolphin**	**Branching coral**
Sea urchin	**Seahorse**	**Starfish**
Crab	**Reef shark**	**Clownfish**
Sea anemone	**Hawksbill turtle**	**Hermit crab**

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____



Credit: Education.com

Exploring Coral Reefs

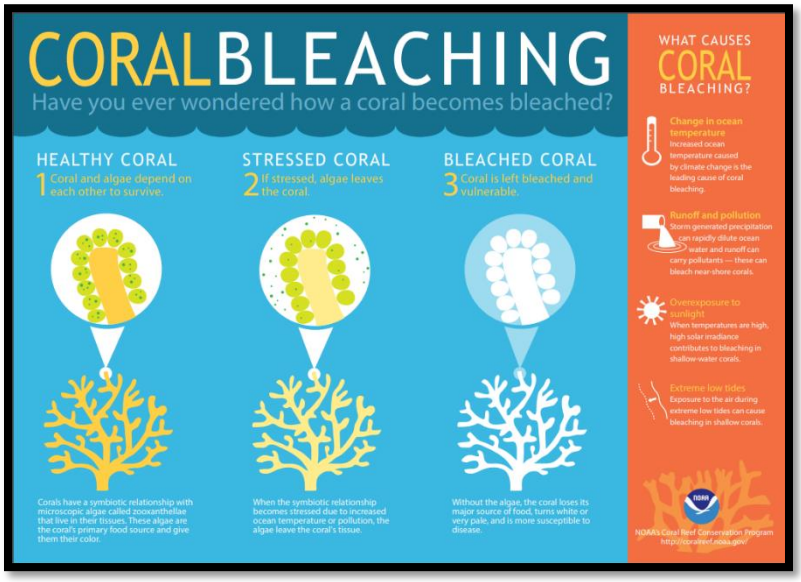
Coral Bleaching Activity

Pre-Activity – Coral Bleaching

From Smithsonian Institution Ocean Portal

"Coral bleaching" occurs when coral polyps lose their symbiotic algae, the zooxanthellae. Without their zooxanthellae, the living tissues are nearly transparent, and you can see right through to the stony skeleton, which is white, hence the name coral bleaching. Bleached corals do not die right away, but if conditions don't improve for a long time, corals either die from starvation or disease.

Many different kinds of stressors can cause coral bleaching – water that is too cold or too hot, too much or too little light, or the dilution of seawater by lots of fresh water can all cause coral bleaching. The biggest cause of bleaching today has been rising temperatures caused by global warming. Temperatures more than 2 degrees F (or 1 degree C) above the normal seasonal maximum can cause bleaching. In 1998, 80 percent of the corals in the Indian Ocean bleached and 20 percent died.



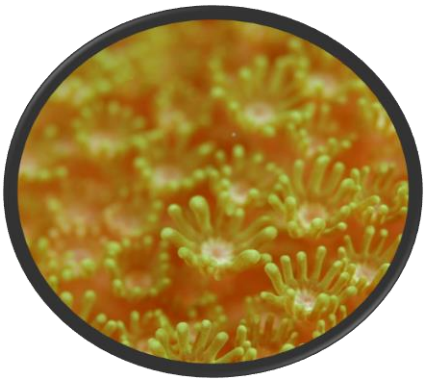
Digital version available for download here:
https://aamboceanservice.blob.core.windows.net/oceanservice-prod/facts/coralbleaching.pdf

Activity

Visit NOAA's Coral Reef Watch Satellite Monitoring and Modeled Outlooks at https://coralreefwatch.noaa.gov/satellite/index.php to complete the questions on the following page.

Exploring Coral Reefs

Coral Bleaching Data Gathering Worksheet



Visit NOAA's Coral Reef Watch Satellite Monitoring and Modeled Outlooks at https://coralreefwatch.noaa.gov/satellite/index.php to learn more about coral bleaching and to complete this activity!

What is coral bleaching?
(Hint: You may have to click on a link!)

_____

_____

_____

What can cause a coral reef to bleach?

_____

_____

What area of the world has NOAA has designated as ALERT 2, the highest level of warning about coral reef bleaching?

_____

Does Florida currently have any NOAA coral bleaching alerts?

_____

Is there anything we can do to stop coral bleaching?

_____

_____

_____

Exploring Coral Reefs

Glossary

Anemone – a sedentary marine invertebrate with a columnar, soft body and tentacles surrounding a central mouth.

Coral Bleaching – occurs when high temperatures cause corals to expel their zooxanthellae and can lead to coral death.

Ecosystem – a community of living organisms interacting in a common environment or habitat.

Habitat – the environment in which an organism or biological population lives or grows.

Larva - an early form of an animal that at birth or hatching is very different from its parents.

Photosynthesis – the process by which plants and algae convert carbon dioxide, water and light energy into carbohydrates and oxygen.

Planula - free-swimming or crawling larval type common in many species of jellies and coral.

Pollution – the presence in or introduction into the environment of a substance or material that has harmful or poisonous effects.

Polyp – the body structure of corals. At their base is a hard, protective limestone skeleton called a calicle, which forms the structure of coral reefs.

Runoff - water that is not absorbed into the ground, but instead flows over land and eventually into a stream, river or the ocean; runoff can carry loose soil, fertilizer, garbage or other pollutants into a body of water.

Salinity – a measure of the concentration of salt in a solution; measured in parts per thousand, or ppt.

Sponge – one of the simplest multicellular marine animals whose porous body is supported by a fibrous skeletal framework; usually occurs in sessile colonies. Sponges are filter feeders, meaning they filter bacteria and fine particulate out of the water for food.

Zooxanthellae – single-celled, golden-brown algae that live in the tissues of a variety of organisms, including many hard and soft corals; provide the host with energy from photosynthesis.

Exploring Coral Reefs

Additional Resources

Smithsonian Institution Ocean Portal

https://ocean.si.edu/

A collection of articles, lesson plans, activities and more surrounding oceans, ocean health and marine animals.

National Oceanic and Atmospheric Administration Coral Reef Conservation Program: Educational Resources

https://coralreef.noaa.gov/education/edureSources.html

Includes interactive activities for students, ocean acidification resources, an online tutorial overview of coral reef habitats, and more.

Reef Relief: Educational Resources

https://www.reefrelief.org/learn/educational-material/

A global nonprofit membership organization dedicated to protecting coral reefs. Website includes information and educational resources on coral reef biology, reef monitoring projects and links to activities for children.

ReefBase

Reefbase.org

A global information system for coral reefs that includes photos, maps and scientific data.

Southeast Coral Reef Initiative

https://southeastfloridareefs.net/student-resource-center/

Lesson plans and activities for K-12 classrooms about coral reefs, marine mammals and more.

National Geographic Oceans

https://www.nationalgeographic.com/environment/oceans/

National Geographic articles and videos focused on oceans, ocean health and human impact on the oceans.

Monterey Bay Aquarium: Educational Resources

http://www.montereybayaquarium.org/education/classroom-resources/games-and-activities

Games, activities and lesson plans for K-12 focusing on marine life.

PBS Learning Media

https://www.pbslearningmedia.org/

An online learning resource destination with videos, lesson plans, activities and links to databases. Search “ocean” for all ocean-related materials.

R.E.E.F. (Reef Environmental Education Foundation)

https://www.reef.org/

Information on citizen science projects, education and coral reef conservation. Educational resources also available on the website.

Coral Restoration Foundation

https://www.coralrestoration.org/activity-packs

Activities and lesson plans about coral reefs and coral restoration projects being undertaken by the Coral Restoration Foundation.