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THE OCEAN

**It's time to dive in
and be a hero!**



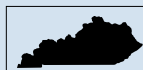
Welcome Future Heroes!

At Toyota Motor Manufacturing, Kentucky, Inc. (TMMK), we believe that protecting the environment is part of our mission to be a good neighbor across Kentucky. As we build cars in our plant in Georgetown, we are committed to protecting the environment, obeying the environmental laws, preventing pollution and continuously improving our processes. But the commitment doesn't stop there. It is everyone's responsibility to protect the environment.

Becoming a Backyard Action Hero is the first step in learning about how we coexist with the plants and animals that make up our environment. Once you have learned about some of the things in this book, you will be ready to take conservation action in your own backyard and beyond. Good luck!

Sincerely,
Your Friends at
Toyota Motor Manufacturing, Kentucky, Inc.

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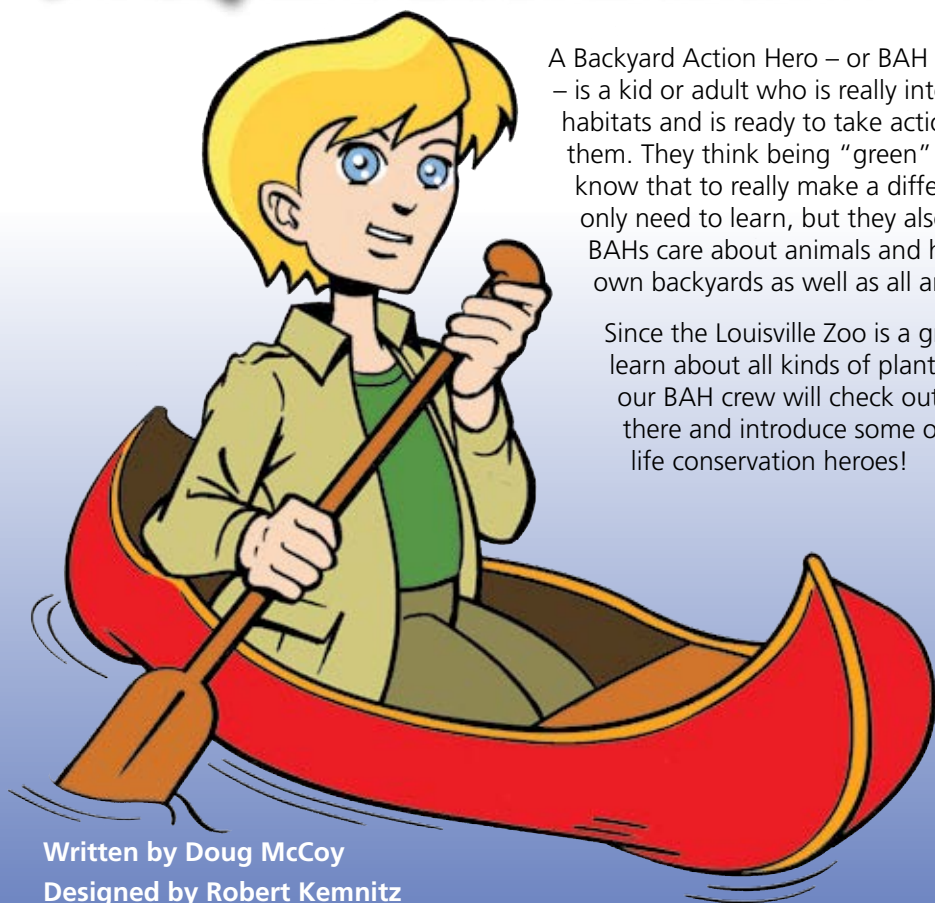
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What is a Backyard Action Hero?

A Backyard Action Hero – or BAH as they are called – is a kid or adult who is really into wildlife and habitats and is ready to take action to protect them. They think being “green” is cool, and they know that to really make a difference they not only need to learn, but they also need to act! BAHs care about animals and habitats in their own backyards as well as all around the world.

Since the Louisville Zoo is a great place to learn about all kinds of plants and animals, our BAH crew will check out what's going on there and introduce some of the Zoo's real life conservation heroes!



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Let's Explore our Blue Planet

It's time to dive into the depths of knowledge as we discover fun facts about our planet's oceans and learn the importance of water to all living things. This issue of the Backyard Action Hero Guidebook is going to explore some areas of our planet that collectively make up 71% of the Earth's surface, have a powerful effect over the weather and temperature in the world and give Earth its nickname, the "Blue Planet." The areas we will be looking at are, of course, the oceans.

Most of us only think of the ocean when we go to the beach or eat seafood. While collecting shells, swimming and enjoying shrimp are great, there are many more reasons why our oceans are important to all of us.

True Backyard Action Heroes would want to know why oceans are so valuable and how they can help protect our Blue Planet.



This Water Tastes Salty

So now that you know that most of the Earth's surface is covered with water, guess how much of that is salt water. Well, a whopping 97% is salt water. That's a lot of salt! Salt water gathers in these huge collection basins we call "oceans." Just to remind you: non-living things like oceans, glaciers, mountains and rivers are abiotic factors and have a lot to do with what we find living in an ecosystem. In many places on land, from forests and deserts to tundras, the amount of sunlight, precipitation (like rain and snow) and temperature play a big role in what lives where. Guess what helps decide what lives where in the ocean? If you said how much dissolved salt is in the water, the depth of the water, and how close we look to shore, then give yourself a pat on the back, because you're right.



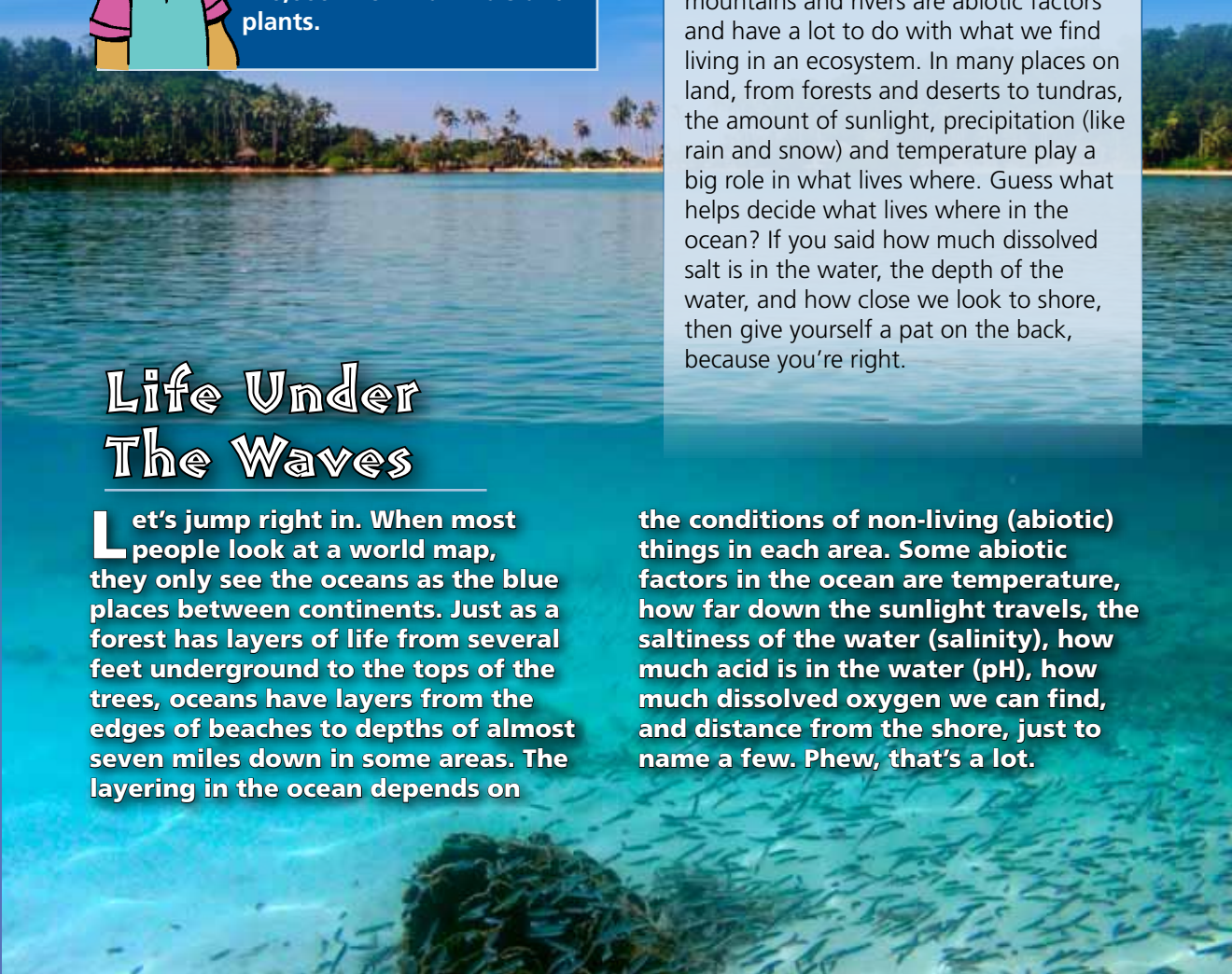
DID YOU KNOW?

Our oceans are home to over 270,000 known animals and plants.

Life Under The Waves

Let's jump right in. When most people look at a world map, they only see the oceans as the blue places between continents. Just as a forest has layers of life from several feet underground to the tops of the trees, oceans have layers from the edges of beaches to depths of almost seven miles down in some areas. The layering in the ocean depends on

the conditions of non-living (abiotic) things in each area. Some abiotic factors in the ocean are temperature, how far down the sunlight travels, the saltiness of the water (salinity), how much acid is in the water (pH), how much dissolved oxygen we can find, and distance from the shore, just to name a few. Phew, that's a lot.





“Tanks” a Lot

Abiotic conditions must also be maintained in exhibits at the Zoo to keep our animals healthy. Here to talk a little about how oceanic species are cared for in the Zoo’s HerpAquarium is Zoo Keeper & Backyard Action Hero, CHRIS FLORENCE.

The ocean is a very complex ecosystem that has been evolving over millions of years. It has the ability to support life from the tiniest microscopic plankton all the way to the largest creature on Earth, the blue whale. The ocean does all of this by maintaining a perfect balance of salinity, pH, temperature, and mineral concentrations, all while having to adjust to challenges like pollution and too much fresh water from melting polar ice (desalinization).

My main task at the Zoo is to care for the saltwater fish we exhibit in the HerpAquarium. I try to make the environment in the tanks as much like the ocean as possible to promote the health of the fish. Saltwater fish tanks need special attention. The most important thing is getting the salt content of the water just right. The salinity of salt water is a measure of the total amount of dissolved solids in the water.

We purchase over a ton of sea salt, which comes in boxes and boxes, about four times a year. This salt is different from the table salt you have at home. It contains several different kinds of salt and various other ingredients that marine animals need to survive. It takes ten to twelve boxes of sea salt to reach the right salinity in our six foot deep holding tank which is used to refill the saltwater tanks you see on exhibit.



Top: Chris Florence poses with a fishy friend.

Bottom: Chris at the piranha tank.

Photos by Robert Kemnitz

Did you know that drinking water has salinity of less than 0.5 parts per thousand? Sea water salinity is 32 parts per thousand. Salt water is equivalent to about five ounces of salt in one gallon of water.

Some water naturally evaporates (see our Evaporation Experiment below) and some is removed during cleaning, so refilling tanks is a daily task.

Another challenge in creating artificial seawater is using tap water as a water source. Some chemicals like chlorine that are used to make our drinking water safe are toxic to fish and must be removed (dechlorination), and air must be added (aeration) before tap water can go in a fish tank. Once this is done, the salt is added and the pH and temperature are set to the right levels. The pH for most marine tanks is kept around 8.0 and the temperature is maintained at 78–80° fahrenheit.

Every week, a small machine called a spectrophotometer is used to take small samples from the tank for testing. It uses light to tell us how much salt and other non-organic things are in the tank. I also test for nitrates, nitrites, pH, temperature, ammonia, salinity and dissolved oxygen. Daily maintenance also involves checking pumps, filters, plumbing, UV sterilizers and lights, and of course, making sure the glass is clear of algae so everyone can see the fish! This may sound like a lot of work, but it is all done to create the healthiest natural environment for the saltwater animals that I care for. ■



Glacier Run

Our pinnepeds (seals and sea lions) depend on the 108,000 gallons of recycled, chilled (to 66 degrees) saltwater in the outdoor pool of the Glacier Run exhibit. Their water is recirculated through high-rate sand filters and ozone disinfection. Salinity is tested using a digital refractometer. Guess how much salt it takes to salinate the huge pool? The answer is below.

You can spot these tanks behind Glacier Run when you ride the ZooTram shuttle (or) use a smart phone to read this QR code to view a video podcast.

A: 25 tons

Glacier Run Tanks photo by Kyle Shepherd

Evaporation

Experiment

Let's examine how water evaporates from different bodies of water.

You'll Need:

- ☐ Water
- ☐ A shallow metal pan
(Example: pie pan)
- ☐ A tall glass jar/bottle
(Example: old milk bottle or juice jar with narrow top/opening)



Here's What You Do:

Take your bottle and pan and place them on a kitchen table or countertop. Fill the bottle several inches deep with water. Place about an inch of water in the pan. Let the pan and bottle sit out over night or maybe a day or two. Go back and look at what has happened. In which container can you see the greatest amount of evaporation?

How might this relate to shallow bodies of water, such as lakes or ponds, and deeper bodies of water like oceans? How do you think depth influences what you see? How does surface area play a role? Can you draw any conclusions from your observations?



Going Down in the Deep Blue Sea

Maps are made with lots of colors. When looking at many maps and globes, you may have noticed that depth is sometimes shown by darker shades of blue, and shallow water is shown by lighter shades of blue. You may have also noticed that the shallower areas tend to be along the edges of the continents. This makes sense because the real line between where the continental rock ends and the oceanic rock begins is at what is known as the "continental shelf." The continental shelf extends out into the ocean in many areas.

Throughout history, the shoreline has changed shape as the amount of water in the ocean increased or decreased. As an example, the continental shelf off the coast of the Carolinas today is only about 12 miles out as compared to around New York where it is about 103 miles out. That's a long way out. You can see this in the colors of blue on your map or globe. ■



Let's Map out the Ocean

Let's look at how the ocean is divided up to better understand its ecosystems. The shelf is the dividing line between the Coastal Zone and the Open Sea. The Coastal Zone includes everything from the continental shelf to the beach and all the way to the high tide mark. There is a continental shelf for each continent. The Open Sea is that area between the continental shelves. The Open Sea represents 90% of the ocean's area. But guess what? Because of varying abiotic factors found in these two very different areas of the ocean, most life is in the opposite place of where you might think it should be. The Coastal Zone is home to 90% of the species that live in the ocean, while the Open Sea only has about 10% of those species.

***The Coastal
Zone is home
to 90% of
ocean species***





Sea Hunt

*Here to talk about a species that is highly dependent on the coastal zone for its survival is **KATHLEEN JOHNSON**. Kathleen is an educator and Backyard Action Hero at the Louisville Zoo. She even spent some time up north observing arctic animals.*

You might wonder what connection polar bears have with oceans. Many people believe that during the wintertime, polar bears are hibernating. Well, you may be surprised to learn that polar bears are very busy during the winter. What are they doing? Hunting! And polar bears depend on sea ice, which is frozen ocean water, to help them hunt their favorite foods – ringed seals and occasionally bearded seals.

In order to help you understand how extremely important oceans are to polar bears, take a look at the map above. Polar bears are found in five different countries: United States (Alaska), Canada, Russia, Norway and Greenland. You will see that these areas all have contact with the ocean. During the winter, when ice has formed on the ocean surfaces surrounding these areas of land, polar bears strike out onto the ice floes, which they use as platforms to hunt for seals.



Kathleen Johnson
Photo by Kara Bussabarger



Seals are mammals. Though they spend most of their time in the water, they still must come up to breathe air. Polar bears patiently wait for the seals. When the seals come up for a breath through holes in the ice, the polar bears grab them with their claws and teeth. The bears then pull the seals out of the water, and eat the seal's fat. The polar bears can only hunt for their survival diet of seals when there is floating ice. When ice melts in the summertime, polar bears come back onto the land where they wait for the ice to form once again. On land, they may snack on a variety of foods found there, but their lives still depend on the ocean-dwelling seals. Eating the seals helps polar bears build up enough body fat to survive the rest of the year. Female polar bears may also use this sea ice as a place to create a maternity den where they give birth to their cubs! Polar bears have special adaptations for living in cold climates and hunting seals from the sea ice. They cannot change their way of life. So take a moment to consider that although polar bears do not live in the oceans, they are dependent on them in many ways. ■



Harbor Seal
Photo courtesy of Lincoln Children's Zoo



Use a smart phone to see video of polar bears in Churchill, Canada (courtesy of the Zoo's conservation partner, Polar Bears International)



DID You K NoW?

The Louisville Zoo is one of only 224 organizations that are members of the Association of Zoos and Aquariums (AZA). The AZA is an important group that ensures that animals get great care and visitors have great experiences at AZA member institutions.

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Why Ocean Life Likes the Shore Too!

There are several reasons why much of the life in the ocean is concentrated near the shore. Can you guess what they are? One reason is the shores are near the ends of the rivers, and the rivers dump tons of nutrients into the ocean on a daily basis. The areas where the rivers meet the ocean are often referred to as **estuaries** or coastal wetlands.

Another reason that coastal areas are so much higher in biodiversity is because in these shallower areas, light has the ability to penetrate to the bottom of the water column. This allows for important producers to thrive. **Producers** form the basis for food webs within any ecosystem, and the ocean is no exception. The penetration of light also tends to lead to warmer conditions in the shallower areas as well as influence ocean currents.

The Open Sea is very different. There are far fewer living things that call this area home. The Open Sea is more of a transitional area where species tend to pass through as opposed to staying all the time. Many Open Sea creatures actually depend on the Coastal Zone for part of their life cycle; this area is particularly important for breeding. The Open Sea ecosystems can be divided into three main

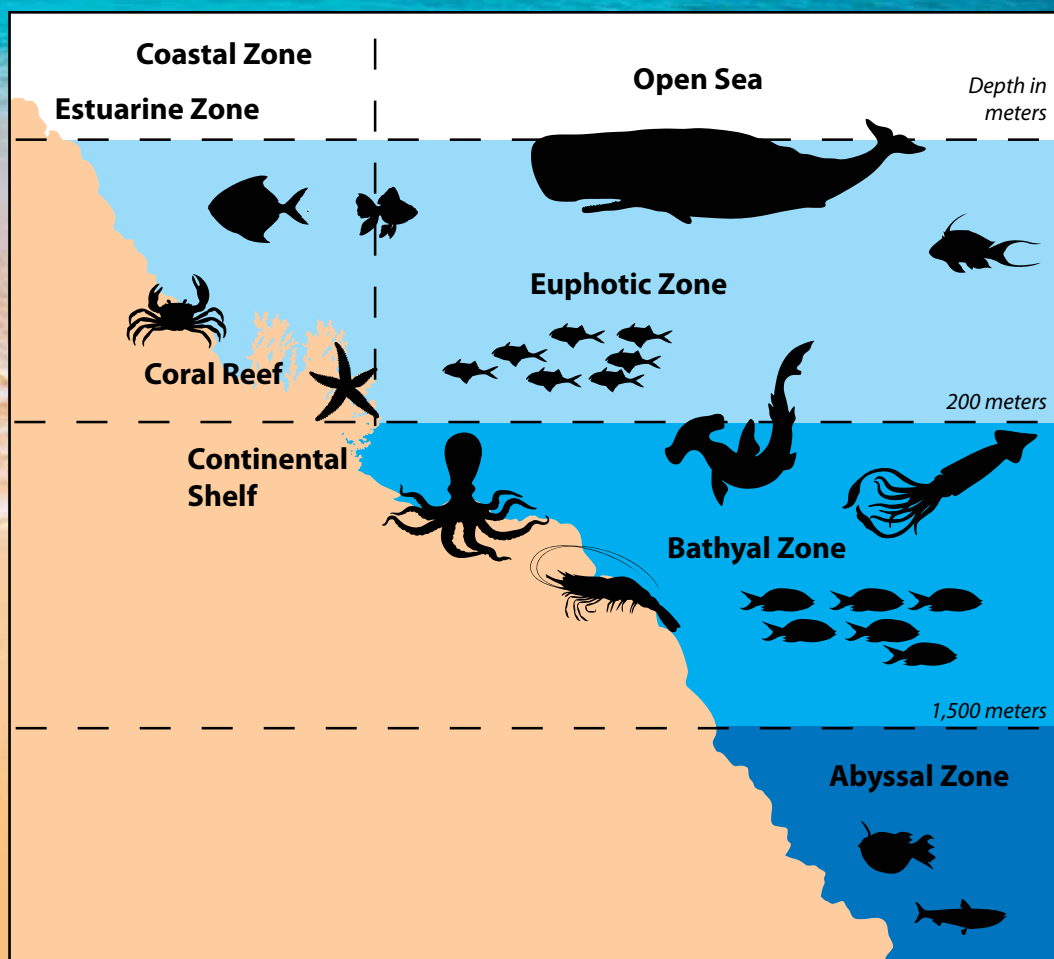
areas determined by the depth of the water: the Euphotic Zone, the Bathyal Zone, and the Abyssal Zone. The water column in the deepest zone may be as deep as seven miles! Abiotic factors such as light penetration, pressure and temperature become important variables in these zones. How might those factors influence which sea creatures live in which zone?

The upper layer, we call the **Euphotic Zone**,

runs from the surface up to about 200 meters (just over 600 ft.) deep in very clean water. The term "photic" means light and the prefix "eu" means "abundance of." So the Euphotic zone is that area where enough light penetrates to allow photosynthesis to take place. This is very important for the producers in the ocean's ecosystem. The actual depth of this zone varies with how clear the water is. When the water gets cloudier or dirtier, light cannot penetrate as far, and there is less room for the producers to thrive. Can you imagine what pollution does to the



life in this area? This layer extends throughout both the Coastal Zone and the Open Sea. Microscopic plants, known as phytoplankton live throughout this zone and are the greatest number of producers on the planet. Through the process of photosynthesis, **phytoplankton**



generates about 30% of the oxygen found in the atmosphere a year. Maybe even more important is that they help remove CO₂ from the atmosphere, and that helps in the fight against global warming.

When we dive deep below the Euphotic zone, between about 200 and 1500 meters, we find the **Bathyal Zone**. This is sometimes referred to as the twilight zone. At these depths, the light from above is so dim that it is not strong enough for photosynthesis to take place. This area usually is a transitional area between the shallow and deep waters of the ocean. Creatures living in the Bathyal Zone depend on what sinks down from above to eat, or they only stay in the area for a short time to hunt. Large schools of squid are one of the few full time residents of this area. Sperm Whale and some seals have been known to dive to these depths to catch squid for a meal.

In the deepest, darkest areas of the ocean, we find the **Abyssal Zone**. It was once thought that nothing lived down there, but it turns out that isn't the case.

Remember, every ecosystem depends on its producers. 99% of the producers on the planet are green plants that create sugars through photosynthesis using CO₂, water and the sun's energy. This is the basis for most food webs. In the Abyssal Zone, where there is no light, photosynthesis is impossible. It turns out that the producers in some of these deep areas are bacteria that are capable of chemosynthesis. **Chemosynthesis** is like photosynthesis, but instead of using the sun's light for energy, chemicals like sulfur are used. Years ago, scientists discovered whole communities of organisms living near geothermal vents in the bottom of the ocean. These vents are where

volcanic activity takes place.

It turns out that certain bacteria in these areas are able to convert sulfur compounds into sugars using the heat energy put off by the vents. – pretty amazing right? These bacteria are the beginning of the food chains and food webs at the bottom of the ocean. ■

The Abyssal Zone is also known as the zone of total darkness.

Why Should We Protect Our Oceans?



ECOLOGIC BENEFITS

Biodiversity

Biodiversity is the number and variety of species living in an area. The degree of biodiversity is one way to measure the overall health of ecosystems. Over 270,000 species have been identified as living in the world's ocean ecosystems. That's a lot of plants and animals!

Biodiversity is highest in the coastal zone areas of the oceans near coral reefs and estuaries. Can you think of some current threats to these areas and how to better protect them?

Climate & Weather

Warm ocean waters provide the energy to drive winds and storm systems all over the planet, including on land. Precipitation from these storms brings fresh water that plants, animals and all living things need. The oceans drive the general weather patterns of the Earth and influence climatic conditions everywhere.

Oceans are a major part of the water cycle. The oceans absorb heat. Air masses passing over warm water are driven upward. Air masses over cool water are driven downward. Evaporation from the surface of the ocean moves moisture along with those air masses. Along with the spin of the Earth and ocean currents (like the Gulf Stream), winds are generated, moisture moves around, and storms are created causing it to rain. We all need the rainfall to grow crops, for drinking water and to maintain natural ecosystems worldwide.



DID You KNoW?

Water vapor also contributes to “greenhouse effect” by trapping heat in the lower atmosphere, mostly in clouds. Water vapor is a greenhouse gas as is carbon dioxide, methane and other chemicals.

Since the ocean absorbs heat, it actually has helped control global warming by absorbing about 80% of the excess heat that is ultimately changing the climate all over the planet.



Greenhouse Effect Experiment

Backyard Action Heroes can get a little better understanding of greenhouse effect by doing the following experiment.

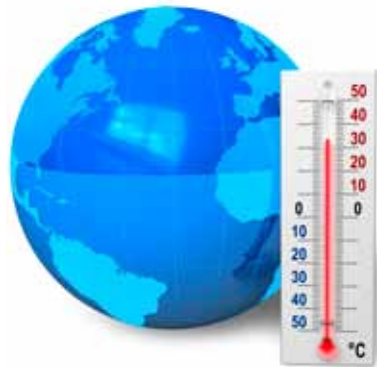
MATERIALS NEEDED:

- ☐ 2 simple thermometers
- ☐ 1 ziplock plastic bag
- ☐ A sunny windowsill with sunlight coming in

PROCEDURE:

Take one of your thermometers and place it in a plastic bag. Seal up the bag and place both the bagged thermometer and the other thermometer on a sunny windowsill. Take note of the temperatures on each just as you place them on the windowsill. Let them sit in the sun for about 10 minutes or so. Go back and check their readings.

You should see that the thermometer in the bag is a higher temperature than the one that was not placed in a bag. This is because the bag acts like the atmosphere around the Earth and the air within the bag has absorbed the sunlight and converted it to heat that could not escape. The gases inside the bag are the same ones found in the atmosphere and include greenhouse



gases like CO₂ & water vapor, which help trap the heat. You may want to repeat the experiment, but this time sprinkle a little water inside the bag before sealing it, and sprinkle a little water on the thermometer that is not in a bag as well. Let these sit for about 15 minutes and see if your results are any different. You may find the temperature in the bag even higher due to the water trapping more heat. The other thermometer may show a bit cooler, because as the water evaporates off of it, the thermometer will experience a little cooling. Your body sweats on a hot day in order to try and achieve this same cooling effect.

How does this relate to what is taking place over the oceans of our planet?



ECONOMIC BENEFITS

The world economy is highly influenced by the ocean. One out of every six U.S. jobs are somehow linked to the ocean. Approximately two thirds of the world's population lives within 100 kilometers of the coastline. The oceans of the world provide about 25% of all the protein we eat. The production and processing of seafood is a multi-billion dollar a year business in the U.S. alone. Ocean creatures provide us with a wide variety of medicines, some of which are used to treat cancers and heart disease. Medicine, too, is a multi-billion dollar a year economic benefit the oceans provide. As mentioned before, oceans are the most inexpensive way to move large quantities of materials around, and it is estimated that the ocean generates about \$21 trillion in ecosystem benefits and services per year.



NATURAL RESOURCES

The sea floor contains so many important minerals and rare metals that we use. Salts, magnesium, potassium, manganese, placer gold (that's gold in gravel form), silver, tin, titanium, limestone and gypsum are just a few of the materials we extract from the ocean. Of course, oil & gas production from drilling in the ocean is also something we hear a lot about in today's news.



TRANSPORTATION

From the early voyages of Viking explorers to the shipping of cars today, the oceans have provided major trade and travel routes for thousands of years. In the U.S. alone, 95% of foreign trade items pass through U.S. ports and harbors each year. Shipping by boat or barge is one of the most efficient and inexpensive ways to move goods around the world.



Vocabulary

ABIOTIC

The non-living/non-organic (also called inorganic) part of our ecosystem.

BATHYAL ZONE

That area of the ocean, generally between about 200 meters and 1500 meters deep, where light is not strong enough for photosynthesis to take place. Also known as the twilight zone.

CHEMOSYNTHESIS

The process of converting sulfur compounds, using heat generated by hydrothermal vents at the bottom of the ocean, into sugars. Bacteria living in the dark of the Abyssal Zone uses chemosynthesis to make their food. These bacteria are the producers in the deep ocean ecosystems.

COASTAL ZONE

The area of the ocean lying between the edge of the continental shelf all the way to the high tide mark.

ESTUARIES

Coastal wetland areas where the rivers of the land meet up with the ocean.

EUPHOTIC ZONE

Those areas less than 200 meters deep that allow enough light penetration for photosynthesis to take place.

OPEN SEA

The deeper water areas of the oceans that lie from the continental shelf outward away from the shore.

pH

A measure of certain ions of hydrogen and/or oxygen that lead to creating conditions of acidity or alkalinity in substances.

PHYTOPLANKTON

Microscopic plants that live in aquatic systems and form the basis for food chains and food webs by acting as producers.

PRODUCERS

Organisms that are capable of creating food from non-living components. (Example: Plants through the process of photosynthesis or bacteria using chemosynthesis)

SALINITY

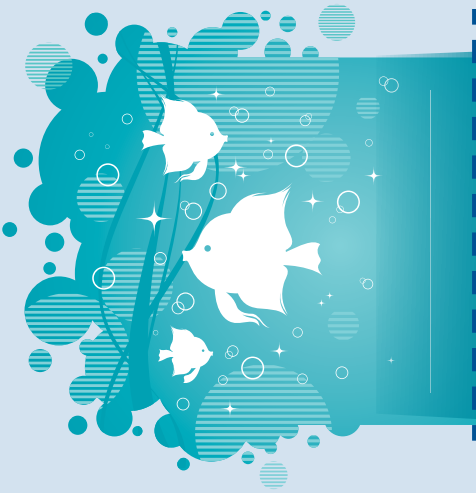
The measure of the amount of dissolved salts in a substance like water.

Catch the Wave...

The Earth is often described as an ocean planet. Life as we know it could not exist without water, and it wasn't until liquid oceans started to form on our planet that life could even begin. Life today still depends on the oceans, whether it is found swimming in the sea, scurrying through the sands of a desert or on the frozen permafrost of the tundra. The oceans have an influence on every ecosystem of our Blue Planet. This is why every Backyard Action Hero needs to get out and spread the word that these important aquatic ecosystems need to be protected.

What are you waiting for? Surf's up!





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Get Your Parents & Teachers Involved, Too!

The Louisville Zoo can be your partner in providing you, your family members and teachers with the knowledge and inspiration to be the future caretakers of nature and wildlife. Visit louisvillezoo.org/education for information about field trips, classes, camps, overnight programs, professional development and so much more.

Kentucky may seem like a long way from the ocean, but your efforts do make a difference. There are lots of ways a BAH and his or her family can get involved in protecting our oceans and planet. Here are some more things YOU can do:

- Reduce, Reuse and Recycle
- Organize a cleanup day and pick up litter around your school or in a local park.
- Find ways to conserve and reduce your carbon footprint around your house. Turn off the water while you brush your teeth. Replace burned out light bulbs with compact fluorescents. Turn your thermostat up or down a couple of degrees (up in the summer, down in the winter.)
- Try to buy products made of recycled materials or that come from sustainable sources. Also choose to buy products with the least amount of packaging. That means there's less to throw away.
- Learn as much as you can about animals and their habitats and how to help protect and preserve them. The Louisville Zoo is a good place to start.

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