Grade Level: 6-8
Time Estimate: 1-2 days

BIODIVERSITY / INSTRUCTOR INFO

Summary

This lesson includes vocabulary, content and, activities to help students learn about biodiversity. Students will learn to identify the different aspects of biodiversity and why it is important. They will learn how biodiversity is affected by damaged ecosystems and how to help ecosystems and biodiversity through conservation.

Part 1. Understanding Biodiversity
Part 2. The Importance of Biodiversity
Part 3. Damaged Ecosystems
Part 4. How People Can Help
Activity 1. Ask the Expert

Goals & Objectives

The students will:
- Learn the aspects of biodiversity;
- Be able to describe what happens when biodiversity is lost;
- Learn about conservation;
- Gain understanding using real-world scenarios.

Helpful Tips

1. The content in this lesson is related to OCEARCH and the Global Shark Tracker. Spend a few minutes getting familiar with the website and the tracker if you have not done so already. The Global Shark Tracker is also available as an app for iPhone and Android.
2. This lesson plan is designed to be adaptable to suit your specific needs. Use the entire lesson plan or just parts of it. This material can be expanded to be an entire unit or condensed for just one day in the classroom.
3. Vocabulary words will be underlined as they appear in the lesson plan. A complete list of vocabulary words is included as well.
4. Answers to questions and prompts for discussions will appear in italics.
5. Have questions for OCEARCH Expedition Leader, Chris Fischer? Email info@OCEARCH.org to schedule a Skype session and let your students/child talk directly to Chris and the OCEARCH crew!
6. Email all questions about this lesson to info@OCEARCH.org.

Grade Level: 6-8

// STANDARDS

This lesson aligns with the following TEKS:

Grade 6 Science: 1B, 2A, 2B, 2E, 3A, 3D, 12A, 12D, 12E, 12F

Grade 7 Science: 1B, 2A, 2B, 2E, 3A, 3D, 10A, 10B, 11B, 11C, 13A, 14A, 14B, 14C

Grade 8 Science: 1B, 2A, 2E, 3A, 3D, 11A, 11B, 11C, 11D

This lesson aligns with the following Next Generation Science Standards (NGSS):

Framework

- Asking questions and defining problems.
- Constructing explanations.
- Engaging in argument from evidence.
- Obtaining, evaluating, and communicating information.

MS. Matter and Energy in Organisms and Ecosystems – MS-LS1-6, MS-LS2-1, MS-LS2-3, MS-LS2-4

Disciplinary Core Ideas

LS2A: Interdependent Relationships in Ecosystems

- Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)
- In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1)

LS2.B: Cycle of Matter and Energy Transfer in Ecosystems

- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3)

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4)

MS. Interdependent Relationships in Ecosystems – MS-LS2-2, MS-LS2-5

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems

- Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)

Crosscutting Concepts

Stability and Change

- Small changes in one part of a system might cause large changes in another part. (MS-LS2-5)

STEM

This lesson plan aims to assist teachers in implementing a STEM-based program into their classroom while inspiring the next generation of explorers, scientists, and stewards of the ocean. Based on real science and the Global Shark Tracker™, this lesson is intended to promote environmental awareness and to prepare students for STEM careers.

Grade Level: 6-8

BIODIVERSITY / VOCABULARY

Agriculture - The science or occupation of farming.

Biodiversity - The existence of many different kinds of plants and animals in an environment.

Biome - A large naturally occurring community of plants and animals occupying a major habitat (i.e.: forest, tundra, etc.)

Conservation - The careful use of natural resources.

Deforestation - The act or result of cutting down or burning all the trees in an area.

Ecosystem - Everything that lives and exists in a particular environment

Endangered - A plant or animal that is at risk of becoming extinct.

Equator - An imaginary circle around the middle of earth that is the same distance from the North Pole and South Pole.

Extinct - No longer existing.

Food Web - A system of plants and animals that rely on each other to eat and survive.

Genes - The part of a cell that determines characteristics and is transferred from parent to offspring

Industry - The process of making products by using machinery and factories

Invasive Species - Organisms that are introduced to a new, non-native environment.

Overexploitation - When a resource is consumed or used up at a rate that is faster than what can be recovered naturally

Pollution - Substances that make land, water, air, etc. dirty and unsuitable for use.

Grade Level: 6-8

BIODIVERSITY / PRE-LESSON ASSESSMENT

Use the following true/false and multiple-choice questions as an introduction/warm-up to the lesson topics. You can do this in a verbal or written format, as a game, individually, or as a whole class!

The questions do not need to be graded. They are intended to give the students an idea of what they will be learning and to see what they already know.

1. True or False
High biodiversity means that there are many different types of plants and animals in a given area.
Answer: True

1. True or False
Rapid changes to the environment or climate of a location cannot cause extinctions.
Answer: False

1. True or False
Genetic variation is an aspect of biodiversity.
Answer: True

2. Because of the warm climate, biodiversity tends to be greater near the _____.
- **a.** Arctic Circle
- **b.** Cities
- **c.** Ocean
- **d.** Equator

Answer: d.

2. Which of these is **not** an aspect of biodiversity?
- **a.** Genetic variation
- **b.** Temporal Variation
- **c.** Species Variation
- **d.** Ecosystem Variation

Answer: b.

2. How can humans help to protect biodiversity?
- **a.** Conservation
- **b.** Industry
- **c.** Overexploitation
- **d.** Deforestation

Answer: a.

Grade Level: 6-8

BIODIVERSITY / LESSON PLAN

INTRODUCTION **10-15 mins**

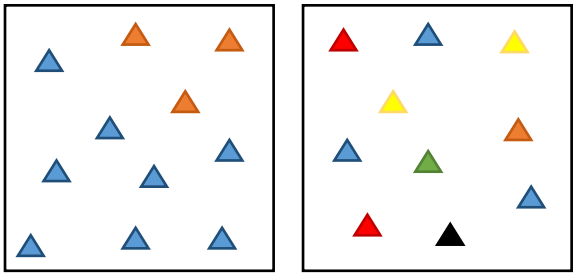
One of the most fascinating things about our planet is the breathtaking life forms that live and grow here. Biological diversity or in short, biodiversity, can simply be explained as the total number of different living organisms in an area or location. The size of the location can be as small as the chromosomes within a cell that make up your genetics, to microorganisms living on the surface of your skin, or as large as a continent, all the way up to size of the entire planet! Biodiversity is a way to measure the variety and variability of different organisms, whether that is genetic variation, species variation, or ecosystem variation.

Assemble the students into groups of three or four. Task each group to write down ten different plants or animals on a sheet of paper. After all groups have finished, have one member from each group write what they came up with on the board. Once everyone is seated, compare what the groups came up with. Were there more similarities or differences? How many different organisms did the class think of? Biological diversity can exist on many different levels such as having many different types of flowers, or even the different colors that a single type of flower can have. Just as the old saying "variety is the spice of life." suggests, rich biodiversity is essential to the survival of all living organisms

PART 1. UNDERSTANDING BIODIVERSITY **10-15 mins**

Biodiversity is a measurement of the variety of living organisms within different ecosystems. Ecosystems are comprised of all the living and nonliving parts of a particular environment such as water, sunlight, soil, plants, animals, bacteria, and fungi. A rich biodiversity means that though many ecosystems may be similar in function, they can still host completely different life forms. The different aspects of biodiversity can be analyzed with a broad scope at the level of the ecosystem down to the much more narrow view at the genetic level between individuals within the same species.

Consider the diagram below. The image on the left has a total of 11 organisms (represented by triangles) while the image on the right has 10 organisms. However, the image on the left has only 2 different species (represented by color) where the image on the right has 6 different species. Therefore, the image on the right has a greater biodiversity.



Ecosystem Variation

Ecosystem variation is the largest scale of biodiversity that can be measured. Biomes are excellent examples of ecosystem variation. Ask the students how many different biomes they can come up with. *Allow the students to answer verbally or write their answers on the board*. Examples include but are not limited to: jungles, forests, deserts, tundra, savannas, coral reefs, etc. With each of these examples of different ecosystems, think of different types of animals that live in each. When comparing ecosystems that are similar, you can narrow the scope or measure of biodiversity further by analyzing different organisms that live within similar biomes but at completely different geographic locations.

Species Variation

Depending on the type of plant or animal, there can be different species that inhabit similar ecosystems and play similar roles in different locations on earth. An excellent example would be comparing the tropical rainforests of Asia and South America. Both located along the equator, these lush habitats are home to thousands of different species of animals. Because of the similarities, certain animals may play a similar function in their equivalent habitat. Consider the Tiger and the Jaguar. Both of these large felines are top predators within their ecosystems. In any case, these species are distinct due to not only their geography, but also because they fit into a specific part of their food web.

The variation of different species of organisms within their environment is what develops a diverse and complex food web. Consider a coral reef food web. At the base of the food web, you have primary producers such as algae and phytoplankton. These tiny organisms are consumed by zooplankton and other herbivores which in turn are consumed by increasingly larger predators until you reach the apex predators at the top. A complex food web is indicative of rich biodiversity because the more organisms that make up the web, the stronger and more durable it is. Disturbances within the ecosystem such as a hurricane can be adapted to or overcome without irreparable damage to the overall food web.

Genetic Variation

Look around at everyone in the room. We are all humans, yet we all look different from one another. This is due to genetic variation. That means that the genes contained within humans, as a species, can differ greatly from person to person. When you have a large population of a single species, genetics can and will tend to vary. This diversity is important, especially when you consider things like inherited diseases or disorders. If a large population has a very small percentage of individuals with genetics for a deadly disease, chances are that the disease will eventually disappear from that species. This is because the genes from the greater majority that do not carry the disease will outshine the few that do carry it. Chances of inheriting the disease grow smaller and smaller with each generation. Genetic variation makes a species as a whole more stable and more likely to adapt to changes or shifts in the environment or ecosystem.

PART 2. THE IMPORTANCE OF BIODIVERSITY **5-7 mins**

Rich biodiversity is important to not only the health of ecosystems, but to the health and wellbeing of people and life on the planet as a whole. The rich diversity found in tropical rainforests and coral reefs have led to scientific discoveries that have helped create medicines and vaccines for people in need. Biodiversity also provides us with a great variety of products (foods, raw materials, etc.) that support the economy. Without diversity in soils, plants, or organisms such as bees to pollinate those plants, gardens and markets would have less produce to work with.

Studies in genetic diversity of different species have led to medical discoveries that have lengthened life spans and shed light on a number of genetic issues that can be more easily managed than in the past. An extremely important part of

genetic diversity relates to agriculture. Thousands of years ago, when humans first began planting crops, they would select the individual plants that provided the most food, and replant seeds from that plant for the next year. Humans would have been unable to choose the plant that provided the most food, if there was no diversity in the genetics of that crop.

When an ecosystem is disturbed, whether it is by a natural event like a flood, or due to human activity such as deforestation, the food web within that ecosystem is also disturbed. Rich biodiversity allows for these disturbances to be overcome without causing the entire food web to fall apart. For example, there are ten species of lizards living in a forest, and the population of two of those species is destroyed in a forest fire. The remaining eight species of lizard will be able to make up for the two lost by filling in the space in the food web. The overall food web is able to recover since the remaining eight species of lizard will not only eat similar foods to the two missing species, but lizards as a whole are still available to the other predators in that food web. When there is very little biodiversity, food webs can collapse and lead to species of animals becoming endangered or even extinct.

When a species is considered endangered, that means that the population is low enough that the species is likely to become extinct in the near future. Aside from the risk of a collapsed food web, the genetic diversity of an endangered species is greatly reduced. This means that the population has a much harder time recovering.

PART 3. DAMAGED ECOSYSTEMS **5-10 mins**

Many things can contribute to decreases in biodiversity. In fact, biodiversity has been increasing and decreasing since life began on Earth. Think of the many species of dinosaurs that are long extinct. While adaptation and extinction are a natural part of the planet's history, loss in biodiversity in current times is largely due to human influence.

Natural habitats and ecosystems all over the world are destroyed as the human population increases. The growing number of humans means that more and more land is needed for housing, farming, and industry. Over 90% of rainforests in southern Asia have been demolished. This deforestation is leaving animals without food or homes. Habitat loss is an enormous part of why there is such a decrease in biodiversity on nearly every continent. Think of your own town or city. Are new houses, shops, and roads being built where there was once natural habitat?

As human populations continue to develop and grow, the need for more of the earth's resources grows. Industry is the economic activity of processing earth's resources into manufactured goods. Where does the gasoline that fuels cars come from? *Allow students to answer.* Gasoline is made from processing the crude oil that is found deep underground. If gasoline fuels our cars, where do our cars come from? *Allow students to answer.* Our cars and trucks are made in factories and moved to dealerships where they are bought and sold every day. Now think of exactly where the car factory would get the parts to make the car. Whether it is the metal for the frame of the car, the fabric for the interior, the complicated engine, or even the paint for the outside, human industry is deeply involved. So what does this mean for biodiversity? The numerous factories, machines, power plants, and even certain farms are all using up the Earth's resources and creating enormous amounts of pollution.

Pollution is responsible for rapid changes to the environment, and in many cases can harm the environment enough to make the area toxic for organisms to live there. Certain types of pollution, like greenhouse gasses, are building up in our atmosphere and acting like a hot blanket covering the earth. The heat from the sun cannot escape and causes increasing temperatures on land and in the ocean. Those species that cannot escape or adapt to these changes will not survive and ultimately cause a collapse in the food web.

Overexploitation is another factor that damages ecosystems and harms overall biodiversity. Overexploitation occurs when a resource is consumed or used up at a rate that is faster that what can be recovered naturally. On land this can be

represented by cutting down trees faster than they can grow back or hunting and poaching for the illegal wildlife trade. In the marine environment, overfishing is one of the top examples of overexploitation. This can lead to a complete collapse of a marine ecosystem. For example, the overfishing occurring in the waters of the northwestern Pacific Ocean has left orcas, or killer whales, without enough of their regular food sources. The orcas have instead turned to eating sea otters. Sea otter populations are drastically reduced because the orcas have nothing else to eat! Sea otters are responsible for eating the spiny sea urchins on the seafloor. With so few sea otters left, the urchins are taking over and eating up all the kelp, or seaweed, that grows into the giant kelp forests. Imagine all of the animals that call those kelp forests home! The action of overexploiting the fish has caused a snowball effect and ended up damaging an entire ecosystem.

Many species of sharks are affected by overexploitation as well. Researchers have estimated that about 100 million sharks are killed each year, though more recent investigations show that the number may be closer to 250 million sharks per year. Many of these sharks are killed simply for their fins. Shark fin soup is a delicacy in some cultures and fins can fetch a high price, even though shark finning is illegal in many places. When the number of sharks in the ocean decreases, the rest of the food web is affected as well. Without sharks to eat predators like squid, the squid populations increase quickly and wipe out smaller species of fish and even very young sport fish like tuna and marlin.

Not all ecosystems are damaged by directly causing harm to the environment. Invasive species, or organisms that are introduced to a new and non-native location, tend to spread out and can cause damage to an existing species or food web over time. These invasive organisms can be plants, fungus or animals ranging in variety from insects to mammals! The introduced species causes competition for food, sunlight and space with other native organisms and in many cases can alter the food web permanently.

An example of a marine invasive species would be the lionfish. The lionfish is native to the tropical waters of the Indo-Pacific Ocean. They are a popular fish in the pet trade because of their beautiful and dangerous spines. In the past 40 years, several individuals were released into the Gulf of Mexico and Atlantic Ocean by irresponsible pet owners. The lionfish, with no natural predators in these waters, quickly began to breed and devour many unsuspecting species of native fish. Within less than 20 years, the lionfish population has grown so large that entire ecosystems along the coasts of Florida have been wiped out.

PART 5. HOW PEOPLE CAN HELP **5-10 mins**

While there are many factors working against keeping the world a naturally biodiverse place, it is largely up to humans to work together to right the wrongs and protect the different species, environments, and ecosystems all over the world. There are many people, programs, and organizations already in place that are dedicated to preserving biodiversity.

Protected Areas

One method of maintaining biodiversity is to designate certain locations as protected zones where humans cannot interfere with the wild habitat. On land these places may be national parks or forest reserves. Protected areas also exist in the marine environment like the Flower Garden Banks National Marine Sanctuary about 100 miles off the coast of Texas. In fact, scientists and researchers spend their lives investigating ecosystems to discover important locations that need protection. For example, it would make sense to protect an area where migrating species go to breed or have their young because this would help to increase populations that might be in trouble.

Restoration Projects

In areas that have already been damaged, people and organizations are working to restore the area with native species to help rebalance the overall ecosystem. Often, these restoration projects are closely connected with protected areas making sure that the work to restore a habitat is then protected from further harm. There are many coral reef restoration projects occurring in places like the Gulf of Mexico and Caribbean. Restoration projects can also aim to remove invasive species so that the native species have a better chance of surviving. In some cases, these projects also involve introducing many individuals of the same species to help create better genetic diversity in populations that are recovering from near extinction. This practice is particularly common with species of plants like grasses and tree nurseries. The Species Survival Plan or SSP is another way to protect genetic diversity by keeping careful track of the genetics and breeding of many endangered species such as the Sumatran Tiger.

Conservation

Conservation, or the careful use of natural resources, is a key factor in helping to maintain biodiversity. By reducing the amount of waste and pollution created by industry, humans can help to protect habitats and ecosystems. Small efforts such as recycling plastic and aluminum, reusing items like bags and water bottles, and walking or carpooling instead of driving can add up into amazing results. Conservation scientists work to find new ways to protect biodiversity and rely on the support of everyone to do their part to help the world's ecosystems.

Knowledge and Education

A major part of helping conservation and the world's biodiversity is by spreading knowledge to other people. Many people are unaware of the impact they can make on the environment. Imagine if you and your family spent a week eating only fast food for breakfast, lunch, and dinner, and using only plastic bags when going shopping. How much waste would that create? Now imagine instead that you and your family used reusable bags at the store where you bought fresh groceries to cook for each of your meals instead of buying fast food. This would create much less waste! There are many ways that people, including students, can help to conserve biodiversity. Starting a recycling club at school, raising money to help conservation organizations with a bake sale, or even joining with friends and family to pick up litter and garbage at your local park are all great ways to help the environment and preserve biodiversity.

Grade Level: 6-8
Time Estimate: 15-20 mins

BIODIVERSITY / ACTIVITY 1. ASK THE EXPERT

INTRODUCTION

This activity will enhance the students' knowledge of the nature and function of biodiversity and ecosystems. They will gain understanding of biodiversity and conservation science in real world applications by interviewing an expert in the field.

MATERIALS

- Pen or pencil
- Notebooks
- Activity Sheet (optional)

INSTRUCTIONS

Set up an interview with a local naturalist, park ranger, zookeeper, or other environmental scientist. The interview can be in person or through digital communication such as Skype. The students should prepare questions ahead of time, or collectively come up with interview questions as a class. The activity sheet provided has suggested interview questions and can be used as a substitute or in conjunction with the students' questions.

After the interview, the students can write a brief report on their interview including what they have learned and how they can make a difference to help protect biodiversity. The report can be an in-class or at home assignment.

TIPS

- The OCEARCH crew is available for interviews! Email info@OCEARCH.org to schedule a Skype session and let your students/child talk directly to the OCEARCH crew!

Grade Level: 6-8

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ACTIVITY 1. ASK THE EXPERT

Name:_____ **Date:**_____

Use the questions below to guide you through your interview with an adult that works to conserve biodiversity.

What is your name?

What is your job?

What kinds of biodiversity do you work with?

Sketch a picture of your visitor below.

The biodiversity you work with is important because…

How do you help conserve biodiversity?

What is your favorite part of your job?

How can a student like me grow up to work in a job like yours?

How can I help to protect biodiversity at home?