

- BIODIVERSITY BASICS
- WHY BIODIVERSITY AND NATURE MATTER
- THREATS TO BIODIVERSITY
- WHAT WWF (AND THE WORLD) IS DOING
- WHAT KIDS CAN DO

**TEACHING  
TOOLS  
ABOUT**





WILD CLASSROOM

WWF's Wild Classroom connects educators and parents with the tools and resources they need to help kids explore and understand the world around them. Visit [wildclassroom.org](http://wildclassroom.org) to choose from a growing library of animal- and nature-related teacher's guides, fact sheets, and activity plans that you can use to enhance your science, writing, art, and other lessons.

# BIODIVERSITY

## ● Biodiversity Basics

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- Biodiversity is all the different kinds of life you will find in one area. It encompasses all the animals, plants, fungi, bacteria, habitats, and genetic material that work together in ecosystems to maintain balance and support life.
- When studying an area's biodiversity, scientists look at different criteria to help them evaluate its current status, as well as how it has changed or improved:
  - The number of different types of species found (composition)
  - The actual count of individuals of each species (abundance)
  - How spread out the individuals are (distribution)
  - How many of these species have been identified as threatened or endangered (extinction risk)
- Forests are home to 80% of the world's biodiversity on land. One square kilometer of forest may be home to more than 1,000 species. The most biologically diverse and complex forests on Earth are tropical rain forests, such as the Amazon.
- The ocean covers more than two-thirds of our living planet's surface and is home to a spectacular array of ecosystems and wildlife. About 90% of life in the ocean is found in the shallow seas close to the coasts.
- Less than 1% of the world's water is fresh and accessible, yet freshwater habitats such as lakes, rivers, and wetlands are home to more than 10% of all known animals and almost 50% of all known fish species.
- One-quarter of all life on Earth can be found beneath our feet. Soil biodiversity consists of a huge underground community of life-forms such as fungi, bacteria, nematodes, tardigrades, ants, termites, earthworms, moles, and many more. These species play a huge role in helping reduce the effects of climate change by regulating greenhouse gases, as well as cycling nutrients through the ground so that they may be used by plants. Without these underground workers, entire ecosystems would crumble. Soil biodiversity is currently facing many threats, including pollution, agriculture, and erosion.



- Humans have only been around for 200,000 years, a tiny fraction of the 4.5 billion years of our planet's history. Yet we have had a greater impact on the Earth than any other species. As humans continue to put pressure on the planet, we are upsetting the balance of ecosystems and losing biodiversity. Three-quarters of the land-based environment and about 66% of the marine environment have been significantly altered by human actions. Wetlands are most affected, having lost 87% of their coverage in the past era.
- Almost 20% of the Amazon rain forest, one of the most biologically diverse places in the world, has disappeared in the past 50 years.
- Populations of fish, birds, mammals, amphibians, and reptiles have declined by 60% in just over 40 years because of human activity such as overharvesting and illegal hunting of animals, agriculture, and land conversion/degradation of habitats.
- Around 1 million animal and plant species—more than ever before in human history—are now threatened with extinction. This includes 40% of all amphibians, 25% of mammals, 34% of conifers, 14% of birds, 31% of sharks and rays, 33% of reef corals, and 27% of crustaceans. The current rate of species extinction is 100 to 1,000 times higher than nature intended.
- Biodiversity is resilient. If humans reduce the pressure we're putting on the planet and manage resources better, in time, ecosystems will adapt. Nature and biodiversity will recover.
- In nature, everything is connected. The ripple effect of any change touches every part of our planet. In order for both people and wildlife to thrive, now and in the future, we need a healthy planet with a rich variety of plants and animals and vibrant ecosystems.



*Galápagos sea lion swimming near mangroves, Floreana Island, Galápagos, Ecuador.*



## ● Why Biodiversity and Nature Matter

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### They provide for us

Biodiversity supports everything in nature that we need to survive. Food, raw materials, fresh water, and medicine come from nature. Nature is responsible for replenishing the fresh water that underpins all agriculture and economic activity. The International Union for Conservation of Nature (IUCN) Medicinal Plants Specialist Group estimates that there are between 50,000 and 70,000 known medicinal and aromatic plants used by humans for medicine or other purposes. Engineers and designers also study wildlife and develop improvements to current technology, such as the means of communication and sources of renewable energy, based on practices observed in nature (called biomimicry).

### They control natural processes

Nature, under normal conditions, is capable of taking care of itself. It is responsible for regulating air quality, climate, water, erosion, waste treatment, pollination, and disease. Nature also moderates extreme weather events such as hurricanes and blizzards. Rain forests breathe moisture into the atmosphere: that moisture is then transformed into rain that waters crops thousands of miles away. Wetlands are responsible for filtering water and recharging aquifers, providing us with plenty of healthy, clean water. Healthy, natural systems can help reduce the damage caused by rising sea levels, extreme rainfall, and the higher incidence of frequent droughts and storms, all caused by climate change. But when natural habitats like forests and wetlands get destroyed, greenhouse gases are released, making climate change more intense.

### They support from the ground up

In order to provide essentials such as food and water, nature has to first support the basis for all life. This includes enabling healthy soil to take shape and allowing photosynthesis and plant growth to occur. The soil is responsible for the cycling of nutrients through the ground, on which the health of all ecosystems depends. Pollinators such as bees and butterflies help continue the process of allowing soil and plants to provide for us. About 87% of all flowering plant species are pollinated by animals, and crops that are pollinated by animals account for 35% of global food production.

### They offer cultural benefits

Nature has proven effects on our mental and physical health, provides recreation and ecotourism, and supports spiritual and religious beliefs. Research shows that being in natural areas improves our physical well-being, and there is growing evidence to show that spending time in nature can also help maintain and promote psychological well-being.



## ● Threats to Biodiversity

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The greatest threat to biodiversity is human activity. We have overfished the oceans, cleared forests, polluted our water sources, and caused climate crises. Overharvesting and agriculture continue to have the most dramatic impact on biodiversity. Over the past 50 years, our consumption of natural resources has increased by about 190%.

### Agriculture

Changing the environment where a species lives is a huge threat to biodiversity. This can happen in a few different ways: completely removing the habitat (such as happens with deforestation), fragmenting the habitat (such as by building dams through rivers), or degrading the habitat (such as by damaging the soil quality). Agriculture is still the number one driver of habitat loss in forests and grasslands. The growing human population and increasing demand for food increase pressure to convert forests and grasslands to farms and pastures. More than one-third of the world's land surface is currently dedicated to agriculture. As habitats disappear and the health of the remaining habitat declines, the plants and animals living within are critically impacted. Even a minimal amount of habitat loss can have devastating effects on biodiversity, particularly in tropical rain forests. Rain forests are home to more species—many of which are rare and endangered—than any other land habitat. Large areas of these forests have been cleared to grow palm oil, an ingredient used in packaged products all over the world. This conversion of rain forest fragments the habitat and threatens the survival of many plant and animal populations.

This shift to agriculture has also affected the quality of soil in many parts of the world. Half of the topsoil on the planet has been lost in the past 150 years. This has had a domino effect on all the species relying on soil and what grows in that soil to survive. It has led to the decline of bees and other insects that help pollinate 75% of the food crops we grow.

### Overharvesting

To overharvest or overexploit a resource means that you are using it excessively and to a damaging degree. Currently, humans are implementing these harmful practices in natural areas all over the world, including oceans and forests. When fishing vessels catch fish faster than the fish can reproduce and replenish their populations, it's called overfishing. Overfishing is one of the most significant factors in the decline in ocean wildlife populations. According to the latest data available, 33% of assessed marine fish stocks were being harvested at unsustainable levels and 60% were fully fished, meaning these populations are likely unable to withstand an increase in fishing. This left only 7% of fish stocks able to support greater



catches. Almost 6 billion tons of fish and invertebrates have been taken from the world's oceans since 1950. Fish are a part of many marine food webs, so by depleting the ocean of its fish, we're impacting all the species that depend on fish to survive. Overfishing is also closely connected to bycatch—the accidental capture of sea life while fishing for a different species. Bycatch has caused countless unintended deaths of fish, sea turtles, sharks, and dolphins. Bycatch is the leading threat to whales and dolphins around the world, estimated to cause at least 300,000 deaths per year.

Forests are also at risk, impacted by illegal and unsustainable logging usually as a result of the global demand for inexpensive wood and paper products. This illegal removal of timber causes the health of the forests to decline as vegetation is damaged, rivers are polluted, and the stability of the soil weakens.

### Climate change

Changes in climate and extreme weather events are already affecting biodiversity across the globe. Life cycles of certain species (such as flowering plants) are being altered, impacting the other members of the ecosystem that depend on them. Species' migrations and breeding seasons also fluctuate, as they are often climate dependent. The availability of food and water is shrinking, creating more competition. As winters get warmer and shorter, pests and diseases spread. The increased ocean temperatures have caused coral reefs to expel the algae they depend on to survive, which results in the corals turning white (bleaching) and often dying. Coral reefs are some of the most biologically diverse ecosystems in the world, and as they become bleached, they're no longer able to support all the species that rely on them for food and habitat. In just three years, around 75% of the world's tropical coral reefs experienced heat stress severe enough to trigger bleaching, and 30% of these corals died.

The effects of climate change are being felt at the poles twice as fast as on the rest of the planet. Sea ice helps protect our planet by reflecting much of the sun's energy back into space, helping regulate climate. With greenhouse gases trapping heat within our atmosphere, the sea ice is melting, causing less of the sun's energy to be reflected back into space and more to be absorbed into the ocean. This warming ocean only contributes to the melting of the sea ice, creating a cycle of melting and warming that accelerates sea level rise. Sea ice not only helps protect us by acting as a sun shield, but also provides essential habitat and feeding grounds for species such as polar bears and walrus. The ice also supports the growth of tiny algae, which are the base of the food web and the source of food for fish and krill. As our planet continues to heat up, the sea ice will continue to disappear, as will the species that depend on it.



### Poor water quality and scarcity

All life on land needs fresh water. Unfortunately, pressures from humans such as water overuse/misuse and pollution are contributing to the decline in quality and quantity of the fresh water that we all depend on. Agriculture uses the highest percentage of fresh water (nearly 70%) and is the leading source of pollution in many countries. Use of pesticides and fertilizers on farms can poison the air and soil, as well as the fresh water that leads into marine ecosystems, decreasing biodiversity everywhere. In addition to this chemical runoff pollution, plastic pollution is also a threat to biodiversity. Plastics have been found from shorelines and surface waters all the way down to the deepest parts of the ocean, including the bottom of the Mariana Trench. According to scientists, plastic particles can be found in 90% of the world's seabirds.

Freshwater habitats are also being impacted by dams that are disconnecting rivers, creating a buildup of sediment that causes waterways to clog and prevents fish and other aquatic species from migrating and reproducing. Freshwater ecosystems such as rivers, lakes, and wetlands provide habitat for more than 125,000 species. These ecosystems also provide us with water to drink and to grow food, so it is essential for them to remain free-flowing and healthy. Increasing human populations result in growing demand and pressure on our fresh water. With more people impacting their watery homes, freshwater species are declining at an alarming rate.

### Wildlife trade

Poaching wildlife for illegal trade is an urgent threat facing hundreds of the world's most beloved species, such as elephants, rhinos, and tigers. These animals are illegally hunted for their fur, tusks, horns, bones, and other parts. Illegally obtained animal parts and products are trafficked by international criminal networks, much like illegal drugs and weapons. This business continues to skyrocket due to an increasing demand, particularly in Asia where these animal parts are often seen as a status symbol and used in medicine or carved into trinkets. In addition to elephants, rhinos, and tigers, countless other species such as sea turtles, pangolins, birds, reptiles, primates, and timber trees are similarly illegally exploited.



*Polar bear mother and cubs walking on ice flow in Svalbard, Norway.*



## ● What WWF (and the World) Is Doing

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WWF is part of the global effort helping to identify the threats to the most pressured areas of the world and working to address them by finding innovative solutions.

### The Convention on Biological Diversity's Aichi Targets

The Convention on Biological Diversity (CBD) was established in 1992 by 150 government leaders dedicated to promoting the concept that biodiversity is about more than just plants and animals—it's about people and our need for food, medicine, fresh air and water, shelter, and a clean and healthy environment in which to live. The vision of the CBD is that by 2050, biodiversity will be valued, conserved, restored, and used wisely, and ecosystems will be maintained to support a healthy planet and deliver benefits essential for all people. To refocus this vision, the convention revised and updated its Strategic Plan for Biodiversity in 2010 to include 20 "Aichi Biodiversity Targets" to be achieved by 2020. These target goals include cutting the rate of natural habitat loss in half and preventing the extinction of/improving the status of threatened species.

### United Nations' Sustainable Development Goals

In 2015, the member states of the United Nations established the 2030 Agenda for Sustainable Development. This agenda is a set of plans designed to significantly improve the level of peace and prosperity for people and the planet, now and into the future. The agenda contains 17 sustainable development goals that call for action by all countries to improve practices such as how we use forest and ocean resources and how we tackle food and water scarcity.

With the deadlines set by these global initiatives approaching, world leaders are making key decisions on our environment, climate, and sustainable development. WWF is working to influence these decisions and send a message that we can no longer afford to destroy nature. In order to protect the wildlife and wild places we love, we must rebuild the web of biodiversity that supports them. WWF is collaborating with universities, conservation organizations, and governments to help achieve these ambitious goals by:

- **Engaging individuals and communities** to understand what's at risk and do their part by rethinking how they use natural resources and making more conscious choices.
- **Pushing governments** to set aside protected lands and end illegal use of resources from forests and oceans.
- **Working with companies** to ensure the products we use every day are produced responsibly.
- **Leading global efforts** to end wildlife crime and illegal wildlife trade.





## ● What Kids Can Do

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To stop the decline of the natural systems that support us and all other species on the planet, we need real change around the world. This means every person of every age must take action!

**Speak out!** Talk with your friends, family, and teachers about the importance of protecting nature. Draw their attention to biodiversity and share what you've learned about why it's so important.

**Start a movement** in your school or community to help the planet by planting trees or saving energy.

**Save energy.** Turn off unnecessary lights and appliances. Bike or walk when you can, rather than using a car. Talk to your family and school about switching to renewable energy and energy-efficient appliances.

**Think about the food you eat.** The ways in which we grow and produce our food have a massive impact on the planet. Reduce the amount of food and water you waste. Also, remember to eat a balanced diet and follow the recommended nutritional guidelines.

**Shop smart.** When buying wood or paper products, look for a logo indicating the product is certified by the Forest Stewardship Council (FSC) as being made sustainably from responsibly managed forests. When buying seafood, look for a similar label from the Marine Stewardship Council (MSC) to be sure it was fished for sustainably and produced responsibly. Do your research on products that contain palm oil and check the label the next time you purchase them. And be alert, especially when traveling; don't buy souvenirs made from animal parts.

**Write a letter to a local politician or business** and tell them about an environmental issue that you are concerned about. And don't be afraid to ask questions!

**Grow plants** that attract bees, butterflies, and other pollinators. You can also create backyard wildlife habitats, such as rotten logs for beetles or bug hotels.

**Use less plastic**—especially single-use items such as straws—and remember to reuse and recycle whenever possible.

**Buy things that last for a long time** and can be repaired or recycled. Things such as bicycles and clothes can be restored or mended.

**Enjoy** and discover the wonders of **nature** around you, but always be respectful of your surroundings and remember to clean up after yourself. Leave nature as pristine as you found it!



## ● More Biodiversity Teaching Tools

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### Biodiversity learning activities

Within the Biodiversity Toolkit, you'll find six fun, engaging activities designed to help students learn about the importance of biodiversity and nature:

#### **Biodiversity Mosaic—Arts Education**

Students will create an artwork piece that reflects their interpretation of biodiversity. After learning about all that biodiversity encompasses, as a group, they will then piece their artwork together to create a large collaborative representation of healthy biodiversity on Earth.

#### **This Just In: News Report—Language Arts**

Students will deliver a news report to inform their peers of the current state of our planet's biodiversity, using facts and statistics from the 2018 *Living Planet Report*.

#### **Biomimicry Design Challenge—STEM**

Upon learning how scientists are using adaptations found in nature to devise products that use Earth's resources more sustainably, students will then use their creativity to develop an idea for a product that is healthier for the planet by mimicking the behavior of an animal or plant.

#### **The Future of Species—Math**

Using data on threatened or endangered species, students will create a graph and draw inferences on the probability of these species' survival on this planet if we don't make serious changes.

#### **Biodiversity Audit—Social Studies**

Students will perform a biodiversity audit of their local grounds, following similar steps as scientists in the field. Based on their findings, they will evaluate the property based on how well it can support species and devise a plan for how they can increase its biodiversity score.

#### **The Connections Between Us—Science**

To understand the interdependence of living things, students will participate in a role-playing activity that demonstrates the vast impacts of threats to our planet's biodiversity and the ways in which biomes and species are connected.

### Living Planet Report for Youth 2018

Since 1998, the [Living Planet Report](#), a science-based assessment of the health of our planet, has been tracking the state of global biodiversity. This special youth edition provides a summary of the 2018 findings.



Learning Activity:

### Biodiversity Audit

Activity Type	Mapping and surveying
Focus Areas	Social studies, science
Time Required	60–90 minutes; could be split between days

## Overview

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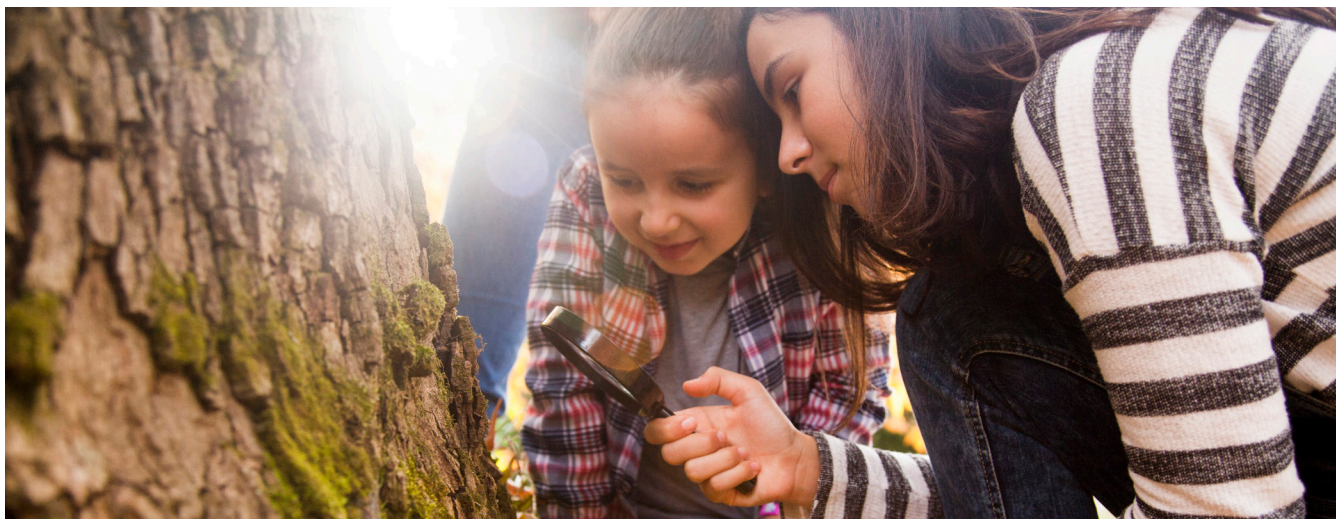
WWF and other leading organizations assess biodiversity around the world in order to evaluate the status of our planet and determine necessary actions so both people and nature can thrive. Scientists look at a number of different factors when determining an area’s biodiversity health. In this activity, students will follow similar guidelines and survey the biodiversity of their school or community grounds. Based on results, they will strategize ways to increase and protect biodiversity by making the area more habitable for species.

## Objective

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**At the completion of the activity, students should be able to:**

- Explain biodiversity and the criteria scientists use when assessing it.
- Design a map of their school or community grounds that defines the natural areas being assessed.
- Develop and implement ideas for how to increase biodiversity in their area.





## ● Subject and Standards

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### C3 Framework for Social Studies State Standards

- D2. Geo.1.6-8: Construct maps to represent and explain the spatial patterns of cultural and environmental characteristics.
- D2. Geo.3.6-8: Use paper-based and electronic mapping and graphing techniques to represent and analyze spatial patterns of different environmental and cultural characteristics.

### Next Generation Science Standards

- MS-LS2-5 Ecosystems: Interactions, Energy, and Dynamics
  - Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- MS-ESS3-3 Earth and Human Activity
  - Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

## ● Materials Needed

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- Internet access
- Smartphones or tablets (optional)
- Graph paper
- Writing and coloring utensils
- Copies of the [Biodiversity Educator’s Resource Guide](#) and/or the [Living Planet Report](#)
- Copies of the “Biodiversity Audit: Student Data Sheet,” included in this activity



## ● Vocabulary

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- **Biodiversity:** all the different kinds of life you will find in one area, including animals, plants, fungi, bacteria, and genetic material
- **Ecosystem:** the living (plants, animals, other organisms) and nonliving (air, water, soil) components of an area that interact with each other in an interconnected way
- **Habitat:** a natural environment in which plants and animals live, breed, and get their food, water, and shelter

## ● Activity Procedure

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### Part 1: Introduction and Preparation

- Provide students with background information on biodiversity and why it's important. This information can be found in the [Biodiversity Educator's Resource Guide](#). Students should understand that a region's biodiversity consists of all life found within that area and in its habitats and ecosystems, including plants, animals, fungi, and bacteria.
- Introduce students to the [Living Planet Report](#). Released every two years, this extensive report is a comprehensive evaluation of our entire planet's biodiversity, the stressors affecting it, and what is at risk if we don't make changes. The information in the [Biodiversity Educator's Resource Guide](#) reflects the most recent findings from the [Living Planet Report](#) of 2018. Take some time to review the current threats to biodiversity as outlined in the guide. Threats caused by human activity have caused the decline of biodiversity to reach a level never seen before, so it is critical that we take action immediately to prevent the extinction of more species.
- It's important to periodically evaluate an area's biodiversity because our health ultimately depends on it. We rely on nature for food, water, air, materials, and regulation of the climate and other processes of our planet. If an area has rich biodiversity, it indicates that the environment is in good condition. The more species and ecosystems existing in an area, the more contributors are working together, making the system stronger and helping nature thrive. If biodiversity is low, the stability of the system weakens and all that depend on it will be affected. Review with students the various criteria scientists examine when performing assessments to effectively evaluate a region's biodiversity:
  - Composition (the number of different types of species/habitats found in the area)
  - Abundance (how many individuals of each species there are)
  - Distribution (how spread out the individuals/habitats are)
  - Extinction risk (how many species within the area are threatened or endangered)



## Part 2: Activity

- In this activity, students will practice assessing biodiversity by performing an audit of the area around their school or home. To assist with this, if technology allows, have students download the [SEEK app](#) from iNaturalist on phones or tablets. This app uses image recognition to identify the plants and animals in uploaded photos.
- Begin by having students create on graph paper a map of the area they plan to assess. Student maps should include an extended perimeter around their school or home, identifying at least two to three spots that they will focus on in order to increase the validity of their results. Distribute copies of the “Biodiversity Audit: Student Data Sheet,” included in this activity.
- Students should use the [SEEK app](#) (if available) to identify as many species as they can from each location. If they do not have access to the app, students should attempt to identify any unfamiliar species by doing internet research on species in their area. Using their data sheet, students should record the various biodiversity criteria in each of the locations they have selected.

## Part 3: Discussion and Assessment

- Have students reflect on their results and complete the two questions found at the bottom of their audit sheet. Based on their findings, how would they evaluate the biodiversity in this area? What characteristics does the area have that support species living there?
- Reiterate the importance of biodiversity, and recap with students the current pressures affecting it. Ask students whether they feel any of these threats are affecting the biodiversity in their local area or state. Encourage students to brainstorm ways to increase and protect the biodiversity in their area by attracting more wildlife. This could include planting trees, planting a pollinator garden, or building birdhouses and bug hotels.
- Conclude the activity by sharing what WWF is doing and what we can all do to increase and restore the declining biodiversity around the world. In collaboration with other organizations, WWF is working to educate governments, companies, and communities about what’s at risk and motivate them to make better choices that don’t negatively impact the environment. Students can be a part of this global effort by taking action to avoid wasting food and water, save energy, and speak out about the importance of biodiversity to friends and family. Additional suggestions of ways kids can help can be found in the [Biodiversity Educator’s Resource Guide](#).



## Extended Learning Options

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- If using the [SEEK app](#), encourage students to continue being aware of the species around them and to upload their observations using the app. The information gathered through this app will help create a useful database of current biodiversity statistics from people around the world. Students can take pride in being involved in a larger effort that will help monitor our planet's health.
- Connect this activity with others from the [Biodiversity Toolkit](#), such as the “The Future of Species” math activity and the “This Just In: News Report” language arts activity.
- Use a tablet or smartphone (if available) to download the [WWF Together app](#). Encourage students to explore the Planet Earth segment to learn more about how to protect life on our planet.
- Start a class fundraiser to protect biodiversity using WWF's online fundraising tool, Panda Nation. Learn more at [pandanation.org](#).

## Additional Background Info

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You can use the information found at the links below to enhance your discussion with the class. You may want to share some links directly with students if you determine they are grade-level appropriate.

- **Report:** [Living Planet Report for Youth 2018](#)—a condensed, young reader-friendly summary of the *Living Planet Report 2018*
- **Video:** [Our Planet](#)—Netflix documentary made in collaboration with WWF that brings you up close and personal with some of nature's most threatened species and habitats
- **Web story:** [What is biodiversity?](#)—explains why biodiversity is important and what is at risk if we don't change our behaviors

For more fun classroom activities with a focus on wild species and conservation, visit [wildclassroom.org](#).





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## Biodiversity Audit: Student Data Sheet

Location (name or describe the area)	Composition (list the species found)	Abundance (number of individuals of each species you observed)	Distribution (how spread out the species are)
1: _____			
2: _____			
3: _____			

If you were to give this area a biodiversity grade, what would it be? Why?

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What could be done to increase the area's biodiversity?

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Learning Activity:

### The Future of Species

<b>Activity Type</b>	Statistics and probability
<b>Focus Areas</b>	Mathematics, science
<b>Time Required</b>	30–60 minutes

## Overview

The recent biodiversity assessments conducted by WWF and other contributing organizations revealed a 60% decline in populations of fish, birds, mammals, amphibians, and reptile species in the past 40 years. More than 1 million species are now threatened with extinction, and that number will only increase if we don't change course now. In this activity, students will plot species population data and use observed trends to determine the probability of those species' survival.

## Objective

### At the completion of the activity, students should be able to:

- Graph population data of endangered species over time.
- Analyze and interpret population trends to predict extinction probability.
- Explain why monitoring these population trends is important in shaping our actions for the future.



*An elephant in Tarangire National Park, Tanzania.*



## ● Subject and Standards

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### Common Core Standards: Math

- 6.SP.B.4: Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
- 6.SP.B.5: Summarize numerical data sets in relation to their context.
- 7.SP.A.1: Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.
- 7.SP.A.2: Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions.
- 8.SP.A.1: Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities.
- 8.SP.A.2: Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.
- 8.SP.A.3: Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.

### Next Generation Science Standards

- MS-LS2-1 Ecosystems: Interactions, Energy, and Dynamics
  - Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- MS-ESS3-4 Earth and Human Activity
  - Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.



## ● Materials Needed

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- [Biodiversity Educator's Resource Guide](#)
- Data table of species population numbers (included in this activity)
- Graph paper
- Pencil
- Internet access (optional)
- [International Union for Conservation of Nature's \(IUCN\) Red List](#)

## ● Vocabulary

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- **Biodiversity:** all the different kinds of life you will find in one area, including animals, plants, fungi, bacteria, and genetic material
- **Ecosystem:** the living (plants, animals, other organisms) and nonliving (air, water, soil) components of an area that interact with each other in an interconnected way
- **Line of best fit:** a straight "trend" line that attempts to best represent the data on a scatter plot

## ● Activity Procedure

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### Part 1: Introduction and Preparation

- Using information from the [Biodiversity Educator's Resource Guide](#), familiarize students with the meaning of biodiversity and why it is important.
  - A key point that students should understand is that the decline of species and habitats is a direct result of the decline of nature, on which we all depend. The more species and ecosystems that exist in an area, the more contributors there are working together, making the system stronger and helping nature thrive. If biodiversity is low, the stability of the system weakens, and all that depend on it will be affected.
- Discuss with your students how scientists study biodiversity. For example, every two years, scientists from WWF and other conservation organizations compile data from meticulous assessments of the world's species and habitats to evaluate the state of our planet in the [Living Planet Report](#). When studying



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an area's biodiversity, scientists evaluate its current status, as well as how it has changed or improved in that area, using different criteria, such as:

- The number of different types of species found in that area (composition)
  - The actual count of individuals of each species (abundance)
  - How spread out the individuals are (distribution)
  - How many of these species have been identified as being threatened or endangered (extinction risk)
- Take a few moments to review species extinction classifications with students using the [International Union for Conservation of Nature's \(IUCN\) Red List](#). This comprehensive database provides information on species, such as their geographic range, habitat, threats, population counts, and current extinction status. It can be difficult to keep an accurate count of many species, given their fragmented populations and/or elusive nature. But it's important for scientists to monitor numbers and draw inferences in trends to shape conservation actions necessary for species to thrive.

## Part 2: Activity

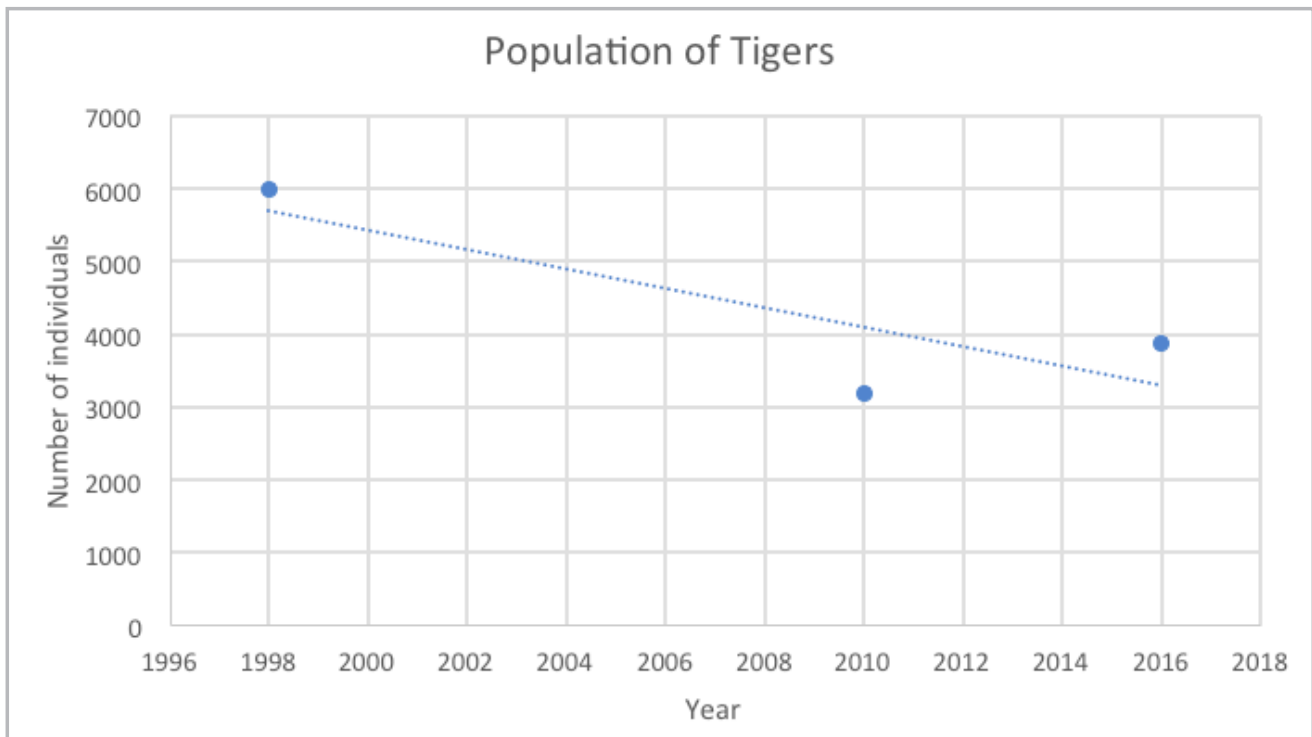
In this activity, students will plot species population data on a graph and use the observed trends to predict the likelihood of the species' survival in the future.

- Have students select a species for which to research population data. They should select a species that is currently classified by the IUCN as vulnerable, endangered, or critically endangered. If time allows, have students select a species to research online and find population counts from at least three or four different years. You can also have students choose a species from the data table included in this activity. This table consists of several species that have been identified as being at risk, as well as their surveyed population numbers from different years.

Species	Extinction status	Population count			
Vaquita	Critically endangered	567 in 1997	245 in 2008	59 in 2015	18 in 2017
Black rhino	Critically endangered	100,000 in 1960	2,410 in 1995	4,880 in 2010	5,042 in 2016
Tiger	Endangered	6,000 in 1998	3,200 in 2010	3,890 in 2016	
Galápagos penguin	Endangered	2,020 in 1970	1,009 in 2007	1,200 in 2018	
Baiji river dolphin	Critically endangered	400 in 1981	300 in 1985	100 in 1990	13 in 1999
Snow leopard	Vulnerable	4,080 in 2003	3,920 in 2013	2,710 in 2016	
Black-footed ferret	Endangered	500 in 2008	274 in 2012	206 in 2015	



- Once students have selected a species and gathered the required information, they should use graph paper to diagram the population counts over time. Once the points are plotted, students should establish a line of best fit (if possible) to predict the population trend. See example:



- Based on their graph, have students draw inferences from the data and make predictions for the future of their selected species. Do they feel this species is on the rise? Or are the population numbers going to continue to decline? What do they think is the likelihood of the species going extinct? If this species were to decline, what effects would that have on the rest of the species' ecosystem?

### Part 3: Discussion and Assessment

- As a class, recap the purpose of this activity and how it relates to the work conservation scientists conduct in the field. In order to ensure a future for biodiversity and nature, it's important to be aware of trends in species populations. Ask students why they think it's important for scientists to perform these biodiversity assessments. What can we learn by evaluating the numbers and distribution of different species?
- Use the information from the [Biodiversity Educator's Resource Guide](#) to share with students what WWF and other organizations are doing to restore biodiversity and bring species back from the brink of extinction. Then, using the "What kids can do" section of the guide, provide students with ways they



can take action in their own community—such as conserving resources and planting trees—to help species around the world. Explain that it will take all of us working together to make real change and reverse our planet’s biodiversity loss.

## ● Extended Learning Options

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- If enough data points are collected and a line of best fit is determined, have students calculate the slope and intercept of their graph.
- Have students select two species and plot their data together on one graph. Are there patterns in the population trends of the two species? Students should use what they've learned about the threats currently facing species and biodiversity to draw inferences about how these species are associated.
- Add another research component to the activity by having students identify the specific threats affecting the species they chose to include in their graph. If the population trend of the species appears to be increasing, what can the increase be attributed to? If it is decreasing, what is being done/needs to be done to stop this trend?
- Use a tablet or smartphone (if available) to download the [WWF Together app](#). Encourage students to explore the Planet Earth segment to learn more about how to protect life on our planet.
- Start a class fundraiser to protect biodiversity using WWF's online fundraising tool, Panda Nation. Learn more at [pandanation.org](#).



*Deforestation to make room for cornfields in Brazil.*



## ● Additional Background Info

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You can use the information found at the links below to enhance your discussion with the class. You may want to share some links directly with students if you determine they are grade-level appropriate.

- **Report:** [Living Planet Report 2018](#)—published every two years, the *Living Planet Report* assesses the state of our planet’s biodiversity and ecosystem health
- **Report:** [Living Planet Report for Youth 2018](#)—a condensed, young reader-friendly summary of the *Living Planet Report 2018*
- **Video:** [Our Planet](#)—Netflix documentary made in collaboration with WWF that brings you up close and personal with some of nature’s most threatened species and habitats
- **Web feature:** [IUCN Red List of Threatened Species](#)—the International Union for Conservation of Nature’s up-to-date data on species and the threats impacting them and their habitats
- **Web story:** [What is biodiversity?](#)—explains why biodiversity is important and what is at risk if we don’t change our behaviors

For more fun classroom activities with a focus on wild species and conservation, visit [wildclassroom.org](http://wildclassroom.org)



Photos: page 1, James Morgan/WWF-US; page 6, © Days Edge Productions/WWF-US; page 7 © WWF-US/Elisabeth Kruger



Learning Activity:

### Biodiversity Mosaic

<b>Activity Type</b>	Visual arts
<b>Focus Areas</b>	Art education
<b>Time Required</b>	30–45 minutes

## ● Overview

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In a mosaic, individual pieces are combined in order to reveal the bigger picture. Similarly, in order for nature to be able to support and provide for our ever-growing world, we need all the components that comprise its foundation—biodiversity—to be strong and healthy. To represent a similar collective effort, students will design individual squares that reflect what biodiversity means to them and then assemble all the squares in a mosaic to raise awareness about the bigger picture: the importance of protecting biodiversity.

## ● Objective

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**At the completion of the activity, students should be able to:**

- Define biodiversity.
- Create a piece of art representing their individual interpretation of biodiversity.
- Reflect on the completed project’s symbolism of efforts around the world to restore biodiversity.



*Water lilies on marshes along the Danube River near Wilkowo, Ukraine.*





## ● Subject and Standards

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### National Core Arts Standards

- Creating
  - Anchor Standard #1: Generate and conceptualize artistic ideas and work.
  - Anchor Standard #3: Refine and complete artistic work.
- Responding
  - Anchor Standard #8: Interpret intent and meaning in artistic work.
- Connecting
  - Anchor Standard #10: Synthesize and relate knowledge and personal experiences to make art.
  - Anchor Standard #11: Relate artistic ideas and works with societal, cultural, and historical context to deepen understanding.

## ● Materials Needed

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- Cardstock (or medium of choice)
- Coloring utensils
- Clear tape
- [Biodiversity Educator's Resource Guide](#)

## ● Vocabulary

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- **Biodiversity:** all the different kinds of life you will find in one area, including animals, plants, fungi, bacteria, and genetic material
- **Ecosystem:** the living (plants, animals, other organisms) and nonliving (air, water, soil) components of an area that interact with each other in an interconnected way
- **Mosaic:** a decoration on a surface made by setting small pieces of variously colored material to form pictures or patterns



## ● Activity Procedure

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### Part 1: Introduction and Preparation

- Ask students to define biodiversity and why it is important to humans and nature. Ask volunteers to list key terms on the board, but do not reveal the correct answer. Working together, students should reach a consensus on one definition. This will be used as a reference during their activity.

### Part 2: Activity

Students will work together to create a large art display that represents healthy biodiversity on Earth.

- Distribute cardstock and coloring utensils. Each student should have their own piece of cardstock, which will be their contribution to the larger mosaic the class is creating together.
- Provide limited instruction for what to include in the design; the only direction the students should be given is to decorate their piece with what Earth's biodiversity means to them. This should be based on the pre-discussion for the activity.
- When the students are finished, find an open area to assemble all their pieces to create one large class project. Tape the mosaic together and display it in the room or hallway.



*Galápagos sea lion swimming near mangroves, Floreana Island, Galápagos, Ecuador.*



### Part 3: Discussion and Assessment

- Reflect on what students included in their biodiversity representation. Did most students draw animals?
  - Biodiversity does not include just animals; it refers to all the different kinds of life found in an area, from genes to ecosystems and everything in between. All of these components work together to maintain balance and support life.
  - An area is considered to have healthy biodiversity when there is a wide variety of these components (plants, animals, bacteria, habitats, etc.). Does the group mosaic adequately depict this?
- Ask students why biodiversity is important. Have a discussion with your students on why biodiversity is often referred to as the “web of life.”
  - Every plant/animal/bacteria/genome/habitat is a thread in the “web of life.” The more threads there are, the stronger the web. However, as threads are removed, the web becomes weaker and eventually falls apart. Biodiversity is the framework for nature, which provides all the things we need to survive. Without biodiversity, there is no nature. And without nature, there is no humanity. In nature, everything is connected. The ripple effect of any change touches every part of our planet. Have students select one component found in the artwork and reflect on how its disappearance would affect other components.
- Biodiversity across our planet has declined dramatically. Human activity has caused populations of fish, birds, mammals, amphibians, and reptiles to decline by 60% over the past 50 years. In order to reverse this trend and bring about real change, we have to work together. This includes action at every level— governments, companies, communities, and individuals. Using the “What kids can do” section of the [Biodiversity Educator’s Resource Guide](#), discuss with students how they can do their part to help restore nature and biodiversity.

### ● Extended Learning

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- Perform this activity using different mediums (if materials allow) to display different art forms.
- Assign students to research human impacts on biodiversity.
- Use a tablet or smartphone (if available) to download the [WWF Together App](#). Encourage students to explore the Planet Earth segment to learn more about how to protect life on our planet.
- Start a class fundraiser to protect biodiversity using WWF’s online fundraising tool, Panda Nation. Learn more at [pandanation.org](#).



## ● Additional Background Info

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You can use the information found at the links below to enhance your discussion with the class. You may want to share some links directly with students if you determine they are grade-level appropriate.

- **Web story:** [What is biodiversity?](#)—explains why biodiversity is important and what is at risk if we don't change our behaviors
- **Report:** [Living Planet Report 2018](#)—published every two years, the *Living Planet Report* assesses the state of our planet's biodiversity and ecosystem health
- **Report:** [Living Planet Report for Youth 2018](#)—a condensed, young reader-friendly summary of the *Living Planet Report 2018*

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*Tiger, Ussuriysk, Russia.*



Learning Activity:

### This Just In: News Report

Activity Type	Research and journalism
Focus Area	Language arts
Time Required	45–60 minutes

## Overview

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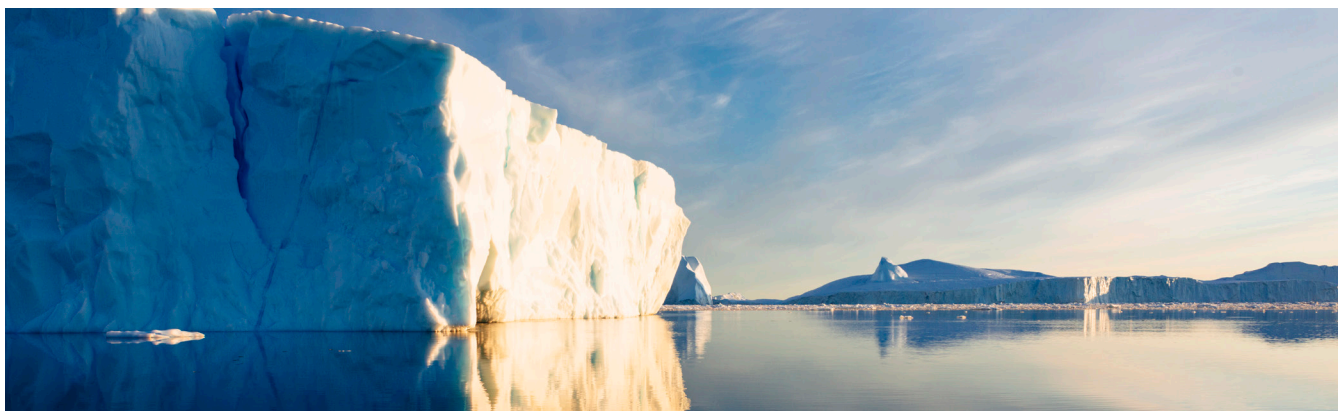
Using statistics from the [Biodiversity Educator’s Resource Guide](#), students will deliver a mock newscast, informing audiences of the current state of our planet and the urgent need for individual as well as collective action. Students will conduct research on the decline of biodiversity, and on how attention-getting communication techniques can help shape their delivery of the information. Like any good news report, the presentation should reflect on why this news is important and how the viewers can get involved. Students will become advocates for restoring nature and biodiversity by using effective communication skills to spread a message among their peers.

## Objective

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### At the completion of the activity, students should be able to:

- Speak knowledgeably about the current status of biodiversity on Earth.
- Use creativity to record a news report containing critical information and statistics about threatened species and habitats.
- Effectively inform and inspire their peers to advance the message of why biodiversity is important and what we can do to help protect it.



Iceberg, Ilulissat, Greenland.



## ● Subject and Standards

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### Common Core Standards: English Language Arts and Literacy in Science

- L. 6.1/7.1/8.1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
- L. 6.3/7.3/8.3: Use knowledge of language and its conventions when writing, speaking, reading, or listening.
- RST. 6-8.1: Cite specific textual evidence to support analysis of science and technical texts.
- RST. 6-8.8: Distinguish among facts, reasoned judgement based on research findings, and speculation in a text.
- SL. 6.1/7.1/8.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6/7/8 topics and texts, building on others' ideas and expressing their own clearly.
- SL. 8.2: Analyze the purpose of information presented in diverse media and formats (e.g., visually, quantitatively, orally) and evaluate the motives (e.g., social, commercial, political) behind its presentation.
- SL. 8.4: Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.
- SL. 8.5: Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.
- SL. 6.6/7.6/8.6: Adapt speech to a variety of contexts and tasks, using formal English when indicated or appropriate.



## ● Materials Needed

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- [Biodiversity Educator's Resource Guide](#)
- Internet access for additional research (if available)
- Video recording devices (mobile phone or tablet)
- Mock news production set of your own design (table, chairs, backdrop)

## ● Vocabulary

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- **Biodiversity:** all the different kinds of life you will find in one area, including animals, plants, fungi, bacteria, and genetic material
- **Ecosystem:** the living (plants, animals, other organisms) and nonliving (air, water, soil) components of an area that interact with each other in an interconnected way
- **Habitat:** a natural environment in which plants and animals live, breed, and get their food, water, and shelter
- **Sustainable:** of, relating to, or being a method of harvesting or using a natural resource so that the resource is not depleted or permanently damaged; an effective and innovative way to efficiently use natural resources and ensure their continued supply



*Sumatran tiger.*



## ● Activity Procedure

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### Part 1: Introduction and Preparation

- WWF and other leading organizations are continuously studying and assessing the current state of our planet and the threats it faces. Every two years, WWF releases the *Living Planet Report*, which compiles our research findings to evaluate the overall health of our ecosystems and biodiversity. Distribute a handout for students using content from the [Biodiversity Educator's Resource Guide](#). This guide summarizes some of the key findings from the most recent biodiversity study as reported in the *Living Planet Report* of 2018. The student handout should include statistics and highlights from the “Biodiversity basics,” “Why biodiversity and nature matter,” “Threats to nature and biodiversity,” and “What kids can do” sections of the resource guide.
- Allow students time to read through the information, either individually or as a group, and then summarize and reflect on the content.
  - The 2018 *Living Planet Report* shows that we have seen a 60% decline in the size of populations of mammals, birds, fish, reptiles, and amphibians in just over 40 years, and that according to the United Nations’ Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) report, around 1 million animal and plant species are now threatened with extinction— all because of human activity.
- Have students explain why this is a warning sign for all of us. Biodiversity is the framework for nature; the greater the diversity of organisms, the stronger the ecosystem and the more nature can provide for us (air, water, food, materials, etc.). As populations decrease and species go extinct (primarily from habitat loss and overhunting), the stability of nature surrounding them weakens. If we don’t start making real changes in the way we use our natural resources, the future of our planet and our existence on it are at risk.

### Part 2: Activity

- Inform students that they will be using information from their handout, along with their own research, to compose an urgent news report. They will work in groups, with each member responsible for a task. Each will contribute to researching the information and statistics, as well as the creativity behind the delivery approach. Tasks related to the actual production of the report (reporting, filming, set design) should be delegated accordingly.





- Provide students with guidelines on what they should include in their newscast:
  - Statistics relating to the current state of biodiversity, including species and habitats
  - Causes of the decline in biodiversity
  - Why it matters/why biodiversity and nature are important
  - What we can all do to help
- Remind students to do the following when planning for the presentation of their newscast:
  - Consider their audience—how can they relate this information so that the audience listens and cares?
  - Use inflection and tones of voice that reflect the urgency and gravity of this information.
  - Be creative—consider news reports, commercials, or any program that they have found interesting. Why did it get their attention?
- Have student groups present their news reports, using recording devices if available.

### Part 3: Discussion and Assessment

- Once all the groups have presented their news reports, have students critique themselves by evaluating which group's communication skills they felt were most effective at getting the viewers engaged with the topic.
- Have students reflect on what they learned by defining biodiversity, explaining why it's important, and what these recent research studies have shown us.
- Conclude the activity by encouraging students to select at least one action that they can commit to that will help bring species back from the brink of extinction and restore biodiversity. Some examples include:
  - Recycling more and/or using less plastic, especially single-use plastic such as straws
  - Turning off electronics when they're not in use
  - Cutting down on food and water waste
  - Spreading the word by raising awareness about biodiversity among friends and family and making suggestions about ways they can help



## Extended Learning

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- When planning for this activity, talk with your school administration about the possibility of a select group of students broadcasting their news report as a part of the student announcements or school assembly. If permitted, this opportunity can be granted to the student team whose news report is most effective at delivering the intended message.
- For more advanced research, provide students with copies of the [Living Planet Report 2018](#) from which to gather their information.
- Students could explore other means of mass communication to spread the message about biodiversity. If your school or community has a newsletter or newspaper, challenge students to write their own summary of the report's findings in an article format.
- Use a tablet or smartphone (if available) to download the [WWF Together app](#). Encourage students to explore the Planet Earth segment to learn more about how to protect life on our planet.
- Start a class fundraiser to protect biodiversity using WWF's online fundraising tool, Panda Nation. Learn more at [pandanation.org](#).

## Additional Background Info

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You can use the information found at the links below to enhance your discussion with the class. You may want to share some links directly with students if you determine they are grade-level appropriate.

- **Report:** [Living Planet Report 2018](#)—published every two years, the *Living Planet Report* assesses the state of our planet's biodiversity and ecosystem health
- **Report:** [Living Planet Report for Youth 2018](#)—a condensed, young reader-friendly summary of the *Living Planet Report 2018*
- **Video:** [Our Planet](#)—Netflix documentary made in collaboration with WWF that brings you up close and personal with some of nature's most threatened species and habitats
- **Web feature:** [IUCN Red List of Threatened Species](#)—the International Union for Conservation of Nature's up-to-date data on species and the threats impacting them and their habitats
- **Web story:** [Green tips](#)—additional ways to help the environment
- **Web story:** [What is biodiversity?](#)—explains why biodiversity is important and what is at risk if we don't change our behaviors

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Learning Activity:

### The Connections Between Us

Activity Type	Role-play and peer interaction
Focus Area	Science
Time Required	45–60 minutes

## Overview

When our planet thrives, it’s because species and habitats interact to contribute to healthy, functioning ecosystems within the biomes where they exist. Students will learn about the interdependence between species and their habitats, and about the current threats facing our planet’s biodiversity, by participating in a role-playing activity that demonstrates how we’re all connected.

## Objective

### At the completion of the activity, students should be able to:

- Define and explain terms like biome, interdependence, and biodiversity.
- Explain different threats that are currently impacting our planet’s biodiversity.
- Interpret the connections between biomes and species, and the ripple effects that occur when a biome or species population is damaged.



*Eastern black rhinoceros females, Ol Pejeta Conservancy, Kenya, Africa.*



## ● Subject and Standards

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### Next Generation Science Standards

- MS-LS2-4 Ecosystems: Interactions, Energy, and Dynamics
  - Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- MS-LS2-5 Ecosystems: Interactions, Energy, and Dynamics
  - Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- MS-ESS3-3 Earth and Human Activity
  - Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- MS-ESS3-4 Earth and Human Activity
  - Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

## ● Materials Needed

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- Species assignments (included in this activity)
- Scissors
- Copies of “Biodiversity Meet and Greet: Student Handout”
- Markers
- Pencils
- Blank, sticky name labels
- [Biodiversity Educator's Resource Guide](#)
- Internet access (optional)



## ● Vocabulary

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- **Biodiversity:** all the different kinds of life you will find in one area, including animals, plants, fungi, bacteria, and genetic material
- **Biome:** a major type of community of distinctive plants and animals living together in a particular climate and physical environment (such as tropical rain forest, grassland, or desert)
- **Ecosystem:** the living (plants, animals, other organisms) and nonliving (air, water, soil) components of an area that interact with each other in an interconnected way
- **Habitat:** a natural environment in which plants and animals live, breed, and get their food, water, and shelter
- **Interdependence:** the reliance all living things have on each other in order to survive
- **Sustainable:** of, relating to, or being a method of harvesting or using a natural resource so that the resource is not depleted or permanently damaged; an effective and innovative way to efficiently use natural resources and ensure their continued supply

## ● Activity Procedure

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### Part 1: Introduction and Preparation

- Review the definitions of biome and biodiversity with students. As opposed to an ecosystem, a biome refers to a larger environment composed of plants and animals characteristic of that environment, such as oceans or deserts. You can find different ecosystems within a biome; for example, kelp forests, coral reefs, and mangroves are all part of the ocean biome. These ecosystems, combined with the plants and animals found within them, contribute to a biome's biodiversity. Discuss different biomes found on Earth, and have students provide examples of biodiversity found in each. If time allows, you can direct students to use the [WWF webpage](#) to research this information. Listing the biomes on a display board will help, because students will need to reference them during the activity.
  - Oceans
  - Forests
  - Deserts
  - Fresh water
  - Icy tundra (Arctic and Antarctic)
  - Grasslands



- All living components of these biomes need each other to create a healthy environment in which to exist. Review the concept of interdependence with students, and have the discussion lead into the importance of biodiversity. For example, in coral reefs, the coral is the foundation that the entire community depends on, but all members of the community have a role to play in the health of the coral. Small fish help keep parasites off the coral, and sharks prey on animals that typically feed on these small fish, helping keep the food web balanced. The number of native species found living around a coral reef is an indicator of how healthy the reef is—with more species, there is more teamwork helping the environment thrive. Students should understand this connection between interdependence and biodiversity. Living things need each other to survive. Therefore, the more living things characteristic of that biome that are present (in other words, the more biodiversity there is), the healthier the environment and the better chances these plants and animals have of survival.
- Now that students understand biodiversity, introduce them to some of the pressures and threats currently facing the biodiversity of biomes all over the planet. You can find this information in the [Biodiversity Educator's Resource Guide](#):
  - Agriculture
  - Overfishing
  - Pollution
  - Dams
  - Plastic
  - Poaching (wildlife crime)
  - Bycatch
  - Illegal or unsustainable logging
  - Climate change
  - Soil health decline
  - Not enough fresh water



## Part 2: Activity

Students will participate in a role-playing activity that will help them understand the connection between species and the threats they are facing around the globe.

- Prior to beginning the activity, print the “Species Role-Play Assignments” sheet included in this activity and cut out each role description. Each student will be assigned one role, so you may need to print multiple copies of the sheet, depending on the number of students participating (it is possible you will have more than one student assigned the same character).
- Distribute one species assignment to each student, along with a blank, sticky name label. Students are to take several moments to read and memorize information about their character. Once the activity begins, they will introduce themselves to classmates as that species and describe the challenges they are facing, as outlined on their assignment sheet. Explain to them that all the species they will be role-playing are currently vulnerable, endangered, or critically endangered and are at risk of extinction.
- Have students write the name of their species on a name label and place it on themselves.
- Distribute copies of the “Biodiversity Meet and Greet” handout to each student.
- Have students move around the room and interact with one another as their characters to learn more about different species across biomes and the threats they are facing. As they meet each classmate (species), they should fill out their chart, detailing the biome where that species is found and what threats the species and the biome are facing. Students should speak about the character in the first person, channeling the perspective of the species they are representing, without reading from the description. Encourage students to embody their character and convey the message that they think that species would want people to know. Allow students sufficient time to engage with several of their peers.

## Part 3: Discussion and Assessment

- As a group, reflect on the information collected from their meet and greet session. What did they learn from their conversations with other “species”? What do different species have in common?
- Ask students: Did you notice any trends across biomes? Similar to how species existing together within a biome depend on one another to survive, biomes also benefit from one another, and what happens in one can impact the health of another. For example, deserts rely on rainstorms generated by ocean water evaporation. Herbicides that are sprayed across grasslands can enter nearby rivers and streams and spread throughout freshwater food webs, poisoning species. Have students assess each of the biomes and make connections between them.



- What makes a biome healthy? (Is it good to have a lot of biodiversity?)
  - Is one biome more at risk than others, based on what they learned in their conversations?
  - What benefits do we receive from each biome that would be impacted if the biome's health were to decline? And what would happen to the species that live there?
  - How does the decline of one biome affect other biomes?
- Discuss with your students how, in addition to species and biomes being connected to each other, the threats that impact them are also connected. Climate change is limiting the availability of fresh water and causing soil health to decline. Agriculture is creating more pollution; unsustainable logging is making large predators like tigers more vulnerable to poaching. Have students reflect on how all of these components—species, biomes, and their threats—are connected. What role do humans play in biodiversity? Are humans impacted by any of the threats discussed?
  - With biodiversity declining at a faster rate than ever before, it's imperative for people everywhere to make serious changes to help protect our planet. When one species or biome disappears, we all feel the effects. Ask students how they can do their part to restore and protect biodiversity around the globe. Suggestions can be found in the "What kids can do" section of the [Biodiversity Educator's Resource Guide](#).



*Deforested land, East Kalimantan, Borneo.*





## ● Extended Learning Options

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- Tie this activity to the Netflix documentary series [Our Planet](#). This series, produced in collaboration with WWF, demonstrates the interdependence of species across biomes and how human activities are impacting them. You can find additional resources to accompany each *Our Planet* episode on the [Wild Classroom](#) webpage.
- Assign a follow-up challenge that asks students to select a species that they met during the meet and greet activity and attempt to connect it to their assigned species. What do these species have in common—are they affected by the same threats? If they are from different biomes, how are their biomes connected?
- Use a tablet or smartphone (if available) to download the [WWF Together app](#). Encourage students to explore the Planet Earth segment to learn more about how to protect life on our planet.
- Start a class fundraiser to protect biodiversity using WWF's online fundraising tool, Panda Nation. Learn more at [pandanation.org](#).

## ● Additional Background Info

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You can use the information found at the links below to enhance your discussion with the class. You may want to share some links directly with students if you determine they are grade-level appropriate.

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- **Web story:** [Green tips](#)—additional ways to help the environment
- **Web story:** [What is biodiversity?](#)—explains why biodiversity is important and what is at risk if we don't change our behaviors

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## Species Role-Play Assignments

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**Tiger**—I’m an Amur tiger. I live in the temperate forests of eastern Asia. These forests are not only my home—they also provide species everywhere with clean air and water. My species was almost completely wiped out because people kept hunting us for our fur and body parts. Luckily, thanks to countries like Russia and China protecting us and our forest homes, our numbers have begun to increase, although we are still endangered. We need a lot of space to roam, so it’s important to keep the forests where we live intact. Unfortunately, in many areas, our forest habitats are still at risk from unsustainable logging.



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**Sea turtle**—I’m a critically endangered hawksbill sea turtle. I spend my time traveling the world’s tropical oceans in search of my favorite hangout—coral reefs. Coral reefs are home to one-fourth of all marine species, so they’re a popular place. I enjoy eating the sponges off of reefs, which helps keep the reefs healthy. Unfortunately, climate change is causing reefs to die, so I’m losing my habitat and favorite food. I’m also at risk because people sell our beautiful shells as souvenirs and trinkets to make money. I constantly have to be alert to pollution and fishing equipment—many others of my kind have lost their lives after being entangled in or choking on fishing nets, hooks, or plastic.

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**Polar bear**—I’m a polar bear living on the sea ice of the Arctic Ocean. Sea ice is important not only for me to be able to rest and hunt, but because it acts like a shield for our entire planet. Sea ice helps direct the energy from the sun back into space, keeping all of us safe. Unfortunately, climate change is causing my home to melt more and more every spring, which means I have to spend longer and longer summers on land. I may not be able to hunt again until the ice refreezes in the autumn, so those can be very hungry times. As sea ice melts, it also creates more opportunities for oil companies to set up drilling operations. If oil were to spill into my habitat, it would damage the entire ecosystem that I am an important part of.

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**African elephant**—I am an African elephant who enjoys walking long distances with my herd across the savannas and woodlands of many countries in Africa in search of food and water. The rich soils of the grasslands and the forests help absorb some of the greenhouse gases that contribute to climate change, while also supplying the vegetation that animals like me need to survive. I can eat hundreds of pounds of grasses, tree foliage, bark, twigs, and other vegetation, and drink up to 50 gallons a day—that’s a lot of food and water. Climate change is altering rain patterns and impacting how often I can find these things. I also need a lot of space, and unfortunately, many of the habitats that I roam between are being removed to make room for agriculture, and roads, railways, and fences block my traditional migration routes. I also have to be on the lookout for poachers who want to sell my tusks in illegal international ivory markets.

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**River dolphin**—I am an Amazon river dolphin, found in rivers and lakes of the Amazon and Orinoco River basins throughout South America. Not only is fresh water home to a large number of aquatic animals, but everything that lives on land depends on fresh water too—for drinking, growing crops, and making goods. The areas I live in are used heavily by humans—most often to build dams to generate electricity. These dams make it difficult for us to travel and they split up our pods. There is also a lot of pollution where I live—especially from mining, which causes toxic mercury to enter our water and food web. Amazon river dolphins like me are one of seven remaining species of river dolphins, all of which are vulnerable or endangered.

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**Black-footed ferret**—I’m a black-footed ferret living in the grasslands of North America. These grasslands are home to many species, including pollinators like monarch butterflies, grazers like bison, and burrowing mammals like my favorite food—prairie dogs. Prairie dogs make up most of my diet, and I live in their burrows, so I need them to survive. Unfortunately, prairie dog populations have declined over the years due to human activities and non-native disease. Without prairie dogs, I don’t have anything to eat. I’m also losing my habitat as humans continue to plow up the grasslands to use the land for agriculture. For these reasons, my species is endangered.

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**Orangutan**—I’m an orangutan. I spend most of my time hanging out in the trees of tropical rain forests on two islands in Asia. Tropical rain forests have the most biodiversity on the planet and provide many benefits—they help regulate climate and cool the planet, provide food and habitat, and clean our air and water. Orangutans like me are critically endangered, primarily because our tropical forest habitat is disappearing to make room for palm oil, rubber, and other agricultural plantations. Despite efforts to try and protect our forests, some people are still illegally cutting down trees. Orangutans are also hunted and either eaten or sold as pets.

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**Vaquita**—I’m a critically endangered vaquita, swimming in the marine waters of Mexico’s Gulf of California. These waters support a lot of other marine life including fish, sharks, whales, and sea turtles. It’s also an area where humans do a lot of fishing for shrimp, fish, and squid, which helps contribute to the humans’ economy and livelihood. Unfortunately, some of this fishing is harming my species because it’s done too often and using damaging methods. Members of my species often are caught by accident in gillnets (a type of fishing material) and drown. Even though my species wasn’t discovered until the late 1950s, humans have already pushed us close to extinction because of unsustainable and illegal fishing practices.

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**Black rhino**—I’m a black rhino, and I can live in a range of places, as long as I can find a healthy supply of shrubs and woody herbs, and also a nearby water source and mineral licks. These are found in a wide range of habitats in eastern and southern Africa, including semi-desert savanna, woodlands, forests, and wetlands. These areas provide for many species besides my own and help regulate the world’s climate. My species was almost completely wiped out due to years of being hunted for our horns. Even today, poaching and wildlife crime remain our biggest threat. We’re also losing our habitat—humans are using our land for agriculture, settlements, and development. Our population is slowly growing thanks to people working to protect us, but protection methods are expensive and depend on the laws in countries where we live. We are still critically endangered.

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**Plains bison**—I’m a plains bison, roaming the grasslands of North America. My grazing helps maintain the grasses and soil that so many other species depend on. My ancestors used to number in the tens of millions, but now only half a million of us remain. Humans have built on the grasslands and converted them to agriculture. With humans using my habitat for other things, it is difficult to find places to roam and graze.

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**Bluefin tuna**—I’m a bluefin tuna, swimming through the waters of the Atlantic Ocean. The open ocean plays a huge role in the health of other regions of the world—it provides oxygen to breathe and forms clouds that control our weather. My life seems pretty cool; I use my sharp vision and speed to swim through these open waters and prey on smaller fish. Unfortunately, I’m also being preyed upon pretty heavily by humans. Turns out, a lot of people like to eat bluefin tuna, so we’re constantly being taken out of the ocean—sometimes illegally and in larger numbers than we can make up for.

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**Walrus**—I’m a walrus, living in and around the icy waters of the Arctic. In the fall, I like to take a break from swimming to feed and rest on sea ice. Sea ice is important not only for me, but for everyone around the world, because it acts like a shield for our planet by directing the energy from the sun back into space, keeping us safe. With climate change causing the sea ice over my favorite foraging spots to disappear each summer, I now have to take my break on land, along with thousands of other walruses in search of the same refuge. This makes finding food and space to rest very challenging.

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**African wild dog**—I’m an African wild dog living in the deserts and grasslands of southern and eastern Africa. These areas provide for many species besides my own and help regulate the world’s climate. Humans are encroaching more and more on my home to develop land for agriculture. Humans are also hunting my species when we come into conflict. Unfortunately, we African wild dogs are one of the world’s most endangered mammals.



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**Sockeye salmon**—I'm a sockeye salmon, spending some of my life swimming in the rivers and bays of Alaska and some of it far out in the salty Pacific Ocean. My freshwater home provides a lot for animals and people (habitat, food, drinking water, and the ability to grow crops). The nutrients I bring back from the ocean when I come home to spawn feed Alaska's magnificent wildlife and forests. Warming weather conditions as a result of climate change have impacted my watery home, making it nutrient poor and affecting my food chain. My survival is also at risk because of increasing development and industrial activities—such as dams and mines. These split up our populations and threaten my ability to spawn. Mines could spill toxic chemicals into my home, making it unusable by salmon, people, and the rest of our ecosystem.

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**Amur leopard**—I am an Amur leopard, found in the temperate forests of eastern Asia. Forests are important because they provide the Earth with clean air and water. They also provide humans with materials that are used to make goods. The forests where we live are often improperly managed, and illegal logging occurs. In addition, my species is often poached for our beautiful, spotted fur. My species is very rare and is critically endangered.

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Learning Activity:

### Biomimicry Design Challenge

<b>Activity Type</b>	Engineering and technology
<b>Focus Areas</b>	STEM
<b>Time Required</b>	45-60 minutes

## ● Overview

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Humans have put immense pressure on our planet by using products and practicing behaviors detrimental to the environment. In order to protect our natural world, we need to find new ways to provide for our growing population, while not degrading our ecosystems. Nature has survived for millennia with animals, plants, and bacteria demonstrating how they are natural problem solvers and survivors. Scientists and engineers are using processes found in nature as a basis for innovative solutions to human challenges. In this activity, students will take inspiration from the adaptations of some of their favorite species to develop an idea to solve a current problem facing our environment.

## ● Objective

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**At the completion of the activity, students should be able to:**

- Define biomimicry and give examples.
- Develop a design solution based on traits found in nature.
- Explain how nature can teach us how to build a more sustainable future.



*An octopus, Indonesia, uses camouflage to protect itself against predators and hide from its prey.*



## ● Subject and Standards

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### Next Generation Science Standards

- MS-LS1-4 From Molecules to Organisms: Structures and Processes
  - Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
- MS-LS2-5 Ecosystems: Interactions, Energy, and Dynamics
  - Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- MS-ESS3-3 Earth and Human Activity
  - Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- MS-ESS3-4 Earth and Human Activity
  - Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
- MS-ETS1-1 Engineering Design
  - Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

## ● Materials Needed

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- Internet access (if available)
- Paper or poster board
- Writing and coloring utensils
- Copies of the [Biodiversity Educator's Resource Guide](#)





## ● Vocabulary

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- **Adaptation:** changes to a plant or animal that make it better equipped to survive under the conditions of its environment
- **Biodiversity:** all of the different kinds of life you will find in one area, including animals, plants, fungi, bacteria, habitats, ecosystems, and genetic material
- **Biomimicry:** the imitation of natural biological designs or processes in engineering or invention
- **Renewable resource:** resource that can be replaced by nature (examples are solar, wind, and water)
- **Sustainable:** of, relating to, or being a method of harvesting or using a natural resource so that the resource is not depleted or permanently damaged; an effective and innovative way to efficiently use natural resources and ensure their continued supply



*Mossy leaf-tailed gecko, Madagascar, uses camouflage to blend into its surroundings.*



## ● Activity Procedure

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### Part 1: Introduction and Preparation

- Familiarize students with biomimicry by defining and providing examples.
  - Definition: Encourage students to define biomimicry by breaking down the word; ‘bio’ refers to life and ‘mimicry’ means to imitate. Biomimicry is the act of imitating something found in nature.
  - Example: Scientists have invented numerous products stemming from ideas found in nature. Georges de Mestral noticed how burs stuck to his dog’s coat as a means of seed dispersal, when walking through the forest. It inspired him to create Velcro, a product widely used on clothing and accessories.
- After defining biomimicry with your students, discuss and provide examples on how it can be used to innovatively solve problems. Plants and animals have been solving problems naturally for years; they’ve learned what works and have adapted solutions that enable them to survive over generations. In turn, by observing these characteristics and behaviors of the natural world, scientists have developed solutions to improve the design of products, processes, and systems to make them more sustainable.
  - Examples: Scientists have looked closely at how leaves retain and distribute water, using that design to rethink how we distribute electricity, water, and air conditioning for more efficient energy use. Similarly, a new design of wind turbines is being modeled after humpback whale flippers. Scientists discovered that the ridges in the whales’ flippers help them steer and gain speed underwater. This led to the creation of an improved and more efficient turbine blade design, resulting in a huge step forward for renewable energy. Scientists have also modeled high-speed trains after kingfisher birds that quickly and quietly dive in and out of water, less painful needles after the stealthy ability of mosquitoes to bite without you knowing, and long-distance communication through water after dolphins using echolocation.
- If time allows, have students research other examples of biomimicry so that they can become more familiar with the topic.



## Part 2: Activity

- Introduce students to biodiversity and have them identify its biggest threats using the [Biodiversity Educator's Resource Guide](#). Be sure to include in the discussion people's everyday actions—such as polluting air and waterways, misusing plastics, and wasting food—that contribute to challenges facing our environment. Brainstorm with students various threats that could be impacting your local biodiversity.
- Take a few moments to review adaptations with students. As the definition states, an adaptation is a characteristic trait of a species that better equips it to survive its environment. Migration, camouflage, flight, hibernation, and conservation of resources (such as food and water) are all examples of adaptations found in nature. Allow students time to brainstorm and research the physical and/or behavioral adaptations of some of their favorite species of plants or animals. Take students outside and have them observe unique relationships and patterns found in nature right in their local ecosystem. We can learn a lot by simply sitting quietly and observing what's around us. Discuss as a class—What appearances or behaviors do species use to help them survive? What could we learn from these species?
- Using the examples of adaptations, students will select one species as inspiration for an invention to tackle a threat facing our environment. You can choose one threat for the whole class to consider or allow students to choose their own. If possible, keep the activity connected to your local environment by using the examples of nearby species and threats facing your local ecosystem's biodiversity that were discussed.
- The biomimicry invention can be presented in a format of your choosing—a report or outline that describes their idea, a model, or a blueprint—but it should clearly define the problem they want to tackle and how their design reflects something found in nature.

## Part 3: Discussion and Assessment

- Encourage students to share their designs with their peers.
- As a class, reflect on why nature is important (considering its intrinsic value—nature as it is—and all that it provides for the planet and for us) and what it can teach us. Students should understand that biodiversity supports nature, which supports life. It's essential for us to continue developing innovative solutions to help minimize our impact on the environment and maintain biodiversity. What better place to look for inspirational ideas than nature itself.
- Refer to the "What kids can do" section of the [Biodiversity Educator's Resource Guide](#) to provide students with additional ways they can do their part to restore biodiversity and create a more sustainable future.



## ● Extended Learning Options

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- You can take this design challenge a step further by asking students to map out how they would test the effectiveness of their invention. Students should include the steps of the scientific method when designing their experiment.
- Keep the challenge local by encouraging students to collaborate in identifying a problem facing their community and suggest ways to solve it, using adaptations found in nature.
- Use a tablet or smartphone (if available) to download the [WWF Together app](#). Encourage students to explore the Planet Earth segment and explore how to protect life on our planet.
- Start a class fundraiser to protect biodiversity using WWF's online fundraising tool, Panda Nation. Learn more at [pandanation.org](#).

## ● Additional Background Info

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You can use the information found at the links below to enhance your discussion with the class, or you may want to share some links directly with students if you determine they are grade-level appropriate.

- **Report:** [Living Planet Report 2018](#)—published every two years, the Living Planet Report assesses the state of our planet's biodiversity and ecosystem health
- **Report:** [Living Planet Report for Youth 2018](#)—a condensed, young-reader friendly summary of the Living Planet Report 2018
- **Video:** [World's Largest Lesson](#)—a colorful animation that share stories of young people around the world that have come up with smart ideas to help the planet
- **Web story:** [What is biodiversity?](#)—explains why biodiversity is important and what is at risk if we don't change our behaviors
- **Web Feature:** [The Biomimicry Institute](#)—an organization dedicated to helping people investigate design lessons from nature when paving the way for our future

For more fun classroom activities with a focus on wild species and conservation, visit [wildclassroom.org](#).