



Learning Activity:

Biomimicry Design Challenge

Activity Type	Engineering and technology
Focus Areas	STEM
Time Required	45-60 minutes

● Overview

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

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

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

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



● Vocabulary

- **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

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

- 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

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 2020](#)—published every two years, the Living Planet Report assesses the state of our planet's biodiversity and ecosystem health
- **Report:** [Living Planet Report 2020: Youth Edition](#)—a condensed, young-reader friendly summary of the *Living Planet Report 2020*
- **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](#).