



Ecology in Classrooms & Outdoors

# BIOMIMICRY TEACHER GUIDE

## Introduction

Life on earth has been addressing issues of disease, water purification, water storage, social networking, carbon storage, and much more for 3.8 billion years; in short, life on earth in itself is genius. And yet humans, in our short time on earth, have often ignored this wisdom in designing products and systems. Biomimicry, however, is a mindset and necessary action that reverses this in an effort to live more sustainably. In this lesson, students will learn what biomimicry is by examining a handful of examples. Then, students have the opportunity to innovate on their own and develop a plan for a product or technology that draws inspiration from nature.

### Materials

- [Biomimicry Presentation](#)
- Biomimicry Design worksheet, print or digital
- Pencil
- Computer and internet access (optional)
- Coloring supplies (optional)
- Building or craft supplies to make prototype (optional)

### Lesson Length

30-60 minutes, asynchronously or combination

### Standards

#### NGSS

#### K-ESS3-3 Earth and Human Activity

Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

#### 1-LS1-1 From Molecules to Organisms: Structures and Processes

Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.

#### MS-ESS3-3 Earth and Human Activity

Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.



## Lesson Procedure

### 1. WHAT IS BIOMIMICRY?

Have students go through the presentation slides, either during synchronous or asynchronous learning time.

Begin by having students read and think deeply about the David Attenborough quote on slide 2: **“Nature is our biggest ally, and our greatest inspiration. We just have to do what nature has always done. It worked out the secret of life long ago.”** Ask students to share their reaction to the quote, either with peers or as a reflection written on a piece of paper.

There are multiple ways to define biomimicry, as its application can range from the microscopic level to the large-scale, systemic level. [The Biomimicry Institute](#) defines biomimicry as **“the practice of applying lessons from nature to the invention of healthier, more sustainable technologies for people.”**

Define the term with students, and spend some time discussing possible examples before moving on to the examples in the slides. Ask students to think about the term and if they have seen, read about, or used an item in real life that might be using biomimicry.



Ecology in Classrooms & Outdoors

## BIOMIMICRY TEACHER GUIDE

### Lesson Procedure, cont.

#### 2. EXAMPLES OF BIOMIMICRY

Challenge: look around your house for something that uses **Velcro**. Congratulations, you have found a bio-inspired design!

Velcro was invented in 1941 after a Swiss electrical engineer named George de Mestral noticed that burdock seeds were sticking to his dog's fur after walking through the forest. The spiky seed casings of many types of plant species, called burrs, are covered in tiny hooks that cling to animal fur helping spread the seeds far and wide.

This inventor took the idea and created Velcro, one of the most widely used fasteners in the world! In this case, nature already had developed a wonderful way to stick two things together by using a simple design.

##### **Example: urban water filter design (bioswale)**

Bioswales are a wonderful way to use a system from nature to solve a human-made problem: pollution. Bioswales are structures built to resemble a natural area with soil, rocks, and native plants, which all work together to filter water from urban streets before the water goes back to the natural environment. Invite students to pay attention next time they are in town and see if they notice any of these installations in their community!

##### **Example: Prosthetic "octopus" arm design**

This inventor, Kaylene Kau, noticed that the majority of people who use prosthetic arms tend to use the prosthetic as a support, and "as an assistant to the dominant functioning hand. The prosthetic needed to be both flexible and adjustable in order to accommodate a variety of different grips." She decided to build an arm to mimic, or copy, the way an octopus tentacle is sleek, flexible, and has an excellent grip to grab objects of different sizes.

##### **Example: structural color inspired by butterfly wings**

This video shows how scientists at Cypris Materials, inspired by the structure of the wings of the blue morpho butterfly, developed a non-toxic "paint". Butterfly wings, opal stones, and peacock feathers are all examples of "structural color" that do not have colorful pigments but rather a complex structure that reflects certain light waves. In addition, this ingenious structure can also help to keep the underlying structure cool.

#### 3. ACTIVITY: DESIGN YOUR OWN BIOMIMETIC INVENTION

There are many ways to apply biomimicry ideas to a design project, depending on students' grade level. **Slides 10-13 show more examples to get students thinking.** Below are suggestions for the student design activity:

- **Elementary students** - draw or sketch an animal, plant, or element (earth, wind, water, fire) from nature that they find inspiring. Encourage them to pick something specific about their organism or element that, if copied, would be a helpful human invention, or "superpower." Ask: how would this idea help humans solve problems like pollution, transportation, food security, water scarcity (etc)? Upper elementary students may also use the Biomimicry Design worksheet to develop their idea.
- **Middle school students** - use the Biomimicry Design worksheet and the Helpful Questions slides to come up with an idea for a biomimetic invention or system. Students may work in teams or individually.
- **High school students** - spend time researching a biomimetic invention in-depth by utilizing the search tools on [www.asknature.org](http://www.asknature.org). This website has hundreds of examples of biomimicry designs, products, and systems that scientists and engineers have developed over time. Have students create and deliver a report or presentation on their research to peers. Then, use the Biomimicry Design worksheet and the Helpful Questions slides to come up with an idea for a biomimetic invention or system. Students may work in teams or individually.

#### Biomimicry Institute Youth Design Challenge

"The Youth Design Challenge is a team competition for students in middle school (grades 6-8) and high school (grades 9-12). A team consists of between two-eight students and one to two adult coaches affiliated with a school, educational organization, or homeschool."  
([biomimicry.org](http://biomimicry.org))

[Interested in learning more? Click here!](#)