

Teacher's Guide

Engineered from Nature 6th-12th grade



Crosscutting Concepts:

Structure & function

Sci/Engineer Practices:

Constructing explanations
& designing solutions

DCI: ETS1: Engineering
Design, ETS2: Links among
engineering, technology,
science and society

Summary:

Students will become familiar with biomimicry by examining adaptations of organisms and considering how to apply these adaptations to improve our lives in a sustainable way.

Objective:

Students will use the engineering design process to apply an adaptation of an animal to develop a sustainable, new product or process.

Essential Questions

- 🌀 How can we use nature as inspiration for human products?
- 🌀 How does nature maintain life sustainably?
- 🌀 What can we learn from organisms in terms of their survival techniques?
- 🌀 Brainstorm a list of inventions inspired by nature.

Vocabulary

- 🌀 *Biomimicry*—the process of using nature for inspiration in designing products and systems
- 🌀 *Adaptation*—an organism's specific structure or behavior that promotes its survival
- 🌀 *Engineering Design process*— Ask-Imagine-Plan-Create-Improve

Biomimicry Background Information

The Biomimicry Institute (<https://biomimicry.org/what-is-biomimicry/#.V5IXDFQrLcs>) gives this rationale for looking to nature as we build for the future: “Biomimicry is an approach to innovation that seeks sustainable solutions to human challenges by emulating nature’s time-tested patterns and strategies. The goal is to create products, processes, and policies—new ways of living—that are well-adapted to life on earth over the long haul. The core idea is that nature has already solved many of the problems we are grappling with. Animals, plants, and microbes are the consummate engineers. After billions of years of research and development, failures are fossils, and what surrounds us is the secret to survival.”

In the world of biomimicry, engineers borrow good ideas from nature, but their product doesn't have to look like the thing that inspired it. Instead, the engineers figure out how to apply the functions of other organisms to improve a product or create something new.

The focus of this program is what we can learn FROM organisms, instead of ABOUT them.

Pre-Visit Activities

- 📺 **Video introduction** Watch a two minute video explanation of biomimicry by Janine Benyus, the biologist and author who coined the phrase biomimicry. <https://www.youtube.com/watch?v=7XBokQUEQiQ>
- 📺 **Raptors and Flight** Watch PBS Nature's Raptor Force, which shows how falcons, eagles, hawks and vultures have inspired aerospace engineers to design some of the most advanced planes based on these raptors' adaptations. (49 minutes) <https://www.youtube.com/watch?v=kXHbe1teO1Y>
- 📺 **Ask Nature** A great reference to jump start thinking like an innovator using nature for inspiration. Search by function or organism to see what others have created or start your own project. <https://asknature.org/>

Post-Visit Activity

See following page for Biomimicry Design Studio project.

Suggested Websites

Biomimicry Taxonomy from AskNature.org helps start the search for inspiring organisms by organizing adaptations by function: http://biomimicry.org/wp-content/uploads/2016/02/Biomimicry_Taxonomy_TBI.pdf

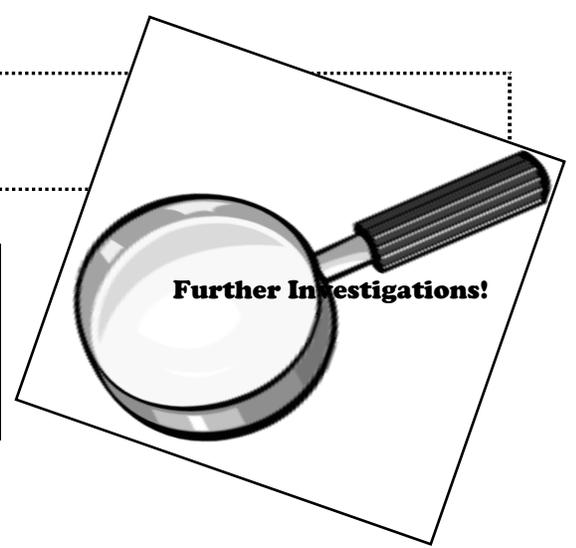
Biomimicry Taxonomy: One page visual: http://biomimicry.org/wp-content/uploads/2016/02/Biomimicry_Taxonomy_TBI.pdf. **How the taxonomy can help with your project:** http://www.asknature.org/article/view/biomimicry_taxonomy

Biomimicry examples:

- 📺 **Sharkskin as inspiration for faster racing swimsuits:** <http://www.mnn.com/earth-matters/wilderness-resources/photos/7-amazing-examples-of-biomimicry/sharkskin-swimsuit#top-desktop>
- 📺 **Self-healing plastics:** <http://www.cnn.com/2015/06/25/tech/self-healing-plastic/>
- 📺 **Rattlesnake gait improves robot movement:** <http://www.latimes.com/science/sciencenow/la-sci-sn-robot-snake-sidewinder-sand-bioinspired-20141009-story.html>

Biomimicry Design Studio

**Think like an engineer:
ASK-IMAGINE-PLAN-CREATE-IMPROVE**



How can you make life better for middle school students? Design a snack carrier that can keep your smoothie frozen or your fries hot. Think about how plants and animals keep cool in summer or warm in winter. What types of insulation or cooling systems do they use?

ASK: Make a list of verbs that describe what your snack carrier will do. For instance, store, cool, protect, absorb, etc. Go to AskNature.org (<http://www.asknature.org/>) and search your verbs in the Explore by Function box to see how organisms in nature do these things.

IMAGINE: Think about how you can use the adaptations you read about to design your snack carrier. Choose one adaptation and brainstorm ways to use it for your snack carrier.

PLAN: Sketch your snack carrier in the box below. Give your product a name and label its cool features.

Inspiring organism:

Product Name:

Description of your product:

CREATE: You don't have to actually build your invention, but think about whether you'd want to buy it. Get feedback from others in your class to see if they'd buy it and if they can think of ways to improve your design to make it easier to use.

IMPROVE: If you want to modify your design, draw a new sketch on this page.

