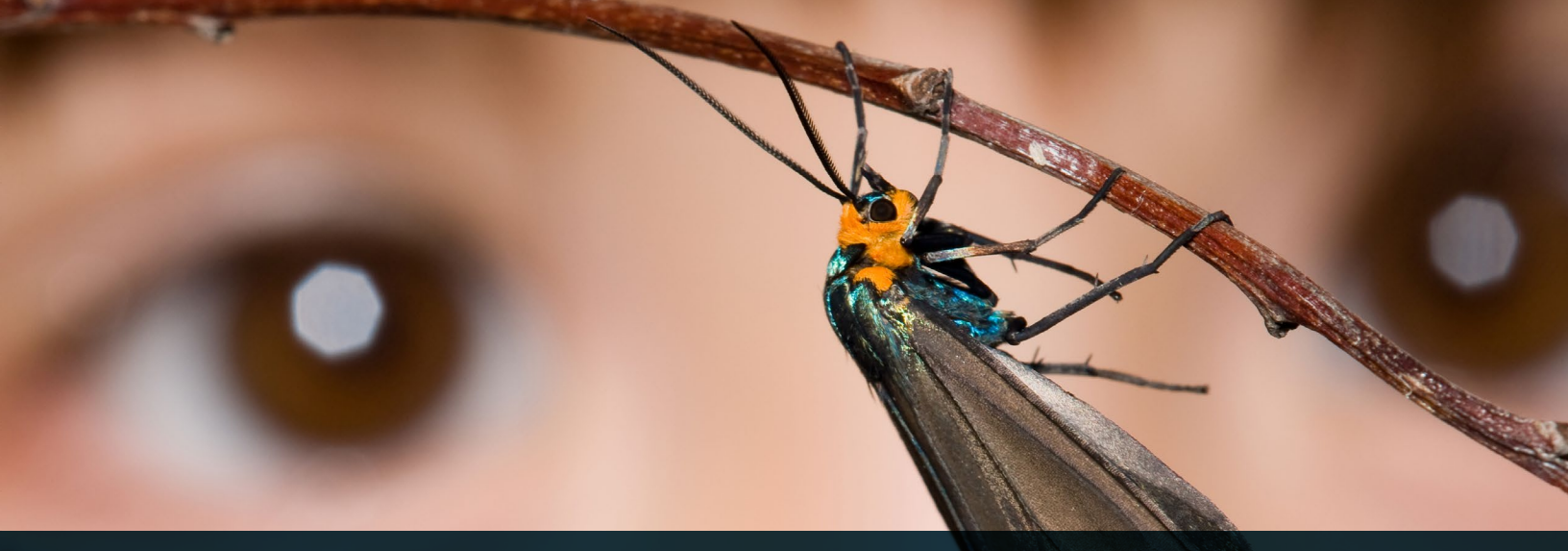# SHARING BIOMIMICRY WITH YOUNG PEOPLE

An Orientation for K-12 Teachers

BIOMIMICRY
INSTITUTE

Welcome to the wonderful world of biomimicry in education!

We are so pleased you have chosen to share this fascinating topic with your students. They will love it. (And you will, too!)

This document was created by the Biomimicry Institute to help K-12 educators like you establish a general foundation in biomimicry and provide ideas for introducing this new way of thinking and problem solving to your students. We begin with a general introduction to the "what" and "why" of biomimicry, along with some ideas for how to fit biomimicry into your education program. The Core Concepts section that follows the introduction provides added depth in key areas and offers additional suggestions and resources for sharing these concepts with students of varying ages. Finally, an appendix at the back will guide you in connecting with other educators who are using biomimicry in their teaching.

If you have any questions or feedback related to this content, feel free to reach out to us at: info@biomimicry.org

From all of us at the Biomimicry Institute, thank you again, and enjoy!

Terms of Use

* NOTE: This is an excerpt from a 26 page document. To access the complete text at no charge please visit: https://asknature.org/resource/sharing-biomimicry
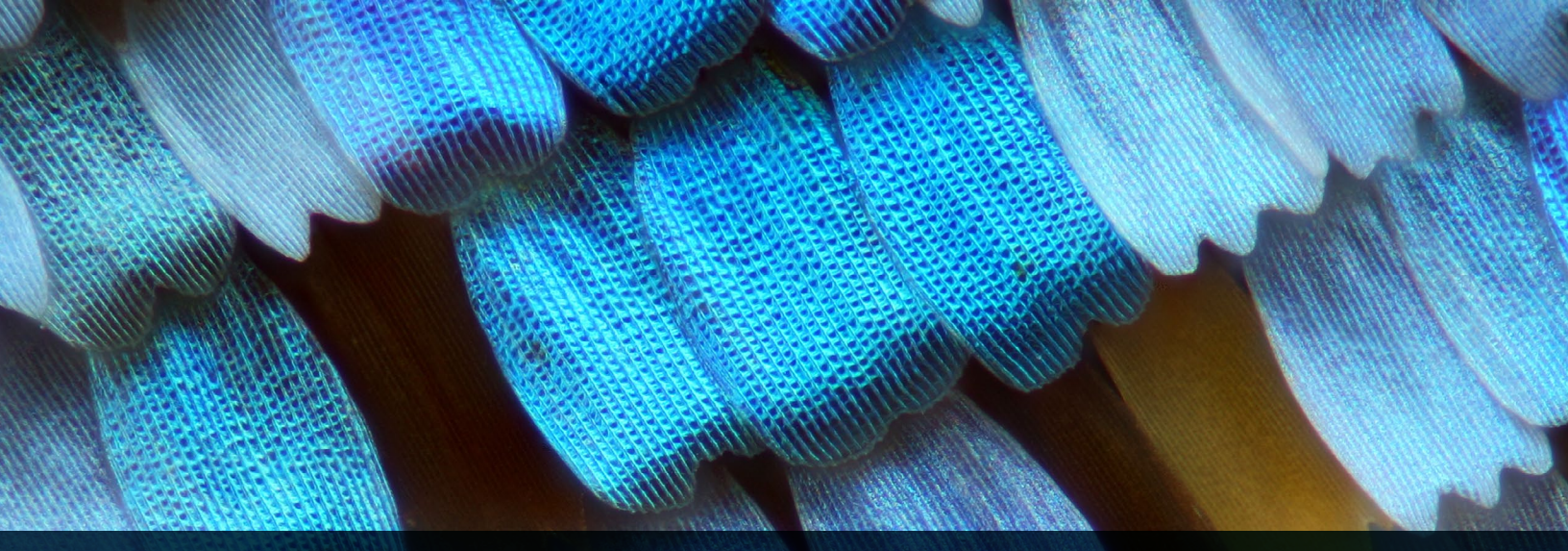
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INTRODUCTION

At the Biomimicry Institute we want to equip the next generation to contend with our planet's toughest sustainability issues with a new way of thinking and problem solving—biomimicry. We believe that biomimicry-based education is not only a great way to engage K-12 students with real-world lessons in STEM and environmental literacy, but perhaps most importantly, it offers kids tangible solutions and a hopeful vision for the future of our planet. In this Introduction we provide a definition of of biomimicry, along with our ideas about why and how to fit biomimicry into your education program.

WHAT IS BIOMIMICRY?

Biomimicry is commonly defined as "innovation inspired by nature," or the practice of applying lessons from nature to the invention of sustainable technologies for people.

Biomimicry practitioners (or "biomimics") study the strategies used by living things to perform specific functions and apply what they learn to improve the design of products, processes, and systems. For example, looking to a leaf for ideas about how to make a better solar cell, or mimicking how a peacock feather selectively reflects light to produce beautiful colors without pigment. The core idea is that the rest of nature has had a 3.8 billion year head start on humans so, we'd be wise to tap into that vast trove of "research and development" when looking for the ideas we need to solve our design problems.

Janine Benyus, co-founder of the Biomimicry Institute, biologist, and author of *Biomimicry: Innovation Inspired by Nature* (the book that brought biomimicry into the public eye), has defined biomimicry as the "conscious emulation of life's genius." To break that down a bit, she means that biomimicry is an intentional practice of learning from (not just copying) living things, and appreciating the "genius" in how life has evolved countless well-adapted solutions that have stood the test of time, within the natural constraints of our planet.

That last point about "well-adapted solutions" is important to how Benyus and the Biomimicry Institute approach biomimicry. We are interested in more than simply making faster, stronger, or "better" things. Rather, through biomimicry, we see an important opportunity to apply lessons from nature to begin creating human technologies that are as sustainable (well adapted to Earth) as the living systems that surround us. Although it may be some time before we humans can power our cities entirely on sunlight or recycle all of our wastes as nature does, we can still use biomimicry as a pathway for improvement by asking, "How has nature solved this problem before?"

Learn About Biomimicry:
- "A Biomimicry Primer," essay by Janine Benyus.
- *Biomimicry*, a 25 min film by Tree Media.
- Janine Benyus' TED Talks
- Asking Nature, the Biomimicry Institute blog.
- *Zygote Quarterly*, a biomimicry journal edited by educators.

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THE POWER OF BIOMIMICRY IN YOUTH EDUCATION

Biomimicry is a rich framework for teaching that can be used to address a wide range of topics in science, engineering, and environmental literacy – all with a hopeful message that encourages students to be positive agents for change in the world.

As the growing field of biomimicry attests, there are countless opportunities to learn from the natural world around us, and doing so may indeed be the key to a livable future on this planet. But to get there, today's young people must learn not just how to live and succeed in a complex world made by other humans, but to see and appreciate the complexity of the natural world around us, and how we are interconnected with it.

We like to say that students should be able to "read" a tree as effortlessly as they'd read a book. That is, to see that a tree is not just a source of fuel, or wood to build a house, but also an amazing technology in its own right—one that stores energy from the sun, moves gallons of water a day without motorized pumps, creates materials out of carbon in the air, and provides countless ecosystem services. When we learn to see technology in nature this way, our eyes are opened to the sustainable world that already exists, embodied in the plants, animals, and other organisms all around us.

It's this eye-opening quality and an accompanying sense of wonder that captivate students and make biomimicry such a powerful framework for teaching. The

compelling narratives and fascinating natural phenomena behind biomimetic innovations provide a refreshing entry point into many of the core scientific subjects educators are already teaching. And because it's an inherently interdisciplinary field, biomimicry

bridges the boundaries between school subjects and connects them to the real world beyond classroom walls. Students get excited by biomimicry because it's about much more than learning facts. Biomimicry is visionary! It's about reimagining human-made technologies and redesigning the human-built world. In this way it taps into young people's innate creativity and desire to shape their world, while enhancing problem-solving skills through design and project-based activities.

LEARNING ABOUT ⟶ LEARNING FROM

Name:
Oak (*Quercus spp.*)

Leaves:
Simple alternate, with irregularly rounded lobes

Range:
Broad, temperate to tropical

Uses:
Furniture, veneer

Canopy humidifies air, increasing inland precipitation.

Leaves capture solar energy with nontoxic and biodegradable materials.

Limbs create structural support with minimal materials.

Trunk moves water against gravity without motorized pumps.

Microscopy courtesy of Eckhard Völcker

When students learn to see technology in nature their eyes are opened to a sustainable world that already exists, embodied in the plants, animals, and other organisms all around us.

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TEACHING APPROACHES & AGE APPROPRIATENESS

Biomimicry may seem like a highly specialized or technical subject, however students of all ages—even preschoolers—are capable of appreciating biomimicry if it is introduced effectively.

There are many ways to bring biomimicry into your teaching. How you decide to do so should be informed by your learning goals, how much time you have, and what your students are ready for. For example, your goal for sharing biomimicry with your students may be simply to make your students aware of it as one of the many ways nature is valuable and interesting to people. Or you might want to use examples from biomimicry as a compelling way to introduce core ideas in science, engineering, and technology. If you have time, you may also want to have your students practice design and engineering skills through nature-inspired projects or challenges. These are all valid goals that could be pursued together or separately.

We suggest that all efforts in biomimicry education, regardless of age, should also aim to impart to students a new way of viewing and valuing the natural world. Students should come away feeling and understanding that nature is full of ideas about how to solve our own challenges, and that they are empowered to address those challenges to improve the world.

There are at least two more factors you will want to consider when planning for age-appropriate biomimicry education: choosing

an appropriate vocabulary and level of complexity for discussing the topic, and choosing biomimicry examples that your audience can relate to.

In all cases, we strongly recommend introducing a definition of biomimicry together with examples, as these are key to helping all learners understand the topic.

For younger students, you'll want to use a simple definition that captures the essence of biomimicry without using confusing terms. (e.g. "Learning from nature how to make things better.") Older students will be able to grasp terms that are more conceptually difficult (e.g. "emulation"), and this allows you to make finer distinctions—perhaps even contrasting biomimicry with other "bio" terms *(See the Core Concepts section, "*__Biomimicry and bioinspired design__*," for more).*

You can apply a similar progression of complexity when it comes to examples of biomimicry. An example that is almost universally familiar to students is Velcro®. Even very young children who have used Velcro® can grasp how it is similar to the hooked barbs on burdock seeds.
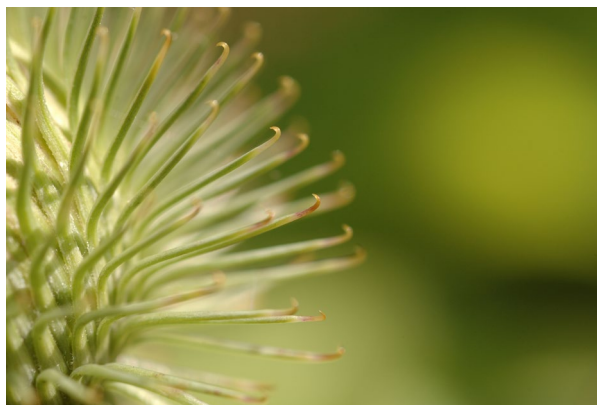
The barbs on burdock seeds were the inspiration for Velcro®.

In general, younger students will find it easier to understand examples that involve phenomena they have experienced or for which there is a clear visual resemblance between the inspiring organism and the biomimetic solution. It's a good rule of thumb to start with this type of simple example even for older students, and then introduce increasingly complex examples to illustrate how biomimicry can also be applied in more abstract ways. *(See Core Concepts section, "*__Matters of scale__*," for more).*

Sources for Examples:
- __AskNature__ - Many examples of biomimicry can be gleaned from the growing library of "Inspired Ideas" and education resources on AskNature.
- __Mother of Invention__ - The Wild Center compiled over two dozen biological strategies are in this slideshow, along with great photographs and examples of applications for each.
- __Bio-Inspired Design: Scientist Audio Programs__ - The radio program *Pulse of the Planet* produced this collection of 28 two-minute segments featuring scientists talking about natural strategies and bio-inspired design.

CORE CONCEPTS & TEACHING STRATEGIES

There are a handful of core concepts that are helpful to understanding and practicing biomimicry. Here we provide an overview of these concepts with some suggestions and resources for effectively teaching them. You can find many more resources addressing these topics in the Resources section of **AskNature**.

Note: Resources hyperlinked in the text are available with full citations and URLs at the back of this document.

WE ARE PART OF NATURE

Humans and our activities are dependent on and interconnected with other natural systems on Earth.

A simple concept that underlies biomimicry is the understanding that humans are part of nature, and that we are dependent on and interconnected with natural systems just like all other living things. Although humans have developed a variety of cultural adaptations that camouflage our kinship with the rest of life, the truth is our similarities far outweigh our differences.

This is the basis for why biomimicry makes sense: humans need to do many of the same things that other organisms do. For example, acquiring resources, making and breaking down materials, processing information, and reproducing. We are also subject to the same resource limitations and habitat conditions as the other 8.7 million species on Earth. The more we understand about how our planet-mates have leveraged the resources and constraints of this place, over billions of years, the better equipped we are to create technologies and systems that will enable all life to flourish long into the future.

But our relationship with nature has more than just practical value. In the U.S., children spend an average of seven hours a day on entertainment media, including televisions, computers, phones, and other electronic devices. This is time that previous generations of children were more likely to spend outside, being physically active, and getting to know nature. Without this experience, young people may lack appreciation and even basic knowledge of their natural surroundings. Biomimicry is an opportunity to reconnect children with nature, take the classroom outdoors, and mend this fractured relationship.

Teaching Suggestions:
- Take students outside and encourage their innate curiosity and affinity for nature.
- Incorporate sensory exploration into outdoor experiences. Ask students to close their eyes and notice what they can detect about their surroundings through hearing, touch, and scent. Can they tell where the sun is? Which way is the wind blowing?
- Prompt students to make observations about what humans have in common with other organisms rather than what makes us different.

Resources:
- **"Wild Nature Survivor Guy"** - This fun Sesame Street clip parodies reality TV programs and demonstrates how nature is all around us and we are nature, too.
- *You Are Stardust* - A picture book emphasizing the connections between all life, from the formation of the universe to the present. A companion lesson plan and app for K-6 students are also available.
- *Sharing Nature* - This book by Joseph Bharat Cornell is a classic in environmental education and contains many great nature observation activities.
- **We Are Not Alone** - This activity prompts students to consider the ways in which humans and other organisms solve the same technological challenges.
- *Exploring the Way Life Works*, by M. Hoagland and B. Dodson - The second chapter in this illustrated popular science book focuses on what all life has in common. *(Out of print, but used copies can still be found online.)*

This is the end of the excerpt. To access the complete 26 page document at no charge please visit:

https://asknature.org/resource/sharing-biomimicry

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EMPOWERING PEOPLE TO CREATE NATURE-INSPIRED SOLUTIONS FOR A HEALTHY PLANET.

The Biomimicry Institute is the world's leading non-profit organization dedicated to fostering innovation inspired by nature. It was co-founded in 2006 by biomimicry pioneer Janine Benyus to provide the tools and training necessary to help innovators, students, and teachers use nature as a model for sustainable solutions to humanity's greatest design challenges.

OUR PROJECTS:

ASKNATURE

AskNature is the world's most comprehensive catalog of nature's solutions to human design challenges. This award-winning website features thousands of inspiring natural phenomena, biomimetic design solutions, and biomimicry education resources. The inspiration and ideas offered by AskNature are facilitating the creation of radically innovative, sustainable products and services around the globe. Learn more at AskNature.org.

BIOMIMICRY GLOBAL DESIGN CHALLENGE

The **Biomimicry Global Design Challenge** is an annual competition that provides a platform for learning, practicing, and celebrating the skills of biomimicry. Each year the Institute selects the most promising entries from entrepreneurial teams and champions them through business training, mentorship, and monetary awards—including the $100,000 Ray of Hope Prize™. Learn more at Challenge.Biomimicry.org.

EDUCATION

The Institute supports the integration of biomimicry into K-U formal and informal education by providing curriculum and training, creating opportunities for educators to connect and share best practices, and by working with leading education organizations to raise the profile of biomimicry both as a field of study and as a framework for project-based education that blends STEM and environmental literacy. Learn more at Biomimicry.org/Education

NETWORKS

The Institute advances biomimicry on a global scale by supporting the creation of networks focused on a specific region or discipline. The **Biomimicry Global Network** includes 36 regional and professional networks from 21 countries representing more than 12,000 students, educators, engineers, designers, biologists, chemists, and trained biomimicry professionals who are facilitating the adoption of the discipline globally.
Learn more at Biomimicry.org/Global-Networks

www.Biomimicry.org   ●   Info@Biomimicry.org   ●   (415) 800-1401