BIOMIMICRY
YOUTH DESIGN CHALLENGE

Welcome

M MOTIVATE

I INVESTIGATE

M MATCH

I INNOVATE

C COMMUNICATE

BIOMIMICRY INSTITUTE

Dear Educators,

Welcome to the Biomimicry Youth Design Challenge (YDC), a STEM learning experience that empowers students in middle and high school to pursue project-based-learning skills needed to solve real-world problems. Learners have the opportunity to work with an adult coach to explore biomimicry and apply their new understanding to create nature-inspired, sustainable solutions to global and local design challenges. This digital resource provides a thorough introduction to teaching biomimicry and will equip you to bring the core concepts and methods into your classrooms, home-school environments, or afterschool programs so that students can successfully incorporate insights from nature into design.

Designing a nature-inspired solution to a global or local problem is a powerful learning experience that requires students to understand and connect:

- The causes and effects of a problem and the functional requirements to solve it;
- How living organisms have solved similar functional challenges;
- and The application of design practices to create and evaluate bio-inspired solutions

Please refer to the following pages for an overview of the YDC Storyline, the MIMIC framework on which it is built, and details about how this curriculum aligns with the 5E instructional model (Engage, Explore, Explain, Elaborate, Evaluate), as well as Next Generation Science Standards, integrating Disciplinary Core Ideas, Science and Engineering Practices, and Crosscutting Concepts.

We hope this curriculum helps you deliver a curiosity-provoking, STEM-aligned educational experience that empowers your students to play an active role in furthering sustainable design and embracing an interconnected, socially responsible, and just society. If you have any questions as you explore this guide, please contact us at youthchallenge@biomimicry.org.

Sincerely,

The Biomimicry Institute

YOUTH DESIGN CHALLENGE STORYLINE

The sequence of lessons for the Biomimicry Youth Design Challenge (YDC) is built on the MIMIC Instructional Framework (see page 6) and focuses student innovators on helping humankind to reach the United Nations Sustainable Development Goals (SDGs).

Anchor Phenomenon: Nature solves problems with well-adapted designs, life-friendly chemistry, and smart material and energy use.

Driving Question: How can learning from nature help us solve local and global sustainability challenges?

Supporting the United Nations Sustainable Development Goals

Using nature as a model, mentor, and measurement tool for sustainability, we can create solutions to solve human design challenges that address the United Nations 17 Sustainable Development Goals (SDGs). Our mission for the Youth Design Challenge (YDC) is to mobilize the next generation of innovators to help address the global challenges we face—with a local approach. Applying nature's design blueprints to these challenges can help achieve the 2030 Agenda for Sustainable Development as agreed upon by leaders worldwide.

The encouraging alignment between the SDGs and the YDC is that all innovation points to climate action—from Goal 13, specifically calling out Climate Action, to all the goals interconnected within the climate crisis, such as Goal 3: Good Health and Wellbeing, Goal 12: Responsible Consumption and Production, and Goal 4: Quality Education. Each SDG in some shape or form can be attributed to furthering regenerative ecosystems for all species. To better understand how the YDC aligns with the SDGs and NGSS, visit this resource.

By implementing successful, locally-adapted, nature-inspired solutions, we can contribute to these collective sustainability goals for the planet.

Introducing and Defining Biomimicry

bio = life ***mimicry = learning from and emulating***

When we study and use nature as inspiration to design sustainable solutions, we are practicing biomimicry. Biomimicry offers hope in finding a way out of the complex challenges present in today's world and encourages humans to reconnect with the natural world. The thinking and application process incorporates learning from nature to create more regenerative, resilient, and biodiverse spaces. It helps students not only connect directly with the problems that affect their lives and communities, but also empowers them to be part of the solution.

Looking to nature to address human problems is not a new idea. Indigenous cultures have looked to fit in with and honor the natural environment for as long as humans have been around. When we're referring to biomimicry, we're approaching the process through the lens of scoping a problem, discovering nature's solutions, abstracting those biological strategies to be used in design, creating prototype concepts or real design applications that solve said design, and evaluating against sustainable benchmarks, i.e. how natural organisms solve these problems without destroying or poisoning their habitat in the process.

Through this approach, we also incorporate the three essential elements of a biomimetic design: Emulate, Ethos, and (Re)Connect, which will be explained in the Motivate section (see pg. 8). Iteration is important throughout the process in order to increase the likelihood of success and to help learners understand this is an iterative approach to design rather than a linear one, i.e. there is not a straight way to get there but rather a repeated process to come to the best solution as more information is discovered.

Ultimately, our hope is that by introducing students to these critical thinking skills and approaches to solving problems, while encouraging a fun reconnection to the natural world, they feel more empowered and passionate about science, technology, engineering, and mathematics.

The MIMIC Instructional Framework

While there are many different ways practicing biomimics look to nature to inform design, we have created the MIMIC Instructional Framework to introduce young learners to the core concepts of biomimicry and how to apply them within the context of a creative engineering-design challenge. Each 5E instructional segment within the YDC curriculum addresses one of the five MIMIC phases, which together encompass the introduction of biomimicry as a concept (Motivate), the core elements of a Biomimicry Design Process (Investigate, Match, Innovate), and the preparation of an entry to the challenge (Communicate).

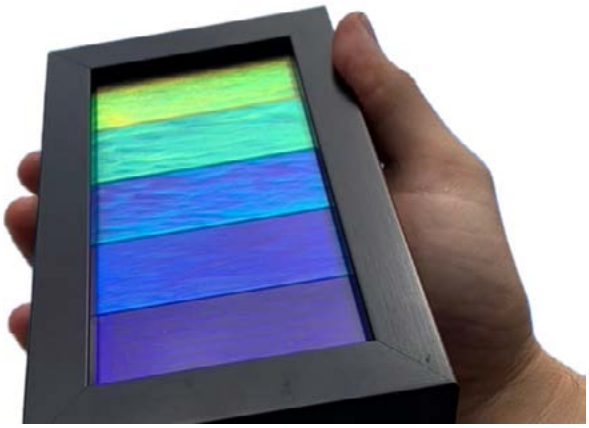
MOTIVATE Get inspired! Motivate your team by exploring a local or global problem and introducing the concept of biomimicry. Learn how the unique abilities of organisms help them to survive and thrive and how people have been inspired by them to design solutions to challenging problems.

INVESTIGATE Investigate the causes and effects of a problem learners are passionate about. Identify aspirational goals, constraints for the design, and the sustainable impact your solution will need to have to address the problem effectively.

MATCH Explore how nature has solved problems similar to yours by matching what you need your design to do with organisms that have similar abilities. Examine why those organisms have those abilities, how those adapted strategies function, and whether they could inspire your solution.

INNOVATE Create a biomimicry innovation that would help solve your selected problem. Refine your innovation after evaluating its strengths and weaknesses both in performance and how well it created conditions conducive to life.

COMMUNICATE Use the power of inspiration, storytelling, and scientific evidence to explain how your biomimicry design solves the selected problem and how nature has inspired it. Offer gratitude for the natural world for sharing wise strategies to better inform design.



Video: Cypris Materials

NEXT GENERATION SCIENCE STANDARDS

The foundational biomimicry, climate change, and design challenge alignments are shown in the table below. Alignment strength will depend on lesson choice, depth of instruction, and problem choice.

Additional specific physical, earth, and life science standards can be selected by choosing a particular Sustainable Development Goal as the focus for the design challenge.

DISCIPLINARY CORE IDEAS (DCI)	SCIENCE & ENGINEERING PRACTICES (SEP)	CROSSCUTTING CONCEPTS (CCC)
BIOMIMICRY		
• MS, HS - LS1.A: Structure and Function • MS, HS - LS4.C: Adaptation	• Developing and Using Models • Engaging in Argument from Evidence • Constructing Explanations and Designing Solutions	• Structure & Function • Patterns • Systems & System Models
ENGINEERING DESIGN		
• MS, HS - ETS1.A: Defining and Delimiting Engineering Problems • MS, HS - ETS1.B: Developing Possible Solutions • MS, HS - ETS1.C: Optimizing the Design Solution	• Asking Questions and Defining Problems • Developing and Using Models • Analyzing and Interpreting Data • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information	• Systems & System Models • Influence of Science, Engineering, & Technology on Society and the Natural World • Structure and Function
CLIMATE CHANGE		
• MS, HS - ESS3.D: Global Climate Change • MS, HS - ESS3.C: Human Impacts on Earth Systems	• Asking Questions and Defining Problems Analyzing and Interpreting Data • Developing and Using Models	• Cause & Effect • Stability & Change
ADDITIONAL PHYSICAL, EARTH, AND LIFE SCIENCE STANDARDS		
Choose a Sustainable Development Goal that matches your class or program content as the focus for the design challenge. Refer to the document, UN Sustainable Development Goals Aligned to NGSS, for suggested alignments.		