

2023-2024 **CURRICULUM PREVIEW**















BIOMIMICRY YOUTH DESIGN CHALLENGE

Welcome













INNOVATE C

COMMUNICATE





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 <u>youthchallenge@biomimicry.org</u>.

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 even 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.



SUSTAINABLE G ALS

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).

OTIVATE 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.

NVESTIGATE 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.

NNOVATE 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



Fall 2023

2024 Program Handbook



2022-23 YDC TIMELINE



OCTOBER Registration opens.

MID-SEPTEMBER

New curriculum available and Challenge officially begins.

Submission form opens. Entries accepted until the submission deadline.

ASAP

Pre-program assessment surveys.

MARCH 29 Registration closes.

APRIL 3 Submissions due. All entries due by 5:00 pm, PDT.

MAY Finalists announced.

THE CHALLENGE DESIGN BRIEF

A "design brief" is a document that describes a design project. Designers and engineers use design briefs (also sometimes called 'problem statements') to make sure that everyone on the project team has a shared understanding of what problem they are trying to solve, and the scope and goals for possible solutions.

The YDC Design Brief introduces the overall focus of the Youth Design Challenge: the Sustainable Development Goals. The clarity with which team design projects address the problem described in the Design Brief is an important criterion on which they will be evaluated. The brief is available on the YDC website and can be downloaded as a handout you can share with students.

PLANNING YOUR TEAM'S CHALLENGE

The YDC Design Brief is written broadly to provide educators with flexibility and to encourage diverse and creative solutions. However, any of the chosen SDGs contain vast and complex topics and it will be essential that you guide your team in selecting a specific aspect of this challenge to focus on.

Defining a design problem is a valuable educational part of this project. It helps improve students' capacity to break large problems into smaller, more manageable ones, and it can help students apply critical and systems thinking to problem solving. Depending on your setting, learning goals, and student population, you may want to direct this "problem definition" aspect of the Challenge to a greater or lesser extent at the outset of the project. You can narrow the scope of the Challenge in a variety of ways to make the challenge more accessible and/or to target specific academic concepts. Just remember, it's important to make sure that students still have a voice and choice in defining the specific problem they will solve.

ADDITIONAL RECOMMENDATIONS

After running design challenges for many years, we've noticed a few pitfalls that sometimes trap those new to biomimicry. We mention these here so that you can help your students avoid them and submit a strong entry to the competition.

- Distinguish between biomorphism, bioutilization, and biomimicry: "Biomorphism" refers to an object that looks like something from the natural world (from the Greek "morph", meaning "shape"). "Bioutilization" refers to using natural materials. Both biomorphism and bioutilization can occur in biomimicry, but their presence alone does not make a design biomimetic. The important indicator is function whether a design "works like" a strategy in the natural world. Make sure students are focusing on function in their designs, not just using, or superficially resembling, biological elements. For a deeper discussion of these terms see our publication, Sharing Biomimicry With Young People (p. 12), available on AskNature.org.
- Stay out of the 'solution space' until you've completed your research: Sometimes a design problem can spark ideas for possible solutions right away, before we even get to researching biology. When this happens, it's tempting for the design team to "jump to the solution space" and spend more of their time looking for justification in nature for an idea they already have, instead of following the biomimicry design process faithfully to investigate new sources for ideas. It's often pretty obvious to our judges when this happens, because the depth of emulation and learning from nature is weak. Encourage your students to stick with the process and really investigate what can be learned from nature before jumping to conclusions about possible solutions.
- Focus on generating new ideas or improving existing ones: As news stories and information about biomimicry have spread, many case studies and biological models have become popular. It can be very tempting to students to recycle these ideas instead of finding and developing their own. Encourage your students to go deeper in their research and, if referencing an existing technology or a frequently-used biological model, prompt them to add their own insights or original ideas to their designs.

COACH CHECKLIST

Below we have provided a checklist of essential tasks and activities to help you and your team stay on track during the Challenge. Please keep in mind that this checklist is not exhaustive and is only intended as a starting point.

COACH'S PREPARATION

Register as a coach for the Biomimicry Youth
Design Challenge and download the Program
Handbook. (If you are reading this, you've
probably already completed this step!)

- Build your team of 1-8 students and up 2 coaches. Coaches may supervise multiple teams.
- Distribute the student pre-program surveys.
- Review the Design Brief and Project Rubric.
- Review the YDC Educator Resources and determine how you would like to use them to support your team.

COMPLETING THE CHALLENGE

- Introduce your team to the topics of biomimicry and the UN Sustainable Development Goals (SDGs).
- Review the Design Brief and Biomimicry Project Rubric and discuss it with your team. Revisit these documents as needed throughout the design process to keep your team on track.
- Support your team through the process of defining a specific SDG to focus on for their Challenge project.
- Support your team through the process of researching biological models.
- Support your team through the process of developing solutions for their selected design problem, inspired by the biological models researched.
- ☐ Support your team in preparing the submission materials according to Challenge requirements and the Project Rubric.

Enter your team submissions via the online form and finalize them by the deadline. Coaches may work with multiple teams, but please only enter your three best submissions.

Distribute the student post-program assessment survey and complete the coach post-program survey.

- Review the judging information pack, rubric, and tutorial videos.
- Review and score team submissions via the online platform, following the provided instructions.
- Complete the post-judging survey.

OPTIONAL ACTIVITIES

- Attend periodic online training and support sessions, when available.
- ☐ Identify experts in your community who can serve as advisors to your team.
- Plan a field trip to a local nature area, natural history museum, zoo or aquarium to allow your students to see inspiring organisms in person.
- Make arrangements to present your team's finished project to your school, community, or other stakeholder group.
- Participate in interviews and focus groups with the Biomimicry Institute and other coaches to help refine the YDC.
- Organize an end-of-Challenge celebration with your team.

Congratulations! Your team has developed a biomimicry design solution and now it's time to enter it into the competition. Here's what you need

BIOMIMICRY YOUTH DESIGN CHALLENGE

MOTIVATE







MATCH









The Youth Design Challenge (YDC) begins with students identifying a local or global challenge that they would like to explore and learn about biomimicry as a design process that could lead to sustainable solutions.

- Students can choose a problem that they have heard about in the news, in school, or ideally one they have experienced in their community (the goal is to choose a problem they feel passionate or interested in learning more about).
- Students are then introduced to biomimicry as a sustainable design practice with the potential to help solve many of the challenges facing our world today.
- The final phases of the Motivate learning progression opens students' eyes to the amazing biological strategies that all organisms possess, that we can learn from as we design our world.

Goal: Introduce biomimicry and identify the problem.

Question Aligned to the Storyline: How could practicing biomimicry help us design solutions to challenges experienced worldwide?

5E Instructional Model—Engage: In Motivate, we focus on the Engage component, prompting students to identify a local problem and reflect on questions like "Why did this happen?", "What do I already know about this?", and "What can I find out about this?" We begin to explore the concept of biomimicry and learn how we can look to nature to solve the problem of interest.

Motivate Questions

Part 1: What are some current problems we are facing as a people?
Part 2: What is biomimicry, and how can it give us ideas to solve problems?
Part 3: Who are nature's design champions right outside our door?
Part 4: What are the essential components of biomimicry, and how do designers learn from nature?

Part 5: How are students like us practicing biomimicry to create nature-in-spired solutions to sustainability problems?



Procedure Part 1

What are some current problems we are facing as a people?

1. Invite students to think about issues that we see on the news and hear are being discussed in their community and/or around the world. Give students about 2 minutes to think of an issue or problem that they would like to share. List the issues that students share and set aside for later.

• **Optional Extension:** Have students take the list generated and sort according to categories or themes they decide upon and have them explain their choices.

2. Tell students that the issues that they feel are important are recognized in some shape or form as challenges we need to face globally. The United Nations developed a list of Sustainable Development Goals (SDGs) that group these issues for countries to align on making progress.

3. Watch the call to action video: <u>We the People for the Global Goals</u>. Afterwards, have students read the <u>SDG Fact Sheet</u> looking for connections to issues that feel important to them.

 Point out an example to help bridge understanding: If students included on their list, for example, that temperatures are increasing every year, causing droughts and fires, then SDG 13 is the most relevant. Show students the <u>SDG 13 Sheet</u> on taking urgent action to mitigate climate change and its impacts, and scroll down to the Overview which has visuals of some of the problems listed.

4. Have students select a specific SDG that they feel aligns with one of the problems they feel passionate about for additional research. Ask students to log onto pre-approved sites to research the local problem more, and have them confirm that the SDG and problem that they've chosen have accessible information.

- Other forms of research might include physically exploring their community and talking with family members, community members, or problem stakeholders.
- Ask students to be prepared to share answers to the following questions once they have selected the SDG (potentially during class, if time allows, or at home, to be discussed the following day):
 - o WHY have you chosen this SDG for further study?
 - o WHAT do you know about issues that are part of the SDG?
 - o HOW might these issues be impacting your community?

5. Tell students that the Biomimicry Institute holds an annual creative challenge (or contest) called the Youth Design Challenge (YDC) that encourages students to apply solutions found in nature to human innovations, to help reach and achieve the SDGs. Give students the <u>YDC Design Brief</u>, <u>Project Rubric</u>, and <u>Project</u> <u>Portfolio Checklist</u> to read and discuss in small groups.

- Share how a design brief is a document used by professional designers and their clients to communicate the context, goals, and requirements of a creative project. They will get to become sustainability champions by taking on this project.
- The Project Portfolio Checklist will help them keep track of their communication process, and the Project Rubric will be the grading and judging guide for their end solution. Terms on the rubric will be explored during this learning journey.

Additional Teacher Resource

• Background on the UN SDG