

# BIOMIMICRY

YOUTH DESIGN CHALLENGE

MOTIVATE



M

MOTIVATE



I

INVESTIGATE



M

MATCH



I

INNOVATE



C

COMMUNICATE



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 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-inspired 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: [We the People for the Global Goals](#). Afterwards, have students read the [SDG Fact Sheet](#) looking for connections to issues they have raised as important to us as a people.

- 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 one most relevant. Show students the [SDG 13 Sheet](#) 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 the students should 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 to be done for home study and returned the following day to discuss):
  - WHY have you chosen this SDG for further study?
  - WHAT do you know about issues that are part of the SDG?
  - 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 [YDC Design Brief](#), [Project Rubric](#), and [Project Portfolio Checklist](#) 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](#)

## Procedure Part 2

### What is biomimicry, and how can it give us ideas to solve problems?

1. Tell students that they are going to hear about a practice called biomimicry. Explain that *bio*=life and *mimicry*=imitate or copy. Introduce Janine Benyus, the author who popularized the term biomimicry, using the short film, [Biomimicry](#) (21:47). Then have students write down one thing they “Notice” and one thing they “Wonder” about biomimicry based on the video.
2. After the video, have students share their “Notice and Wonder” to the whole group. Create a list to keep for discussion later in the instructional segment.
  - Consider asking a student to record the responses while they engage in the activity.
3. Tell students that biomimicry has been happening all around us. Show [Biomimicry Case Studies](#) one image at a time. For each example, ask students: “How would you describe this example of biomimicry?”
4. Tell students that each image shows a pair of photos: a bio-inspired technology and the organism that inspired it (biological model). Read (or request a volunteer) the notes on the [Biomimicry Case Studies](#) after each image has been shown and provide students with an opportunity to discuss the images.
5. Give students the [Biomimicry Definition and Key Terms Sheet](#). Have students put a tally mark next to the words used during discussions so that they can begin to build familiarity with the biomimicry vocabulary words.

### Additional Teacher Resources

- [What is Biomimicry?](#)
- [Biomimicry Toolbox Introduction](#)

## Procedure Part 3 (Outdoor Option)

### Who are nature’s design champions right outside our door?

1. Have students watch the video “[What is Biomimicry?](#)” (2:03)
2. Review the [Exploring Function in Nature](#) worksheet and plan for a 45-minute activity outdoors (or indoors if there are natural objects available). In this activity, students learn to recognize function in biology by encountering, describing, and considering natural objects. Students will examine structures, behaviors, and processes of plants and animals through the lens of function, and connect this function to human challenges and technologies.
3. Head back inside and explain to students that biomimicry goes beyond observing nature: that we also learn *from* nature.
  - Show the image [Two Viewpoints of a Tree](#) and explain that knowing about something might require instant recall (like a tree has leaves) but learning from that is a more complicated task (like *how* those leaves generate energy for the tree to grow), requiring deeper learning. That is our goal in biomimicry.
  - As part of this experience, they will be looking for patterns that can be found across natural

ecosystems, essentially: what does nature do well and why do we want to mimic natural forms? Invite them to consider how we are striving to emulate patterns across the natural world, such as how organisms and ecosystems:

- o Adapt locally attuned and responsive strategies
- o Are resource efficient both in materials used and energy expended
- o Cultivate cooperative relationships
- o Breakdown products into safe nutrients
- o Utilize multifunctional design
- o Recycle all materials
- o Build from the bottom up
- o Fit in modular and nested components

### **Additional Teacher Resources**

- For examples of ten patterns that can be found broadly across the majority of life on Earth, visit [Nature's Unifying Patterns](#) on the Biomimicry Institute's Biomimicry Toolbox.
- Another resource that contains additional design lessons based on nature is [Life's Principles](#), from Biomimicry 3.8.

### **Procedure Part 4**

#### **What are the essential components of biomimicry, and how do designers learn from nature?**

1. Tell students that biomimicry has three essential parts: Ethos, (Re)Connect, and Emulate and that they will need to strive for all three as they complete the YDC and work toward their design solution.

- **Ethos** refers to the aspirational goal of biomimicry. That is, understanding how life works and creating designs that continuously support and create conditions conducive to life (sustainability).
- **(Re)Connect** acknowledges that humans are part of nature. Biomimicry finds value in connecting to our place on Earth as part of life's interconnected systems, and encourages us to observe/ spend time in nature to better understand how life works.
- **Emulate** refers to the scientific, research-based practice of learning from and then replicating nature's forms, processes, and ecosystems to create increasingly regenerative designs.

2. Explain that biomimicry designers abstract terminology from biology to be used in design. During the design process of emulating an object's form, process, or system, a biomimicry designer might need to translate what an organism can do into what an engineer might understand. More will be explained on this process in the lessons to come.

3. Have students complete [The Language of Biomimicry](#) activity. Students can do this activity on their own, in small groups, or led by a teacher. Tell students that:

- Biomimicry innovations are based on the biological strategies of organisms.
- [AskNature.org](#) is a website that organizes biological strategies by function to help biomimicry designers find inspiration for new organisms.
- **Optional Extension:** Have students do an [AskNature Scavenger Hunt](#) as an independent activity.

### Optional bonus activities to further understanding and engagement:

- **Media:** Have students watch [CBS Sunday Morning: The Fascinating World of Biomimicry](#) (6:00) that introduces biomimicry designers and how they are solving problems by learning from nature.
- **Outdoor Activity:** Take students outside for [Exploring Function in Nature](#) using the Function Junction Cards Activity. The [Function Junction Activity Cards](#) allow students to work in partners using their senses to describe organisms to one another and select a function to find an organism outside that performs that function. These activities have modifications that allow for them to be done indoors.
- **Guest Speaker:** Invite a local naturalist, zoo/aquarium staff, park/garden staff, etc. (anyone who works closely with plants or animals) to speak to your class about the unique adaptations and abilities of the organisms they've encountered.

### Procedure Part 5

#### How are students like us practicing biomimicry to create nature-inspired solutions to sustainability problems?

1. If time during class or home activity: Tell the students that young people across the world have been using biomimicry to propose innovative sustainable designs. Pick either the first place winner for your grade from a previous program year or a project of general interest to the class.
  - You can review previous submissions that include project videos in the [Youth Design Challenge \(YDC\) Winners Collection](#) on AskNature.
2. Place students in small groups to view the previous YDC winners you have selected.
3. Ask the students to think about how the teams learned FROM (not just about) the organisms that inspired their projects. What do they find inspiring about these solutions?
4. Ask students to pick two teams to review and share what excited them about the problem, the steps they took to learn from nature, or the final solution.
5. Return to the [Design Brief](#) and brainstorm with the students what they will need to know and be able to do to be successful in this design project.
6. Have students begin a Biomimicry Notebook that has [a template of the submission documents](#) with a document organizer. Review each part of the submission process and briefly discuss so they understand what their final project will need to include.
7. Have each student either write a 1-3 paragraph summary of what biomimicry is or fill out the [Frayer Model](#) as an assessment to check their understanding.
  - **Optional Extension:** As an essay prompt, have students write a short 1-3 paragraph essay explaining what biomimicry is and how others have used biomimicry to solve design challenges.

## Motivate: Vocabulary

Biology  
Biological Model  
Biomimicry  
(Design) Brief  
Climate Change  
Design  
Designer  
Emulate

Engineer  
Ethos  
Form  
Function  
Innovation  
Organism  
Process  
(Re)Connect

Regenerative  
Sustainability  
Sustainable Development  
Goals (SDGs)  
System  
United Nations

## Additional Teacher Resources

- [30 Animals that Made us Smarter Podcasts](#) (15-20 minutes)
- [How Does the Star Nosed Mole Sense AskNature Video](#) (3 minutes)
- [BEETLES I Notice I Wonder Activity Guide](#) (45-65 minutes)

