Outdoor Solo: Observing Nature

Who are nature’s design champions outside our door?
Organisms with key structures or traits that make them well adapted to a particular habitat can be thought of as “nature’s design champions” for that environment. In this outdoor lesson, students spend time quietly observing local plants and animals in search of traits that help them survive and thrive. This nature exploration awakens the senses and sparks curiosity for seeing nature through an engineering-design lens.
Outdoor Solo

Standards Alignment

Next Generation Science Standards (NGSS)

Disciplinary Core Ideas

- **MS-LS1.A: Structure and Function**
  In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.

- **HS-LS1.A: Structure and Function**
  Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.

Science and Engineering Practices

- Constructing Explanations and Designing Solutions

Crosscutting Concepts

- Structure and Function
- Patterns

Objectives

- Students will increase their familiarity with the natural world around them and connect biomimicry concepts to their observations of local plants and animals.

Demonstration of Learning

Student Design Notebook entry includes drawings with labels and descriptions of organisms observed, their structures, and the possible function of the structure. With the help of team discussions, the entry will also have ideas for a biomimicry design inspired by (modeled after) one or more of the structures.

Estimated Time

1-2 classes (45 minutes)
Materials

- Student notebooks and pencil or pen
- Colored pencils (optional)
- Shoes and clothing to walk, sit, stand outdoors

Background Information

What sets biomimicry apart from other design processes is the step of identifying models from nature that effectively do what we want our designs to do. This is made possible by understanding both nature and design through the lens of function. Function, by definition, is the purpose of something. In the context of biomimicry, function refers to the role played by an organism’s traits (physical attributes, behaviors, etc.), which enable it to survive. Importantly, function can also refer to something a design solution needs to do. Once a student can identify the functions being served by biological elements, they can begin to relate those biological solutions to human technological challenges.

A nature “Solo” is an observation exercise and opportunity to reconnect with the natural world. Visiting a natural space outside the classroom allows students to hone their observation skills and to reflect on the traits and functions of the plants and animals they observe. Sitting or standing alone in silence minimizes distractions and maximizes the potential to observe animal activity and pick up on subtle sounds and movements.

Getting Ready

- Identify a natural outdoor area near your classroom or team meeting location. Select the quietest natural space where students can sit or stand alone in silence to use their senses to observe nature. When possible, try to find a place that has wild vegetation (vs. landscaped). Establish boundaries for where students can go, and for how far apart students should be from each other to encourage an individual experience.
- Decide where you will meet to start the activity (if other than classroom), how long the Solo will last (15 minutes recommended), the signal you will give to alert students that the Solo is over, and where they will gather after the Solo to debrief.
Activity

Engage
1. Ask: What plant or animal would you describe as a design champion? Why would you consider it a champion?
2. Explain: A literal interpretation is an organism in nature that has features or traits that make it very good at doing something in a given environment. In biomimicry “design champions” are organisms that have structures and processes that are great at doing something that you want your design to do. Right outside our door, we are surrounded by potential champions that could inspire designs.
3. Before heading outside for the Solo activity, spark interest and model the activity by demonstrating what they will do with the full group or with student partners.
   - Show several natural artifacts or images of plants and animals (e.g. leaf, bird feather, photo of butterfly). In Pair-Share, have students describe structures on the organism, and describe what that structure does to help the organism (i.e., the function of that structure).

Explore
1. Introduce the Solo in a classroom or outdoor circle. “We are going to take our class outside into a quiet natural space to observe plants and animals that live around us.”
   - Ask for a thumbs up/side/down for having spent quiet time alone in nature.
   - Ask for a 1-5 rating for comfort with quiet sitting or standing alone outdoors observing plants and animals.
2. Explain that spending time outside quietly observing nature is an essential part of biomimicry. In order to create a design that is nature-inspired, we want to understand and experience nature. The goal of this experience is for students to begin recognizing and describing the relationship between structure and function in nature’s organisms.
3. Set expectations for working outdoors:
   - Take only what they need: Design Notebook, pencil or pen, and colored pencils (optional). If possible, eliminate electronic device use.
   - Describe and show the site location and boundaries. Model the minimum distance between students (recommend at least 8-10 feet if space allows). Explain the stay-put requirement (sit or stand within a 3-foot area), length of time, and the teacher signal that it is time to leave this location and return to the gathering place. Have a plan for students who are challenged to stay in one place quietly for the time allotted.
4. Give students a copy of the Nature Solo instructions, going over the procedure and answering questions.
5. Silent-time: Have students walk in silence once released to find a quiet space for their Solo, and remain silent until they gather at the end of the Solo. Let them know that this will both increase the activity level of the organisms around them, and increase the chances of noticing the organisms by using all senses.
6. Signal the end of the Solo and gather in the place you designated to discuss the experience.

Explain
1. Large group reflection:
   - How did it feel sitting quietly in one place looking at nature? Did your feelings change over the time you were there? Explain.
   - What did you notice that surprised you?
2. Share notebook entries in small groups, and then share out to the full group.
   
   • Give an example of an organism’s structure or behavior that you observed and the function (purpose) you think it serves. [Accuracy is not important here; the point is encouraging students to observe with a curious mind. Hypotheses about functions can be clarified by later research.]
   • What patterns or common features did you observe among the different organisms you saw? Why do you think these organisms share those features?

**Elaborate**

1. Define biomimicry and how biomimicry designers look to nature’s design champions for inspiration.
2. Discuss: How might an organism you observed become inspiration for a new design or technology? As a class, pick a student’s example of a structure and its function. Brainstorm how it could inspire a design. This could include generating specific design ideas, or simply suggesting human challenges or fields of innovation that could be informed by the natural model. Continue as a full class with other examples or let students work in pairs.
3. Have students share some of the open-ended questions they wrote in their notebooks about the organisms observed during the Solo.
4. Choose 1-2 of the questions shared and ask the class to describe what they would need to know and understand in order to answer the question. Which of those understandings relate to the organism’s structures, functions, and adaptations?

**Evaluate**

1. Reflection: (May be done at the end of this class, or review at the beginning of the next class.) Show students the image *Two Views of a Tree*. Ask students to explain which descriptions represent how a biomimicry designer sees nature. Include a comparison of the two sides. Connect this description with one organism you observed on your Solo. Draw a graphic similar to the poster, giving the organism’s name and two types of descriptions. Mark those which represent the biomimicry viewpoint.

**Modifications and Extensions**

If you are unable to go outdoors, bring nature into your indoors.

• Collect parts of plants, feathers, fur, shells, and other parts of living things for students to touch and observe.
• Show a video or photographs of natural places nearby, including images of living things that live around you.
• Provide students with instructions for the Solo experience and ask them to find time to do it outside of class in their own favorite natural space.
Resources
All resources are indexed on the Youth Design Challenge website. To access them, log in at youthchallenge.biomimicry.org and go to the Instructional Storyline page of the Educator Resources.

- Nature Solo Instructions for students
- Two Views of a Tree

Create your own handout like the example below, or download and print from the copy provided with the Resources on the Youth Design Challenge Website.

**Nature Solo Instructions**
Sit or stand in your Solo Place (about a 3-foot radius circle around you). Observe the living things that are around you. Pay attention to sights, sounds, and smells. Record your observations in your Design Notebook (e.g., in a table or drawings with labels). Pay attention to structures and behaviors in the plants and animals that you observe. Think about their possible functions (purposes) for the organism. How do they help make it well-adapted to its habitat?

1. Sit quietly, looking and listening to the plants, animals, or other organisms around you.

2. Observe: What structures or characteristics do these organisms have that help them survive and thrive? Write about or draw 3-6 of these structures or characteristics in your Design Notebook.

3. For each structure or characteristics, complete the statement:
   “The __________________’s __________________ makes it a champion at ________________.”
   organism characteristic function

   Example: The bat’s wrinkled nose makes it a champion at capturing sound waves.”

4. Write several (8-12) open-ended questions about the organisms you are observing. Begin all questions with why, how, what, when, where, which, or who.

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