

# Biomimicry

## A bite-sized introduction

Advance Copy, v.1



### Lesson 5

## Learning to Make Connections between Nature's Abilities and Human Aspirations

*Duration: 1-2 class periods (~50 min each)*

*Grades: 6-12*

#### What students do:

Students begin exploring the process of making connections between nature's abilities and human needs/wants, the basis of how biomimics draw inspiration from nature for innovation.

#### Learning objectives:

1. Students gain familiarity making functional connections between nature's abilities and human needs/wants.
2. Students gain experience brainstorming innovations inspired by nature.
3. Students gain experience communicating their ideas to their peers.
4. Students gain an understanding of analogies.
5. Students gain experience sharing their work.

#### Materials:

- Slide deck for Lesson 5
- Drawing materials or digital tools for students to use to create an illustration for a proposed biomimicry invention.

### Getting Ready

- Review the provided slide deck, suggested discussion questions, and activities.
- Determine how you want students to present their biomimicry invention ideas.

### Procedure

#### Check in

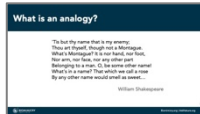
Have students share and discuss entries from their biomimicry journals.

#### Discussion

**Engage** students in a discussion about the role of analogy in biomimicry, using the provided images and excerpts.

**Discussion Guide:**

**Slide 1: Biomimicry: A bite-sized introduction.** Lesson 5: Learning to Make Connections between Nature’s Abilities and Human Aspirations.



**Slide 2:** First, what even is analogy? Work inductively with students, presenting some examples of analogy. For instance, how is this famous excerpt from Shakespeare’s play, *Romeo and Juliet*, an analogy?

*'Tis but thy name that is my enemy;  
Thou art thyself, though not a Montague.  
What's Montague? It is nor hand, nor foot,  
Nor arm, nor face, nor any other part  
Belonging to a man. O, be some other name!  
What's in a name? That which we call a rose  
By any other name would smell as sweet...*

In the play, Juliet and Romeo are in love, however they come from warring families, and this creates difficulties for the would-be couple. Romeo is a Montague. In this selection, Juliet is speaking. Here, she makes an analogy between the superficiality of the name “rose” and the actual sweet smell of a rose, and the family name “Montague” and the actual lovability of Romeo.

How does this analogy help explain what Juliet is feeling? We understand the logic that a rose smells sweet regardless of what it’s called, and understand that were a rose known by another name, it would be silly to think this changed how it smelled. By using analogy, Shakespeare quickly and powerfully communicates the absurdity of Romeo’s family name getting in the way of their relationship. Analogy can transfer ideas from one situation (what roses are called and how they smell) to another situation (complicated love between people).



**Slide 3:** Another example of analogy comes from Maya Angelou’s poem, *Caged Bird*:

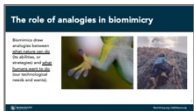
...a bird that stalks  
down his narrow cage  
can seldom see through  
his bars of rage  
his wings are clipped and  
his feet are tied  
so he opens his throat to sing.

Throughout the poem a contrast is drawn with free birds. This selection describes several things about a caged bird, especially how the bird suffers from imprisonment, even if the bird isn't fully aware of this suffering. Do we think Maya Angelou really wanted to write about birds, or is she making an analogy to something else? Why is it effective to make an analogy between caged birds and the much bigger topic of oppression of people? By making an analogy between a large and complex topic (the oppression of people) and a simple, easy-to-picture phenomenon like a caged bird, it makes it easier for the reader to think about and access their feelings about a bigger, more difficult topic.



**Slide 4:** Another example of analogy comes from the MONIAC device. The MONIAC (Monetary National Income Analogue Computer) uses water flows to model the national economic dynamics of the U.K. It was created in 1949 by New Zealand economist Bill Phillips. How does the device make an analogy? What are the advantages of explaining economics this way?

The MONIAC makes an analogy between water flowing through a series of tanks and pipes and money flowing through the economy. The physical representation of the “flow” of money makes it easier to see how spending impacts the economy. (Read [more about the original MONIAC](#) on Wikipedia).



**Slide 5:** What role does analogy play in biomimicry? Biomimics draw analogies between what nature can do (its abilities, or strategies) and what humans want to do (our technological needs and wants).

How do biomimics use analogies in the examples of biomimicry we've learned about so far? Refer to examples of biomimicry that the class has learned about. Have students explain the analogies that were made by biomimics in each case.

As one example, biologists drew an analogy between how geckos climb walls and how humans might be able to adhere to surfaces without glue.

## Activities

Use the following activities to **extend** student learning.

### **AskNature Game**

In this activity, students will practice connecting biological strategies with analogous human needs.

- 1) Divide the class into two or more teams.
- 2) Randomly choose a biological strategy from [AskNature](#) and present it to the teams.

- 3) Students race to come up with related (analogous) human needs/wants, or situations in which people could potentially learn from that biological strategy.

The teacher serves as the referee and each approved analogous situation gives that team a point. (If meeting asynchronously, you can choose some biological strategies from AskNature and have students try to come up with related human needs/wants on their own.)

Example: Let's say you pick the strategy, "[Whiskers sense prey movement](#)," about how seals use their whiskers to sense the movement of prey in dark water. In what situation might humans find such an ability useful? How about searching for something in a backpack? Or finding one's way to the bathroom at night?

### **Propose a biomimicry invention**

Have students apply what they've learned by coming up with an idea for a biomimicry design and presenting it to their peers. You can choose what format you want students to use. A fun idea is to treat it like a "Shark Tank" pitch, product commercial, or advertising jingle, etc.

1. Go outside to observe nature and identify an inspiring ability of an organism. How does the function performed by the organism's adaptation(s) relate to things humans want/need to do?
2. Brainstorm an idea for an invention that helps people, inspired by the functional design they've identified in nature. Create a drawing or diagram that helps to communicate your idea.
3. Present the idea to the rest of the class.

Example: A spider's ability to spin silk to help it safely catch the wind and disperse could help make air travel safer by inspiring a new type of parachute that quickly deploys from a failing aircraft.

### **Modifications**

If it is not possible or safe for your students to go outside, the biomimicry invention activity can be modified by having students choose an organism they are interested in (e.g. from AskNature or another source) and brainstorm an invention from there.

## Lesson Feedback

This lesson is part of an advance release of five lessons within a ten-lesson unit of study that is currently in development. If you teach this lesson, we would love to hear how it went and any thoughts you may have for improving it. Please share your feedback via the following survey link: <https://forms.gle/MGQGX8NAg6MLSGHY6>

## Resources

- The original MONIAC: <<https://en.wikipedia.org/wiki/MONIAC>>
- Another MONIAC installation and video <<https://danieldebruin.com/moniac/>>
- AskNature Strategy. "Whiskers sense prey movement: Harbor seal." <<https://asknature.org/strategy/whiskers-sense-prey-movement/>>
- AskNature <[AskNature.org](https://asknature.org/)>

## Standards Alignment

### Next Generation Science Standards (NGSS)

#### Science and Engineering Practices

- Engaging in Argument from Evidence.
- Asking Questions and Defining Problems.
- Evaluating, and Communicating Information.
- Constructing Explanations and Designing Solutions.

#### Crosscutting Concepts

- Structure and Function.
- Connections to Nature of Science: Science is a Human Endeavor.

### Common Core State Standards (CCSS)

- ELA-LITERACY.SL (Speaking & Listening).6-12.5/6