



Lesson Time: 15–20 minutes

## Ideas from Nature

### Objectives & Outcomes

**Lesson Objectives:** Students will learn how scientists and engineers get their ideas from nature through a case study.

**Lesson Outcomes:** *Students will be able to...*

- describe the mechanism behind the Hercules beetle
- brainstorm ideas for a device based on biomimicry

**Subject Area Connection:** Science/Engineering

### Background

Scientists use ideas from many sources to design and improve things we use each day. How can nature help us solve problems? In this lesson, students will investigate the question: “Where do we get our ideas?” by recognizing that people can learn from nature’s designs. The example in this lesson will be the Hercules beetle, which changes color under certain environmental conditions.

“How can **nature** help us **solve problems?**”

### Introduction and Modeling

Begin by talking to students about things we use every day. Where do people get ideas for the products we use? Sometimes, ideas come from nature. The application of nature’s designs is called biomimicry. One example is Velcro, the two-sided sticky, hook system used in many places, especially sneakers. Share with students that Velcro was invented in the 1940s when a Swiss engineer noticed burrs on his dog. When he examined the burrs under a microscope, he saw tiny hooks that caught onto anything with a loop such as clothing fibers or hair. Tell students that they will read a short text on another example of biomimicry, the Hercules beetle.

### Getting Ready

**Teacher Preparation:** To prepare for this lesson, read the background information on the Hercules beetle. (attached)\*

**Materials Required:**

- paper
- pencils, markers
- background information on the Hercules beetle (attached)\*

### Key Vocabulary

**biomimicry:** using an idea from nature to solve a human problem.

**humidity:** a measure of the amount of water in the atmosphere.

## Procedure

1. Give students time to read the text on the Hercules beetle or read it aloud in class.
2. Put students into pairs or small groups.
3. Students will work together to brainstorm a device that uses the mechanism utilized by the Hercules beetle.
4. Encourage students to make sketches of their design and to elaborate on the purpose of their device.

## Discussion Questions

- Why would a plant need to produce a burr that attaches to other things?
- Can you suggest an idea for why the Hercules beetle changes color with humidity? What advantage does this give the insect?
- What other things do scientists use for inspiration to solve problems?

## Evaluation

Ask students to draw a picture of the Hercules beetle in both dry and humid environments. The sketch should include a close-up of the cells in the filaments in both dry and humid environments.

## Tips for Tailoring this Lesson

### For Higher Grade Levels

- Ask students to design a new product using an idea from nature for inspiration.
- Ask students to identify existing products that mimic nature's design.

### For Lower Grade Levels

- Challenge students to suggest a new use for Velcro.
- Ask students what inspired the design for the following items: airplane, glue.

## Alignment to Standards and Frameworks

### Common Core State Standards:

#### College & Career Readiness

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#### Anchor Standards for Speaking and Listening

**CCRA.SL.1** Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

#### Anchor Standards for Reading

**CCRA.R.1** Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

### Next Generation Science Standards

Next Generation Science Standards: based on the Framework for K–12 Science Education developed by the National Research Council. Publisher: Achieve, Inc. on behalf of the twenty-six states and partners that collaborated on the NGSS. ©2013 [www.nextgenscience.org](http://www.nextgenscience.org)

#### MS-ETS1-2

Evaluate the competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

# Background Information on the Hercules beetle

Many organisms have certain features that give it an evolutionary advantage. For example, honeycombs are hexagonal because that shape offers the best strength, ample space, and uses a small amount of wax. Scientists have studied nature's designs in part to provide inspiration for real-world human application. The Hercules beetle is one such insect. It is commonly found in Central and South America. It gets its name from its large size and its ability to carry up to 850 times its weight. It can grow to be up to 17cm in length. Another unique feature of the beetle is the fact that its wings change color from green to black depending on the humidity of the environment. Scientists have determined that the manner in which this reversible change occurs is rare. There are tiny holes within the filaments of the beetle's wings. When the environment is dry, the holes are filled with air. However, when the environment's humidity level increases, the holes fill with water. This difference causes a change in how light is refracted by the wings. This is the mechanism behind the reversible green to black color change. Even more interesting is the fact that scientists do not know a definitive reason for why this change even occurs. No one knows what advantage this characteristic provides to the beetle.