

**Bio/Diversity Project
 Biomimicry in the Sonoran Desert**

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Grade Level: 8th grade

Common Core Standard:	<p><i>CCSS.ELA-Literacy.CCRA.W.8.1: Write arguments to support claims with clear reasons and relevant evidence.</i></p> <ol style="list-style-type: none"> <i>Introduce claim(s), acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.</i> <i>Support claim(s) with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text.</i> <i>Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.</i> <i>Establish and maintain a formal style.</i> <i>Provide a concluding statement or section that follows from and supports the argument presented.</i>
Content Objective: Science	<ul style="list-style-type: none"> <i>Students will be able to use define the term biomimicry.</i> <i>Students will be able to explain how engineering design and redesign relates to biomimicry, and how this can help solve society's challenges.</i> <i>Students will use teamwork and problem solving to complete activities.</i>
Language Objective: (Optional)	N/A

Vocabulary	Materials
<ul style="list-style-type: none"> Biomimicry Engineer Invention Materials Patent Systems 	<ul style="list-style-type: none"> Computer Biomimicry Worksheet (attached under “Exploratory Activity”)

<p>Guiding Questions:</p> <ul style="list-style-type: none"> What are some ways in which nature is sustainable? Can you think of any adaptations that Sonoran Desert plants, insects, and/or animals have that would make your life easier? Can you think of any inventions that could be improved if they were more like Sonoran Desert plants, insects, and/or animals? Can you think of any cultures or peoples who have modeled their tools from environmental designs? Why is biodiversity important for biomimicry to work? Why is diversity important in coming up with new science and engineering designs? Why is biomimicry useful for humans? Think about the amount of time it would take you to create a leaf from scratch, with no idea of what a leaf is – it would be incredibly difficult. But think about inventing a leaf based on an existing design of another leaf – not only would it be easier to work from, but your invention would probably work better because it uses thousands of years of evolution that the leaf has already had to go through.

**Engagement/Introductory Activity:**

- Introduce the concept of the lesson by using a Ted Talks video on biomimicry
 - “Designer and architect Neri Oxman is leading the search for ways in which digital fabrication technologies can interact with the biological world. Working at the intersection of computational design, additive manufacturing, materials engineering and synthetic biology, her lab is pioneering a new age of symbiosis between microorganisms, our bodies, our products and even our buildings.”
 - https://www.youtube.com/watch?v=CVa_IzVzUoc-powerpoint
- Show students a PowerPoint on biomimicry and ask them the “Guiding Questions” to advance the presentation

Exploratory Activity:

Provide students with the following worksheet that asks them to engineer a biomimicry product. Discuss the terms “invention” and “patent”, and why patenting a scientific idea is important. Do patents have to be novel ideas? (Yes)

Biomimicry Worksheet**Engineering Teamwork and Planning Phase**

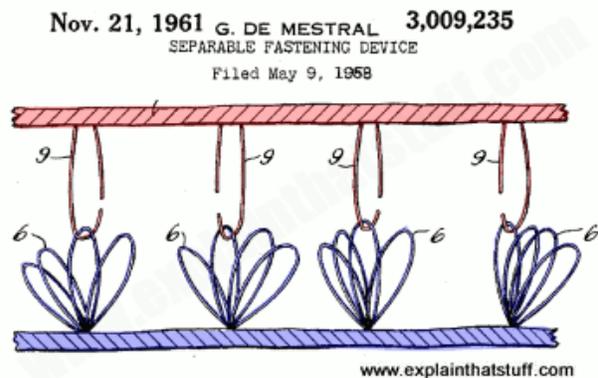
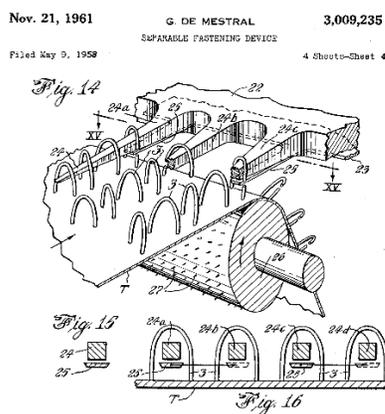
You are part of a team of engineers and are given the challenge of developing a system or a building that would be located on the moon. It must be modeled from a product or system found in nature on Earth. You'll research ideas online, then work as a team to develop a drawn diagram. You'll also consider patenting your idea, and will present your design to the class.

Research Phase

Read the materials provided to you by your teacher. If you have access to the internet, visit Asknature.org and take some time to explore the various challenges and solutions nature has to offer. For example, you might search for "store oxygen" or "termites" or anything related to what you are considering working on. Gain ideas by seeing what others are working on.

Design Phase

Leonardo da Vinci studied how birds flew and drew intricate illustrations of his designs in preparation for construction. In the same way, George de Mestral, a Swiss engineer hiking in the Alps found that many burrs from a burdock tree were sticking to his clothing... he later invented what is now known as Velcro. He also had to draw his ideas in order to gain a patent for his invention. Mechanizing the process of weaving the Velcro hooks took eight years, and it took another year to create the loom that trimmed the loops after weaving them. After a decade, he finally created a mechanized process that worked. He submitted his idea for patent in Switzerland in 1951 and the patent was granted in 1955. Check out Mestral's patent designs below:





Now it's your turn!

- On a separate piece of paper draw a detailed diagram showing several views of your system, similar to what might be required for a patent.
- Below the drawing, list the materials that you might need for your biomimicry invention and include a paragraph or more describing how it works and how it relates to nature.
- Answer the question – What about your design is an example of biomimicry?

Presentation Phase

- Present your ideas and drawings to the class
- Explain the example of biomimicry in your invention to the class – what is it modeled after in nature?
- Complete the questions in the reflection sheet (below)

Explanation Phase

Reflection Sheet

1. What was the most interesting proposed use of biomimicry that was developed in your class presentations? Why?
2. Do you think that your design is patentable? Is it unique enough to be approved?
3. Do you think your product, building, or system would work if it were manufactured?
4. Do you think that you could raise the funds necessary to pay for manufacturing? How would you go about raising funds?
5. Do you think that many engineers explore using nature in their inventions?
6. Did you think that working as a team made this project easier or harder? Why?

Extension Activity/Questions:

- Write an essay or a few paragraphs about one example of how past/current cultures or today's engineers have looked to nature to find solutions to societal challenges.

Evaluation Activity:

- Ask students – What are some aspects of the nature in Tucson (in the Sonoran Desert) that you could imitate to create more sustainable products?