

SIEMENS STEM DAY ACTIVITY

DESIGN ALL AROUND US

OBJECTIVES

Students will be able to:

- **Analyze** how effective design enables plants and animals to thrive in nature,
- **Apply** that knowledge to a product in order to create an original design, and
- **Evaluate** computer aided designs presented by their peers.

STEM LESSON FOCUS

Engineering Design Cycle

- Designing Solutions

21st Century Skills

- Critical Thinking

LEVEL OF DIFFICULTY

2

GRADE RANGE

9–12

ACTIVITY TIME

45–60 min

BUSINESS CATEGORY

IT

TOPIC

Attributes of Design

OVERVIEW

It's no secret that nature is a master designer. Craftsmen and engineers often look to the plants and animals around us for innovative solutions to design challenges. For instance, when designing the Airbus A350XWB, aerospace engineers observed how seabirds could sense gusts of wind with their beaks and react by adjusting the shape of their wing feathers. The nose of the new aircraft contains probes which detect gusts of wind (much like the beaks of the seabirds), and deploys movable wing surfaces to maximize efficiency.¹

In this lesson, students will examine images from nature. They will then be handed the name of a random product. The student must “mash up” the product with one design influence from nature and present the product design to their peers using a Computer Aided Design software.

¹“Biomimicry.” Airbus Commercial Aircraft. 2017. <http://www.airbus.com/company/eco-efficiency/biodiversity/biomimicry/>.

MATERIALS

For this lesson, students will need:

- ***Mother Nature Mash-Up Student Worksheet***
 - Product List Teacher Resource
 - A tablet or computer with access to the internet and CAD software installed*
- Note: prior to engaging in this classroom activity, it is recommended that educators familiarize themselves and their students with CAD software.

*Free CAD software is available for educators and high school students from several online resources including:

[Siemens PLM Solid Edge](#)

[Google SketchUp](#)

[Tinkercad](#)

[Blender](#)

HAVE YOU EVER WONDERED...

How a shark glides so easily through the water? If you look closely at shark skin under a high-powered microscope, you'll see lots and lots of tiny, overlapping scales. The scales have grooves in them that align with the flow of water. This helps a shark to cut through turbulence in the water with ease. Designers have mimicked this overlapping scale design to make everything from the hull of boats to the swimsuits of Olympic athletes more efficient at cutting water resistance.²

How we can learn from the plants and animals around us in order to solve the pressing challenges facing society? Biomimicry is the name given to the process of applying design principles from nature to the products, policies, and processes that humans create. Scientific principles such as competitive exclusion and natural selection have refined species over millions of years. We can ascertain sound design principles by learning from what has (and hasn't) worked in nature.

²Gunther, Shea. "8 amazing examples of biomimicry." Mother Nature Network. October 6, 2016. <http://www.mnn.com/earth-matters/wilderness-resources/photos/7-amazing-examples-of-biomimicry/sharkskin-swimsuit>.

MAKE CONNECTIONS!

How does this connect to students?

Sometimes the most innovative solutions are right under our noses. This activity will encourage students to think critically about how the principles of nature transcend our forests and oceans and apply to the products they love, like sneakers and mobile devices.

How does this connect to careers?

Material Scientists use the properties of matter to improve the design of products in many realms, from the creation of non-stick cooking surfaces to the design of moisture-wicking clothing meant to maximize athletic performance.

Biomedical engineers combine expertise in manufacturing design with the scientific principles of biology in order to create effective solutions in a variety of industries.³

Industrial Designers combine art and engineering to make elegant and effective products.⁴

How does this connect to our world?

Students will look at their environment in new ways when they see how nature is full of innovative ways to improve products, processes, and policies. They will mash up old and new ideas in order to create a product with a unique solution.

If you want students to further explore career opportunities connected to this topic, please allow for more classroom time.

BLUEPRINT FOR DISCOVERY

Follow the instructions below to complete the activity.

1. Provide each student with the following
 - a. Smartphone or tablet that is sufficiently charged, connected to the internet, and has a CAD software application downloaded
 - b. One copy of the ***Mother Nature Mash-Up Worksheet***.
2. Allow students 10 minutes to use their device to find examples of the following design principles in nature—balance, emphasis, movement, pattern, repetition, proportion, rhythm, variety and unity. Students will write the name of the object found in nature that displays the following principle and draw a sketch of

³U.S. Bureau of Labor Statistics. "Occupational Outlook Handbook: Biomedical Engineers." December 17, 2015. <https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm>.

⁴U.S. Bureau of Labor Statistics. "Occupational Outlook Handbook: Industrial Designers." December 17, 2015. <https://www.bls.gov/ooh/arts-and-design/industrial-designers.htm>.

how that object embodies the principle listed using the *Mother Nature Mash-Up Student Worksheet* to capture their work.⁵

3. Explain to students that nature often inspires new inventions or designs to solve human problems. Using the provided *Product List Teacher Resource*, randomly assign each student a different product.
4. Instruct students that they must combine one of the natural elements and design principles from the sheet with their assigned product to create a Mother Nature Mash Up. They will then use the Computer-Aided Design software to draw a prototype of this mash up design and present it to their class. Available free CAD software provides a platform for students to draw in 3D. Invite students to share out how can CAD help engineers avoid costly mistakes.
5. Allow students 20 minutes to draw their product in CAD software, providing assistance as needed.
6. When students have finished their Computer-Aided Design (CAD) drawing, ask them to form a group with the other students who used the same design principle (for example, all students who used the principle of symmetry in their product designs would form one group).
7. In their groups, students will observe how the same principle has been used to enhance a variety of products. Invite student groups to share out to explain why their design principle is important, where it can be found in nature, and what products they have enhanced with its use.

TAKE ACTION!

Inspired? Students and educators can use the following resources to learn more about biomimicry, CAD drawing, and design principles:

[The Biomimicry Institute](#)

[Google Sketch-Up Blog](#)

[Siemens PLM Corporate Blog](#)

[Blender Nation Blog](#)

[Tinkercad Blog: From Mind to Design in Minutes](#)

[Understanding Formal Analysis: Principles of Design—The J. Paul Getty Museum](#)

NATIONAL STANDARDS

[International Society for Technology in Education](#)

III. Technology Operations and Concepts—Students demonstrate a sound understanding of technology concepts, systems and operations.

Students

A. understand and use technology systems

B. select and use applications effectively and productively

⁵The Paul J. Getty Trust. "Principles of Design." 2011. https://www.getty.edu/education/teachers/building_lessons/principles_design.pdf.

Directions: Nature can be our best teacher when it comes to the principles of design. For each principle listed below, find one natural object where that principle can be found. Then, sketch how you see that design principle at work in the natural object you chose.

Design Principle	Natural Object	Sketch of Principle
Balance		
Emphasis		
Movement		
Pattern		
Repetition		
Proportion		
Rhythm		
Variety		
Unity		