

Biomimicry Learning Activity

Grade Level: 5th grade and up. (Activity should be facilitated by an adult.)

NGSS Cross-Cutting Concepts: Structure and Function; Patterns.

NGSS Practices: Designing Solutions, Communicating Information

Goal: Participants become comfortable with the concept of biomimicry by better understanding the relationship between structure and function, both in nature and in the designed world.

Resources:

- Poster or large sheets of paper.
- Markers/Pens/Pencils
- Nature's Secrets Cards (provided with the activity).
- [Whale and Dolphin Conservation Biomimicry video](#)

Vocabulary:

Adaptation: a displayed behavior or structure of an organism that helps it become better suited to survive.

Biomimicry: A designed product or system that was inspired by the structure and function of a particular organism's adaptation.

Function: the purpose or effect of something (in this case the structure). How or what it is used for.

Structure: the physical make-up of something. The way it looks, feels, or is arranged; its observable features.

Biomimicry Activity

Section One: Watch WDC Biomimicry Video

The participants and facilitator should [watch the video](#) for an introduction to the concept and key terms. Feel free to stop the video when necessary if participants have questions or need clarification. After the video and before moving to the next section, make sure participants feel more comfortable with the concept of Biomimicry. The facilitator can ask one or all of the following questions:

1. What did you feel was the most interesting example of biomimicry in the video?

2. In your own words, can you explain why companies are looking at humpback whales' pectoral fins in the field of biomimicry?
3. What is the role of **structure** and **function** in nature and in biomimicry?

Section Two: Practice identifying structure, function, and examples of biomimicry.

After watching the WDC Biomimicry video, the facilitator provides participants with the "nature's secrets cards." They can work through all five nature's secrets cards or you can pick and choose specific ones. It is recommended that participants work through a minimum of two.

Before participants look at the nature's secrets cards, explain the activity.

- Participants will read through each card. A "T-Chart" is provided on each card, which the participants need to fill out identifying the **structures** and **functions** of that particular nature's secret card. Note: You may not need all of the lines provided.
- Next, participants will write down inventions or product ideas based off of these **structures** and **functions**. Encourage them to come up with as many ideas as possible for each nature secret card.

Facilitator Note: Participants take the lead in this section. However, the facilitator should stay engaged to make sure that participants are moving forward in the right direction identifying **structures**, **functions**, and writing down their inventions/product ideas.

Section Three: Invent A New Product

Have participants pick one of their inventions/product ideas from the nature's secrets cards and create a two-minute pitch, commercial, skit, or poster that advertises their invention/product. You may need poster paper, pens, and any props participants want to use for presentation.

The two minute presentation should include:

- Explain how the invention was inspired by a structure in nature.
- Describe the function of the invention. What does it do?
- If you have multiple participants, make sure everyone is involved in the presentation.

To get started, you can provide the following example to participants to reference and help guide their presentation.

State the problem your product will resolve:

Does your cat make too much noise?

Introduce the product:

Introducing, Kitten Mittens!

Explain how the product works:

Our patented mitten technology creates an insulated pad that muffles the sound of your noisy kitten. They're designed based off of the proven stealth technology of the red panda.

Provide expert witness:

I'm field biologist Dr. Tanaka and I've been studying red pandas for 30 years. The secret to their stealth is in the structure of the red pandas' padded foot. Take a closer look. Our mittens copy this structure giving your kitten the quietest mittens on the market!

Show the product in action:

Go from this (loud walking) to this (silent stalking)
with, Kitten Mittens!

Provide satisfied customer testimony:

I used to stay up all night because of my noisy kitten. But now I sleep like a rock thanks to Kitten Mittens!

Students present their new product!!

Facilitator Note: As participants start to create their presentation, make sure to check in with them to make sure they're on the right track. Facilitator should guide the participants as much as they need to be guided, and remind them of what needs to be included in the presentation.

Section Four Reflection:

Participants are asked to work through the following prompts to complete the activity. Please use the space provided for your answers.

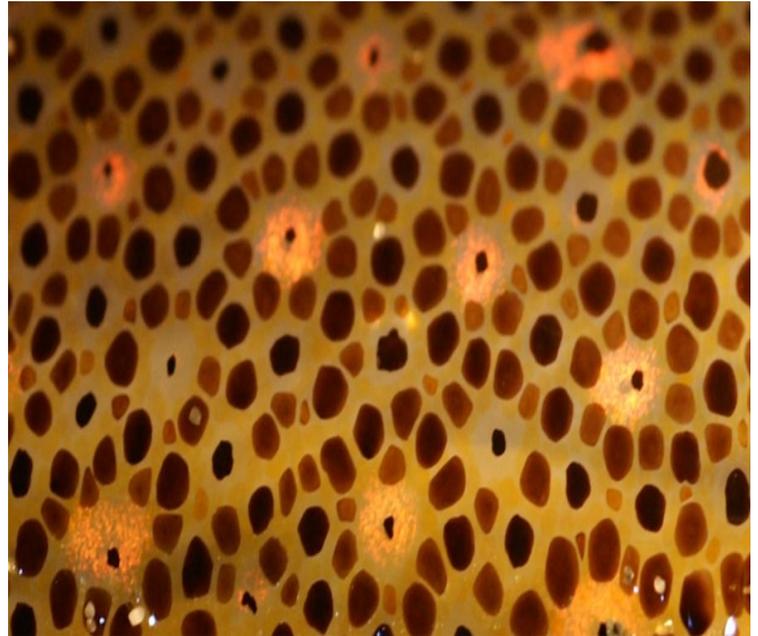
Define biomimicry in your own words.

Why do you think biomimicry is so important?

Look around your house at various items for ten minutes. As you look at these objects, do you think any could have been inspired by something in nature? If so, write the name of the item and what its inspiration might have been.

Nature's Secrets Card: Octopus Chromatophores!

An octopus is a fascinating animal that has captured the curiosity of humans for decades. Part of this curiosity stems from an octopus' ability to **change the color of its skin to seemingly camouflage with its surroundings**. This ability is used by an octopus to **ambush their prey or hide and/or escape from predators**. The secret of an octopus' ability to camouflage is found in **specialized cells in the skin called chromatophores**. Each **chromatophore** contains **pigments of various colors (red, yellow, brown, and black)**. The **chromatophores can expand or contract**, which **allows the octopus to control how much light is exposed to each chromatophore**, thus **giving it the ability to camouflage**.



Octopus Skin (Chromatophores)

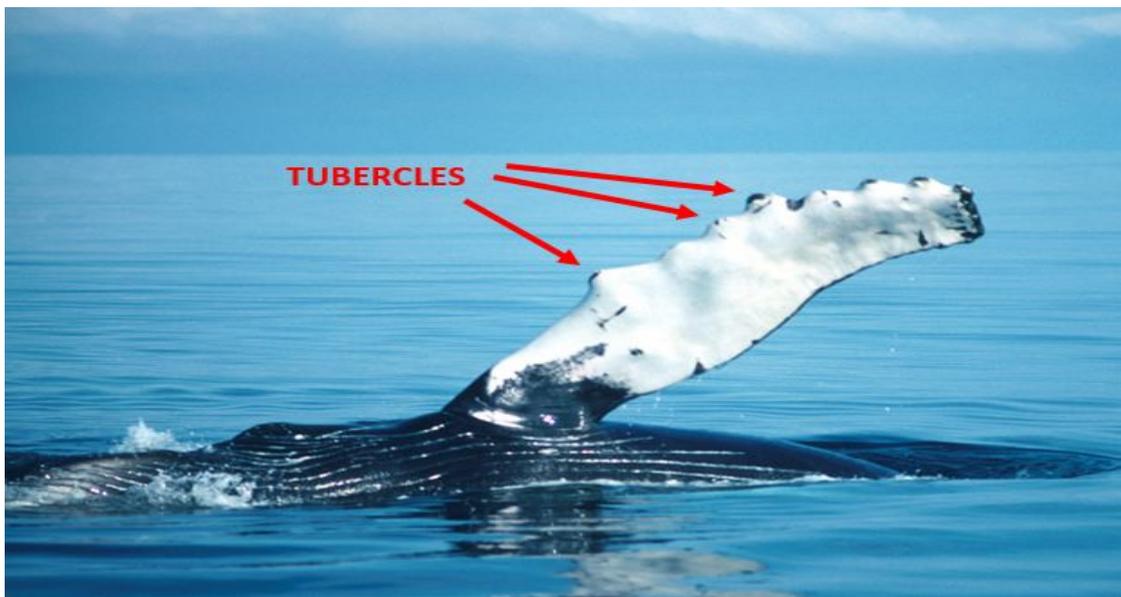
Structure	Function

Invention/Product Ideas:

- 1.
- 2.
- 3.

Nature's Secrets Card: Humpbacks' Pectoral Flippers

Humpback whales are incredible animals! Their pectoral flippers are thought to be the largest appendage of any animal on earth. Not only that, these pectoral flippers have bumps called tubercles that line the front side of the flipper. The tubercles have been found to increase a humpback's agility, grip, and balance in the water, as well as support their ability to lift out of the water. This is amazing, as mature humpbacks can weigh up to 66,000 pounds and be 40 feet long! These round knob-like tubercle structures ultimately provide a humpback various and unique methods to capture food, such as bubble-net feeding. In bubble-net feeding, humpbacks can swim in tight enough circles that they produce bubbles of only five feet across the water! This is all thanks to the tubercles on the pectoral flipper!



Tubercles

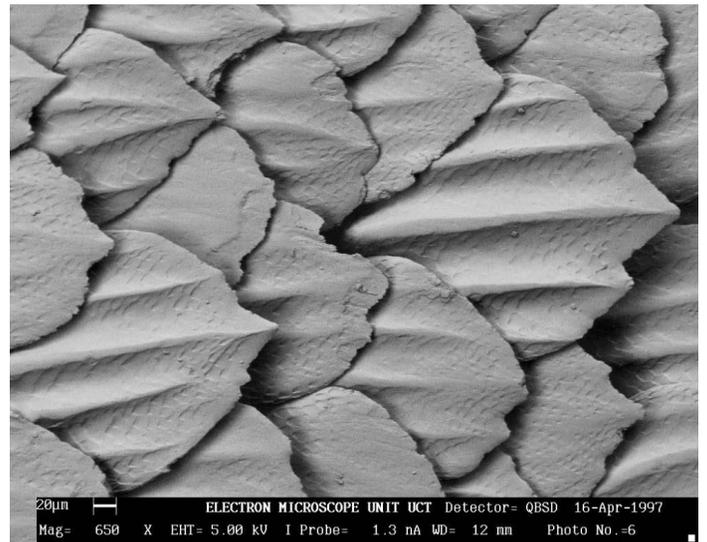
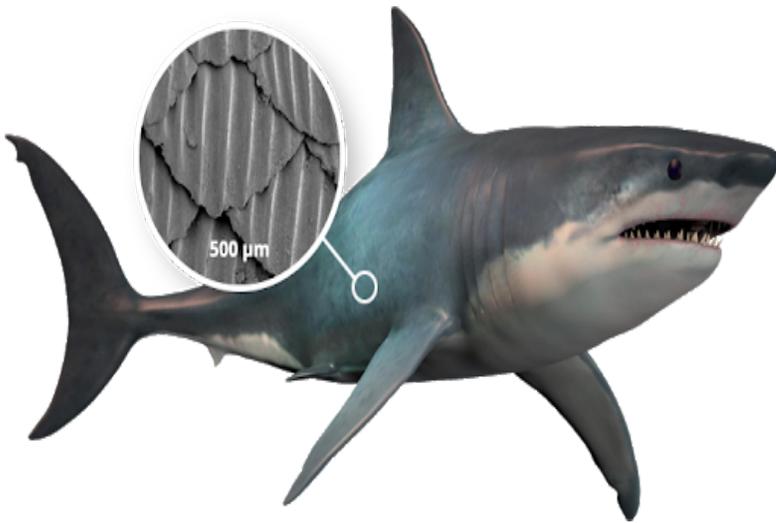
Structure	Function

Invention/Product Ideas:

- 1.
- 2.
- 3.

Nature's Secrets Card: Shark Skin

Under a specialized microscope, it was discovered that shark skin is constructed of many **overlapping scales** called dermal denticles. These specialized **scales** have **raised grooves that flow with the water**. These **grooves** help the shark **move through the water faster**. Also, the **rough structure of these scales** make it extremely difficult for barnacles, algae, and parasites to grab hold of this surface and grow.



Shark Skin

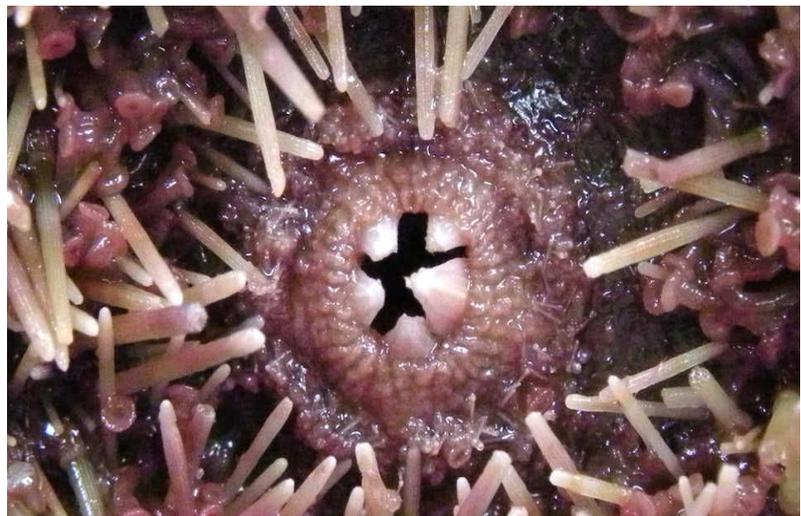
Structure	Function

Invention/Product Ideas:

- 1.
- 2.
- 3.

Nature's Secrets Card: Sea Urchin Teeth

What an interesting looking creature! Most likely you recognize a sea urchin for its army of pointed spines fending off potential predators. However, another unique feature of the sea urchin is found in the structure of their teeth. The teeth are made of **layers of strong calcite crystals that take on different forms (fibers and plates) arranged crosswise**. Between these crystals exists **weaker organic material** that is designed to **easily break** (like the edge of a piece of paper) when stressed. When the weak organic material breaks, it provides a new **sharp point** for the sea urchin. These **sharp points** help sea urchins **cut through hard or tough surfaces like rocks to look for food and find shelter**. The teeth are always growing, so this **self-sharpening** process continues throughout a sea urchin's life.



Sea Urchin Teeth

Structure	Function

Invention/Product Ideas:

- 1.
- 2.
- 3.

