Bio-inspired Protection

Learning Objectives

- Students will learn about adaptations of plants and animals that help protect themselves in their environment.
- Students will explore how biomimicry uses plant and animal adaptations when creating new products and solutions.

Activity Overview

- Students will design gear that protects a client from an impact by drawing inspiration from how plants and animals protect themselves.

Standards Addressed

- **SC.4.N.3.1** - Explain that models can be three dimensional, two dimensional, an explanation in your mind, or a computer model.
- ***SC.5.P.13.1*** – Identify familiar forces that causes objects to move, such as pushes or pulls, including gravity acting on falling objects.
- **SC.5.L.17.1** - Compare and contrast adaptations displayed by animals and plants that enable them to survive in different environments such as life cycle variations, animal behaviors, and physical characteristics.

Materials

Item	Quantity Needed	Notes
Measuring tape	1	
Duct tape	1 roll	
Masking tape	1 roll	
String	1 skein	
Floral foam	2 blocks	*5"x5"x10"*
Gallon bags	2	
Hole punches	2	
Washers	24	
Felt sheets	6	
T-shirts	6	*Large*
Plastic grocery bags	12	
Plastic cups	18	*1 oz*
Plastic dessert plates	18	
Craft sticks	96	
Toothpicks	240	

Preparation

- Put each block of floral foam in a plastic bag. The bag is intended to contain any floral foam dust or particles created during the testing process.
- Make a set of materials for each group: 1 sheet of felt, 1 t-shirt, 2 grocery bags, 3 plastic cups, 3 dessert 16 craft sticks, 40 toothpicks

Science Content

Materials engineers use their understanding of the properties of different materials (such as metals, plastics, or woods) to design and improve technologies. Materials engineers explore the properties of different materials to help them choose which material will work best to solve the problem.

Bioinspiration is the act of being inspired by living things. Bioinspired engineering is a growing field that integrates the knowledge of natural sciences with engineering to develop technologies that are often more sustainable than technologies that are not inspired by nature. Many technologies are bioinspired, such as Velcro strips inspired by plant burrs, or aerodynamic cars shaped bike boxfish.

Source: EiE Engineering Bioinspired Gear

Facilitation Guide

Engage (10 minutes)

1. Tell students that today they will design an article of clothing inspired by the various ways animals and plants protect themselves. What are some ways that animals and plants can stay protected?
    - Skunks release a smell, turtles have a strong shell, lions have sharp claws and a loud roar, etc.
2. Introduce the scenario of today's activity: a sports client would like you to create a form of gear to help protect their stomach from impact.
3. Show the students some of the materials available to them and ask how some of them could be used.
    - Can you think of a bioinspired use for toothpicks? *They are sharp at the ends, serving a similar function as porcupine quills.*
    - What could be a bioinspired use for cups? *They are hard, so they can function like a turtle shell.*
4. Tell each group that they will only get one t-shirt, so they have to plan their design carefully before they create.

Activity (45 minutes)

1. Using the list of plant and animal protection examples, have groups plan out what adaptations they will use to inspire their design and what materials they will use. Once they have come up with a design plan, have ONE student come and grab a tray of materials.
2. Let groups know they will have about 30 minutes to create their design.
3. As they are building, circulate around the room and ask:
    - What is the bioinspiration for your design?
    - What materials will your group use?
    - How will your design meet the needs of the client?
4. Once time is up, have groups test their design by placing their t-shirt over a block of floral foam in the gallon bag. Each side of the foam block should be designated for one group to test on, so there is no confusion over any divots left from another test.
5. Have groups loosely tie several washers together with a piece of string and drop them from 1 foot above the gear. Then, have groups check to see if the washers leave a mark on the foam.
6. Allow the groups about 7 minutes to improve their design. At this time, groups can use more materials if they would like.
7. Conduct another test using the same method stated in step 4.

Reflect (5 minutes)

1. What animal or plant did you use as inspiration for your design?
2. Can you think of other ways plant or animal modes of protection could be used to create bioinspired gear?
3. Why might someone want to incorporate protection into a bioinspired pack or bag?