

# FIRST

## LIFE SCIENCE: Something Borrowed

### **Background Information:**

People have been studying and taking inspiration for ideas from nature for a long time. Biomimicry or biomimetics is the study of structure, function, materials, and processes found in nature in order for humans to make or mimic them into products, thus providing useful solutions.

Velcro, whose name is a combination of velvet and crochet, is an example of a nature inspired item. George de Mestral noticed that the burrs clinging to his clothing and his dog's fur acutely had little hooks on the end of them. Several years of research later, this engineer invented the first form of what we call Velcro. Leonardo da Vinci was inspired by seed pods and flowers falling for parachute designs. He also studied birds, their wings, and flight. When a new Japanese bullet train created too much noise as it entered a tunnel, the solution was found in nature. Innovation and a solution to decrease the noise and handle the pressure change called for redesigning the front of the train. The solution was a kingfisher's beak. The Morpho species of butterfly is able to create interference of light wavelengths with the scales on its wings, which is how the brilliant blue coloration shows on its wings. Some e-readers and other technologies having comparable screens use similar techniques.

Hydrophobic means water fearing. Many fabrics are treated chemically so that water will not be absorbed by the material, making the material hydrophobic. Clothing, furniture, and many other items use this application. Stain repelling chemical treatments can also be applied to materials. The creativity of this idea is attributed to the lotus leaf which is self-cleaning.

### **Lesson/Activity Name: Something Borrowed**

#### **NGSS PEs:**

1-LS1-1 From Molecules to Organisms: Structures and Processes: Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. <https://www.nextgenscience.org/pe/1-ls1-1-molecules-organisms-structures-and-processes>

K-2-ETS1-1: Engineering Design: Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. <https://www.nextgenscience.org/pe/k-2-ets1-1-engineering-design>

### **Materials:**

- Student Pages
- Art Supplies
- Power Point
- Idea Cards
- Leaf (Optional)
- Dropper
- Cup
- Water
- Stain Resistant Fabric
- Non-treated Fabric
- Water Resistant Fabric
- Velcro
- Mustard (Or other stain)
- Spoon (Optional)
- Hand Lens
- Burr Cards

### **Advanced Preparation:**

Determine where and how materials will be distributed.

### **Suggested Implementation:**

Distribute a section of Velcro to each group of 3-4 students. Allow time for students to observe and examine the material. Encourage using a hand lens. Assist groups as needed.

Reconvene the class for a discussion. Ask questions such as the following:

- **Does anyone know the name of this material? (If not, share the name with students.)**
- **What did you notice or observe?**
  - **How did it feel?**
  - **What did it look like?**
  - **Did the pieces stick together?**
  - **Did the pieces pull apart?**
- **Have you seen this before? Where have you seen Velcro?**
- **What problem(s) does Velcro solve?**

Have students return to their groups. Distribute a set of burr cards to each group. (If cards are not available, then use the power point.) Again, groups should observe and discuss what they see within their group. Share with students that the idea of Velcro came from a person's dog being covered in burrs.

Reconvene the class and host a discussion with questions such as:

- **What did you notice about the burrs?**
- **Describe how the end of the burrs looks.**
- **How do you think burrs got stuck in the dog's fur?**
- **Why do you think the idea of Velcro came from this?**

Using the same process, students will now explore and test fabric samples regarding their water and stain repellent capabilities. Share with the class that they will be testing fabric/material.

Work with students on the proper method of using a dropper if needed. Guide the fabric testing through the following steps:

- Use the hand lens to examine the fabric samples.
- Place water droplets, start with one, on each piece of fabric and observe.
- If available, test a leaf in the same fashion.

Discuss student results. Pose questions such as:

- **What is made from fabric/material?**
- **What can happen to material?**
- **What did the water droplet do on the fabric/material?**
- **Why would it be helpful for fabric/material to soak up water?**
- **Why wouldn't it be helpful for fabric/material to soak up water?**

Continue exploration of the samples using the following idea:

- Place a small amount of staining product (such as mustard) on each sample. Try to clean the “spill” from each sample.

Discuss student results. Pose questions such as:

- **What can happen to material?**
- **What did the “spill” do on the fabric/material?**
- **Would you want to be able to clean a stain out of fabric/material? Share an example.**

Share the lotus leaf video or power point. Have a class discussion of why the lotus leaf was the inspiration for water repellent and stain proof fabric.

Students will now begin the development of their own product that uses biomimicry. Share with students that they will have a set of cards. The groups look at each card. The focus is to examine the features of the animals and plants and how the plants and animals use these features. Assist groups as needed. It is suggested to host a class discussion for groups to share what features they noticed.

Pose questions such as the following to the class:

- **What are some problems that we could solve using the features you saw?**
- **What idea started Velcro?**
- **What things could we make using the features you saw?**

Allow time for groups to share ideas. (If possible, you may wish to have groups share their ideas with other groups.) Also, if students have access to pictures of other animals and plants, have them observe features and consider possibilities of products made from these organisms.

Have students design a product based on a feature(s) of a plant and/or animal. Student pages will help students frame their thinking.

**Debrief Questions:**

- **Have students share their products.**
- **What problem does your idea solve?**
- **Why is your idea important?**
- **What plant and/or animal features helped you come up with your idea?**

**Assessment:**

The following single point rubric can be used to assess student understanding. For each of the four criteria listed below, either circle the proficient description or add notes to a box indicating why the student’s performance was either lacking or exceptional.

Areas that need improvement. <b>Developing Performance</b>	Criteria for <b>Proficient Performance</b>	Evidence of exceeding standards. <b>Advanced Performance</b>
	Explained specific uses of features in various organisms.	
	Identified problem to solve and developed possible solution based on observations.	
	Explained why specific parts were used to create an item.	

**Extension:**

Hold a product fair. Students develop and pitch their ideas to others, such as an older grade level.

**Materials:**

Cards: Color printing may not be an option. You may wish to use a power point instead.

Fabric: Stain and water repellent fabric is sold in stores such as Joann. Inexpensive drapery lining was used for this lesson. Teachers may register for a discount at [https://www.joann.com/teacherrewardsform/?icn=TeacherRewardsLP&ici=Enroll\\_Now\\_desktop](https://www.joann.com/teacherrewardsform/?icn=TeacherRewardsLP&ici=Enroll_Now_desktop) (Link viewed 2/5/19.)