 

**ELEMENTARY SCHOOL**

**Sustainable Science**

**The Secrets of Sharks’ Skin**

**Lesson 5: Data and Denticles**

**Teacher Background and Overview:**

The science behind Sharklet film is all about surface area. Because of its micro-texture—the etched pattern on the film—bacteria are unable to hold onto the surface of Sharklet. This pattern is designed to mimic the pattern of shark scales, or denticles. These scales promote sharks’ ability to swim fast while creating minimal turbulence, so sharks can sneak up quickly on their prey. In this way, sharks’ denticles have been supporting their evolutionary success and survival for thousands of years.

In this lesson, the class will compare the Lesson 3 data from each team. After discussing the results as a class, the students should conclude that the size of their Sharklet pattern and the spacing of their puffy paint matters more than the shape of their pattern. This leads to a discussion of how the Sharklet film works to prevent the growth of bacteria. The lesson and the unit wrap up by considering how the pattern of shark denticles benefits sharks’ survival.

**Time Required:** 30 minutes

**Learning Objectives:** Students will…

* Evaluate class data.
* Draw conclusions related to how Sharklet works.
* Explain how sharks’ adaptations support their survival.

**Standards:**

***NGSS***

**4-LS1-1** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

**3-5-ETS1-2** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

***Massachusetts Standards***

*STE*

**4-LS1-1:** Construct an argument that animals and plants have internal and external structures that support their survival, growth, behavior, and reproduction.

**4.3-5-ETS1-5(MA)** Evaluate relevant design features that must be considered in building a

model or prototype of a solution to a given design problem.

*ELA & Literacy*

**RSIT. 4.7** Interpret information presented visually, orally, or quantitatively (e.g., charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

**SL.4.1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others’ ideas and expressing their own clearly.

**Materials:**

* Lesson 3 Student Lab Reports
* Sharklet Lesson 4 PowerPoint
* Prepared digital spreadsheet of student data

**Teacher Preparation:**

* Create a table of the student data in Excel or Google Sheets. Make one row for each shape used to make a Sharklet pattern (plus one row for the control/flat surface), and one column for each of the three sizes (one inch, two inch, and three inch). Your table should reflect the total number of binder clips held by sticky notes on each surface across the class.
* From your student data table, create a bar graph, as well as one or two other types of graphs, to visually represent the student data.

**Keys to Success:**

* Introduce the other types of graphs first before showing them the bar graph, then ask your class to consider which graph works best and why.

**Procedure:**

1. Pass back Student Lab Reports from Lesson 3.
2. Share with the class the data table and/or the bar graph you have made.
3. Ask the class what they observe when they look at the results.
4. Remind the class that the purpose of Sharklet film is to prevent bacteria from growing on it.
5. Ask the class to identify what the best Sharklet model was, and why.
6. Have the class consider the difference between the sizes of the models. Ask if it’s the size or the shape of the Sharklet model that matters more when considering the effectiveness of the pattern.
7. The size and spacing of the puffy-paint Sharklet model matters more than its shape. Ask the class why they think the smaller, less-spaced-out models performed better.
8. Show the class the three graphs you have made in your digital spreadsheet. Ask the class which graph they feel best represents their data, and why.
9. Discuss with the class that the smaller model has less surface area for the sticky note to hold onto. When the puffy paint is more spaced out, the sticky note can grab hold of the transparency film in between the dots, in addition to the dots. When the pattern is smaller and the puffy paint is closer together, the sticky note is only able to touch the dots, and there is not enough surface area among the dots for the note to get a strong hold. In the same way, bacteria are unable to grow on the Sharklet film because there is not enough surface area for them to hold onto.
10. Ask the class how this method of controlling germs is different than other methods, like hand sanitizer, antibiotics/medicine, or cleaners like Lysol.
11. Explain that the Sharklet film doesn’t try to kill the bacteria. When we use cleaners or antibiotics, we kill off all but the strongest bacteria. Just like other animals will adapt to better survive, these strong bacteria will keep adapting to be resistant to our traditional methods of fighting germs. But Sharklet doesn’t encourage bacteria to become stronger. Instead, Sharklet simply prevents the growth of bacteria wherever it’s used.
12. Remind the students that the Sharklet film is a biomimicry technology based on sharks’ denticles, the unique teeth-like scales that make up their skin.
13. Show the class the PowerPoint slide with the pictures of a whale and a shark. Ask the students to discuss with a partner what differences they observe between the shark and whale, and to use what they learned about the Sharklet film to explain those differences.
14. Ask the class to share some of the answers they came up with.
15. Share the next slide, which shows a close-up of shark denticles compared to whale skin. Explain that the shark denticles prevent barnacles, as well as bacteria, from sticking to the skin of the shark.

**Wrap-Up/Assessment:**

1. Ask the students to each write 1–2 sentences to explain how having denticles helps to support the sharks’ survival and gives them an evolutionary advantage over other marine animals.