Title: The Evolution of Sailcloths for Sailboats
(Historical Perspectives)

Grade Level(s): 6-8

Introduction: The most important and obvious feature of sailboats are the sails. Sails have evolved throughout the years, not only in their shape, but their sailcloth material. The most common sailcloth today is Dacron, which is an extremely durable yet inexpensive sailcloth developed by Du Pont in the early 1950's. Until the 1980's Dacron was the only sailcloth in use. However, the last few years have seen a virtual explosion in the development of new woven and laminated sailcloths. Today's cloths include not only the familiar woven Dacrons and woven nylon in various weights and finishes, but laminates using Kevlar, Mylar, Technora, PBO Zylon, Pentex and Spectra yarns.

Woven polyester sailcloth is extremely durable and rather inexpensive. Specific styles of woven polyesters are commonly named by weight, such as “6.1 oz. Dacron”, or “8.3 oz. Dacron.” Usually the unit of weight in the United States is ounces (oz.) Per “sailmaker’s yard,” which is 36 inches by 28.5 inches.

More and more sailors are turning to laminated sailcloths because laminates are lighter for their strength than Dacron. Laminates also have superior shape-holding ability. As the name implies, laminates all have some cloth or yarn glued to one or more layers of Mylar.

In the following class activity, the students will use Dacron sail pieces, available from any sailmaker, and other common materials to simulate other sailcloth materials. A common burlap bag will simulate the canvass sails used by ancient mariners on their clipper ships and transparent gift-wrapping cellophane to simulate modern laminates such as Kevlar and Mylar.

Learner Objectives:
• The student will be able to compare and contrast sailcloth materials used throughout the years and test the cloths for stretch (Durability), permeability, and resistance to puncture.
• The student will be able to discuss the advantages and disadvantages of the three different sailcloth types.
**Sunshine State Standards:** Science: Sci.H.1.3.5; Sci.H.3.3.4

**Competency-Based Curriculum:** Science: M/J1-IA6 M/J1-VIA2

**Materials:**
4 1ft. x 1ft. pieces of burlap bag  
4 1ft. x 1ft. pieces of Dacron sail  
4 1ft. x 1ft. pieces of transparent cellophane paper  
water for each group

**Activity Procedures:**
1. Divide the class into four groups and each group receives one sample of each of the three simulated “sailcloths.”
2. Each group will perform several different experiments to test the durability and effectiveness of the “sailcloths.”
   a) Manually pull the edges of all three “sailcloths” to test for material stretch and flexibility.
   b) Pour water on each of the three “sailcloths” to test for permeability.
   c) Puncture each “sailcloth” with a pencil point, and then pull the edges of the sailcloth to test for durability of material.

**Student Assessment:**
Allow students to answer critical thinking skills questions assigned by the teacher.
1. Which of the three simulated sailcloths stretched the most when the edges were pulled? Which sailcloth was most resistant to stretch?
2. Which of the three simulated sailcloths allowed the most water to pass through it (permeability)? Which sailcloth was the least permeable?
3. Which of the three simulated sailcloths resisted stretch after puncture? Which of the sailcloths (if any ripped after puncturing and stretching?)

**Activity Extensions:**
1. From the data obtained from the tests why would racing sailboats use plastic composite sails rather than the Dacron or canvass sails?
2. From the data obtained it was shown that the plastic composite sailcloths have a tendency to rip apart easily when punctured. Dacron and canvass sails were sown using needles and thread to give shape to the sail. So, knowing that the composites sails puncture easily, how would panels of these composites sails be joined together to give the sails their shape?
**Home Learning Activity:**
Research the price differences for Dacron and composite sailcloths. Calculate how much it would cost to design various size sails based upon the cost of materials.

**Vocabulary:** Dacron, Kevlar, Mylar, Technora, PBO Zylon, Pentex, Spectra

**References/Related Links:**
- http://uksailmakers.com/encyclopedia2.html
- UK Sailmakers Encyclopedia of sails, 1999 - Sailcloth information
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Reading Passage


Ratsey & Lapthorn were the No.1 sail makers in the early part of this century and developed the flax sail dyed with red ochre. Flax and Egyptian cotton were the most commonly used sailcloths until the advent of Terylene in the mid-1950’s. Terylene held its shape much better, but its main advantage was longevity. Whereas Terylene was almost inert in the marine environment, cotton sails needed to be dried and ideally washed or they would grow mold and rot.

In the late 1970’s Kevlar sails were introduced on racing boats because of their low stretch. However, Kevlar was (and still is) expensive, difficult to handle and susceptible to chafe. Since then the greatest development in sail technology for racing boats has been molded sails, such as Sobstad’s Genesis and North’s 3DL. These can be built with a better aero foil profile, are lighter in weight and can be accurately engineered with high-tech fibers, such as Spectra, laid in the exact lines of load.
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FCAT Questions

Directions: Read the passage, then answer all the questions below. Answer multiple-choice question by circling the letter of the answer that you select. Write your answer to “Read, Think, and Explain” questions in the lines provided.

1. According to the passage, which of the following statements were not mentioned about Kevlar sails?
   A. Expense
   B. Stretch
   C. Weight
   D. Chafe

Answer: C

2. What does the author mean by “most inert to the marine environment?”
   A. Most flexible in adverse conditions
   B. Most durable to marine conditions
   C. Most commonly used
   D. Least expensive

Answer: B

3. What does the author mean by “moulded (molded) sails?”
   A. Sail made in molds
   B. Sail molded to exact lines of load
   C. Sails molded to increase hydrodynamics
   D. Kevlar can be molded to any shape

Answer: B

4. Why would molded sails be more effective for racing boats?

   Read
   Think
   Explain

   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________

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