Soccer ball experiments

**Time:** 1.5-2 hours

**Summary:** The central focus of soccer is, quite often, the ball.  In this activity students will be dissecting a soccer ball and performing a variety of materials tests on the layers. The goal is to give students a set of tools and instructions that give them enough direction to learn but also the opportunity to think of new things they might want to test themselves.  **This activity also has intro slides and a lab handout/manual they can follow.**

ILOs:

1. Define what a composite material is.
2. Use basic laboratory tools (force gauge, ruler, balance) to measure physical properties of a material.
3. Present results in an organized presentation. (Time dependent)

**Equipment list:**

We will need to following materials:

* Soccer balls (size 1 or 2)
* (Exacto) Knife to open the soccer ball initially, consider breaking balls into smaller pieces (halves or quarters) to conserve materials
* Scissors
* Pliers to take apart each of the layers
* Water
* Ruler
* Vegetable oil
* Stopwatch
* Rubber balls
* Force gauges

**Intro:**

Today we will be getting a deeper look INSIDE what some of you all constantly play with. We will be looking at what a soccer ball is really made out of! Instead of kicking around these soccer balls, we will use our hands to cut open and explore the variety of materials the ball consists of. Materials testing is the measurement of the characteristics and behavior of such substances under various conditions. In this experiment, we will proceed by looking at the different material tests on soccer ball layers.

Material tests that we will conduct:

* Static tension and compression tests
* Measuring ductility or the indentability/elasticity
* Slipperiness
* Absorption and wettability

**Procedure:**

1. Take the rubber balls and the soccer balls and try bouncing them. Focus on how the balls bounce differently, and how they react to impact with the ground. There is an option to do a juggling competition in pairs, with one partner juggling a rubber ball and the other juggling a soccer ball, so pay attention to how easily the balls bounce!

(Optional) Time for the juggling competition! Partner up with the person next to you. Decide who will be juggling the rubber ball and who will be juggling the soccer ball. At the end, we’ll add up each pair’s total juggles across both balls, and the pair with the most juggles wins!

* 1. Starting on our count, juggle the ball for as long as you can, and make sure to keep count of how many times you’ve juggled it!

1. Now to move onto the dissection portion of the lab: Cut into the soccer ball with the knife/scissors. Cut it into a few large pieces.
2. Cut the different materials of the soccer ball into 5cm by 3cm rectangles.
3. Starting off with our static tension and compression test, look into how difficult it is to pull apart each layer.
4. Observe and record your experiences of which layers were more difficult and why you think they were more difficult. Pull apart each material and notice how it elongates. Record your observations.
   1. Use a force gauge to record how much force it takes to pull/stretch. This quantifies resistance.
5. Examining the slipperiness and wettability of the materials now. Pick out all of the different material rectangles the soccer ball has (Hint: there should be 4)
   1. We will conduct two different tests: one water and one oil test.
6. To prepare for these tests, tape the different materials in a line close enough together but also allow for some space between each material.
7. Repeat steps 7 once more to prepare for the oil test.
8. Starting off with the water test: Use a cup and fill the cup with a little bit of water.
9. Use a pipette and drop 1 droplet of water onto the different types of materials.
10. Wait a few seconds before using your camera to take a picture of the water droplet on the side point of view.
11. Take pictures of all of the water droplets, and use a protractor on the picture that you took to find the internal contact angle (look above for example).
12. Now repeat this same idea, but with a new cup filled with oil.
13. Use a new pipette to drop the oil onto the new taped-up materials.
14. Record the visual differences and the internal contact angles for each of the water and oil droplets.
15. If you have time, soak the layers in the water cup for a few minutes. Then repeat the water contact angle measurements. Is there a difference to before they were soaked?

**Discussion questions/debrief:**

* What was your methodology in cutting apart this soccer ball? What was easy about it, and what was difficult? Why do you think that is?
* The outer layer in particular is made out of several materials. How many different materials did you end up identifying? What made them different?
* Some layers were easier to pull apart than others. What do you think contributed to why this is? Why could it be better to have some that are easier to pull apart? (Consider these layers’ other properties.)
* What did you conclude about each material’s slipperiness? What are some potential advantages and disadvantages of this, particularly in a soccer setting?
* Different materials absorb water differently. How do you think this factored into the order in which the materials are layered in the ball, and how do the materials contribute to the ball’s function?
* All soccer balls are not made out of the exact same materials. Consider the soccer ball you dissected today and all of its properties that you observed. What do these properties say about how well the ball can fare in different types of weather conditions and situations?

**Lab handout needed?**

Yes. There are also introductory slides with additional discussion questions