

Six Unlabeled Swatches: Which Ones Did Nature Make?

Investigation question: Using only property tests you can run on a desk, which of six unlabeled fabric swatches are made of natural fibers and which are synthetic, and which test gives the most trustworthy evidence?

Evidence-based mystery

Groups of 4

1 session

Setup 5 · Activity 40 · Cleanup 5 min

MS-PS1-3 · practice

Name _____

Group _____

Date _____

Your role today

- ☐ **Tester:** Runs each test exactly the same way on every swatch: same drop size, same soak time, same crumple grip, same lens.
- ☐ **Timer and measurer:** Times the water drop and the soak, reads the balance, and calls out every value before anyone interprets it.
- ☐ **Recorder:** Writes every value in the evidence table as it is called out, and fills the verdict table only after all four tests are finished.
- ☐ **Skeptic:** Challenges every verdict with 'which test says so?' and makes sure each swatch has at least two pieces of evidence behind it. Keeps the group from deciding by feel or color.

Safety

- No flames anywhere in this lab. The fabric burn test is deliberately not used: synthetic fibers melt and drip, and the fumes from burning acrylic and nylon are harmful. Tell students not to try it at home.
- Water on hard floors is a slip hazard; keep the soak tray on a paper towel and wipe spills at once.
- Jute and burlap shed coarse fibers that can irritate eyes; do not rub eyes after handling it, and wash hands at the end.
- Tweezers are pointed; pull fibers at desk level, pointed away from faces.
- Some students are sensitive to wool; anyone with a known wool allergy handles swatch C with a paper towel or lets a partner run that test.

Procedure

1. Lay the six squares out in letter order. Do not guess yet. Each person writes one prediction in q1 of how many of the six are natural, without discussing it.
2. Water-drop test. The tester places one drop of water in the center of square A from a height of about 1 cm. The timer starts at once and stops when the drop has fully soaked in and no shine remains, up to a limit of 120 seconds. Record the time; if the drop is still beaded at 120 s, record 'over 120 s, beads'. Repeat for B through F, same drop size, same spot on the square. Blot each square dry and set it aside.

3. Soak-and-weigh test. Weigh strip A dry and record its mass to 0.1 g. Lay it flat in the tray of water for 60 seconds, lift it with tweezers, hold it above the tray for 30 seconds so loose water drips off, then weigh it again. Record the wet mass. Repeat for B through F. Compute the percent gain for each: (wet mass minus dry mass) divided by dry mass, times 100.
4. Crumple test. Using the dry squares, the tester crushes square A into a tight ball in a fist for 30 seconds, then opens the hand and lets the square lie flat without smoothing it. After 60 seconds, the group rates the wrinkles from 0 (no creases) to 3 (sharp creases everywhere). Repeat for B through F with the same grip.
5. Fiber look. With tweezers, pull three or four fibers from a cut edge of each square. Look at them against a dark surface with the hand lens. For each swatch record: are the fibers all the same thickness or do they vary? Are they smooth and shiny or dull and uneven? Are they straight, crimped or wavy? Are they long and unbroken or short? Sketch two contrasting swatches in the drawing box.
6. Fill in the evidence table completely before anyone argues a verdict. The skeptic checks that every cell has a value.
7. Verdicts. For each swatch, the group decides natural or synthetic and writes the two strongest pieces of evidence and a confidence rating (sure, fairly sure, guessing). The skeptic must hear a test named for every verdict; 'it feels fake' does not count.
8. Only when the verdict table is complete, open the envelope. Record the real identities and mark each verdict right or wrong. Then answer q2 and the analysis questions individually.
9. Optional if time allows: lay the six wet strips flat on paper towels at the same time and check them at the end of the period. Record which are dry to the touch and which are still damp.

Record your observations

Lab 1 recording sheet: Six unlabeled swatches

Fill in every cell of the evidence table before your group decides anything. The verdict table is completed only when all four tests are done, and the identity column only after the envelope is opened.

Evidence table

Swatch	Drop soak-in time (s) or 'beads'	Dry mass (g)	Wet mass (g)	Percent gain	Crumple rating (0- 3)	Fibers: same or varied thickness?	Fibers: shiny/smooth or dull/uneven?	Fibers: straight, crimped or wavy?
A								
B								
C								
D								
E								
F								

 Sketch the fibers of two swatches that looked most different under the hand lens. Label each sketch with its letter and write one word for the thickness (same or varied) and one for the surface (shiny or dull).

Verdict table (complete before opening the envelope)

Swatch	Our verdict: natural or synthetic	Strongest evidence (name the test and the value)	Second piece of evidence	Confidence (sure / fairly sure / guessing)	Real identity (after the reveal)	Right or wrong?
A						
B						
C						
D						
E						
F						

- Before testing: how many of the six swatches do you predict are natural fibers, and what made you guess that number?

- After the reveal: how many verdicts were right? For any wrong verdict, which test led you astray and why?

Analysis questions

- Which test separated natural from synthetic swatches most cleanly, and which test was least reliable? Use values from your table, and explain what besides the kind of fiber could affect the unreliable test.

4. Wool felt usually beads a water drop for a long time but gains a lot of mass when soaked. Explain how one material can give two different answers about water, and say which result you would trust more for deciding whether a fiber is natural.

5. Pick one swatch that turned out to be synthetic. Write the natural resource it came from, the kind of chemical process that turned the resource into the fiber, and one property your tests showed that engineers were aiming for.

6. A company wants a fabric for a lightweight rain jacket that sheds water and comes out of a stuffed backpack without creases. Using your data, recommend one of the six fabrics and name one cost of that choice for people or for the environment.

7. Cotton fibers are made of cellulose, a polymer of long chains, and polyester is also a polymer of long chains. Yet they behaved very differently with water. What does this tell you about the difference between the words 'polymer' and 'synthetic'?

8. Rayon is made by dissolving wood pulp with chemicals and re-forming the cellulose into smooth, even fibers. Predict how a rayon swatch would behave in your four tests, then decide whether this lesson's definition would call it natural or synthetic, and explain.
