



The Technology of Paper: Taking a Closer Look

Grade Level: Science Grades 3, 5, 6, 8

Time: 45 min

Objectives: Students will be able to use microscopes to look at paper both wet and dry on a cellular level so they can learn about the properties of paper. Then students will participate in a discussion regarding paper's plant sources, habitat and use as a renewable resource.

I Can Statement: Students will be able to: (1) use microscope safely and responsibly; (3) use accurate vocabulary; (3) perform multiple tests on paper to take a close look at paper properties; (4) discuss different paper source plant habitats and use as a renewable resource

Georgia Standards of Excellence:

Science

3rd: S3L1.a

5th : S5L3.a

6th: S6E6.a

Vocabulary:

calcium carbonate — a white insoluble solid occurring naturally as chalk, limestone, marble, and calcite, and forms mollusk shells and stony corals.

creping — paper is scraped with a razor down the length to ripple paper.

fiber — a cellulose material produced by a plant and used to make paper. Cellulose is produced through the process of photosynthesis, creating fiber which can be separated from the plant via chemical or mechanical means.

fibrils — fibers that have become very separate due to heavy beating.

hand lens — a convex lens that is used to produce a magnified image of an object.

magnification — the process of enlarging the apparent size, not physical size, of a sample being analyzed.

microscope — instrument that is used to see objects that are too small to be visible by the naked eye. It produces enlarged images of small objects, allowing a close view of minute structures for examination and analysis.

opaque — not able to be seen through; not transparent, blocking the passage of light.

scanning electron microscope (SEM) — a type of electron microscope that produces images of a sample by scanning the surface with a focused beam of electrons. The electrons interact with atoms in the sample, producing signals that contain information about the surface and composition of the sample

sub-atomic particles — a particle smaller than an atom

Materials: One set of each of the following per group: 1 hand lens, 1 microscope, 1 paper tray with 6 compartments, 1 plastic dropper, 1 roll of transparent tape, 1 piece of black construction paper, 1 piece each of notebook paper, newsprint, paper towel, copy paper, magazine paper, and toilet tissue, 1 plastic screw-top jar of water, about 8 oz.

Preparations: prepare paper samples, short pieces of tape, microscopes, pieces of black paper, small containers of water for dropper

Essential Questions: (1) what is paper made from? What fibers can paper be made from? (2) Do paper samples look different when wet vs. dry? (3) Are papermaking materials renewable or from sustainable sources? (4) What habitats do paper source materials grow in? (5) How is paper used in our everyday life? (6) How are paper source materials used in our everyday lives?

Introduction: Let's take a closer look at paper. Instructor will demonstrate by taking one paper sample and examining it with a microscope, using proper microscope safety and methods. Demonstrate looking at different properties of the paper, the torn edge, fibers. Demonstrate adding water to the paper sample. Demonstrate going through the post-activity questions with one paper type.

Procedure

1. Put each sample in a compartment in their paper tray. Students will tear off a corner of the first sample of paper.
2. Rub the torn edge of the first sample between thumb and finger several times.
3. Observe the torn edge and observe the rest of the paper sample. First look with just eyes, then hand lens, then microscope. Look for patterns in the paper *fibers*, the things that look like thread.
4. Use a small piece of tape and put the sticky side over the torn edge of the paper sample. Then press very gently. Gently peel the tape off the paper. Examine the tape with the hand lens and then with the microscope. If it is hard to see fibers on the tape, students will put a piece of black construction paper underneath the tape. Students will record observations of the tape and paper sample.
5. Using the plastic dropper, students will place one drop of water near the middle of the paper strip. Gently rub the water in if it does not absorb. Slide the wet section under the microscope lens and observe. Record observations on the data sheet.
6. Students will gently pull on the dry ends of the paper. Students will observe any changes in the wet middle section and record observations.
7. Repeat this process with remaining samples.

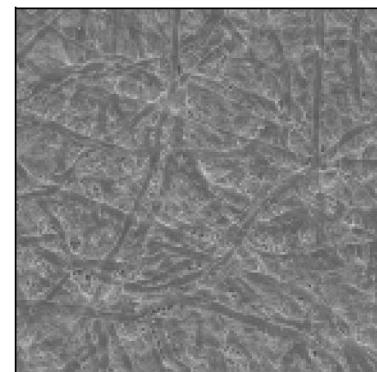
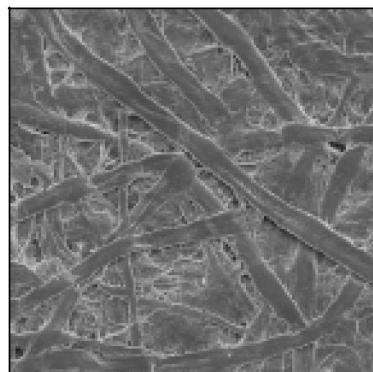
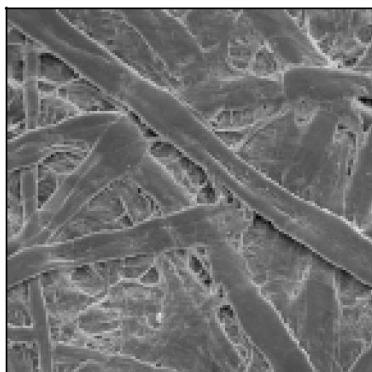
Activity Discussion Questions/ Observations to be recorded:

1. How does the paper look under magnification? What did you observe about the torn paper?
The tape after you pressed it to the paper?
2. In what ways were the paper samples alike? How are they different?
3. In what ways was the wet part of the paper different from the dry parts?
4. Based on the observations you just made, how is paper affected by water? Give examples of what you saw.
5. Based on your observations, what do you think would happen if paper soaked for a longer period in water?
6. Review your observations and hypothesize what paper is made from. See if others came to the same conclusion. Why did you draw that conclusion?

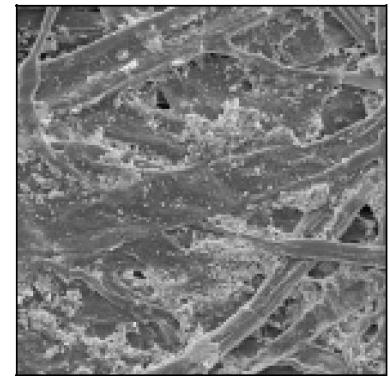
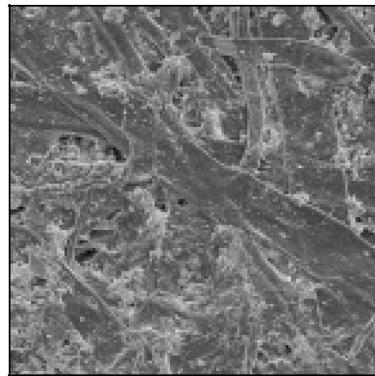
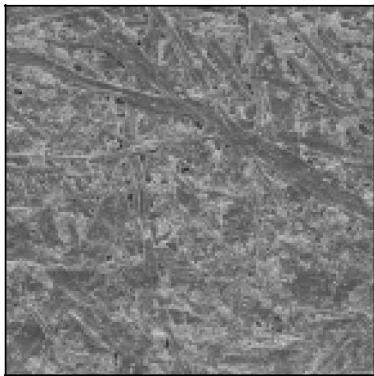
Extension Activity: Taking an Even Closer Look at Paper

When we look at object what we see are little packets of light bouncing off of the object's surface, but sometimes we might want to look at things that are smaller than those little packets of lights, which are called photons. A scanning electron microscope, SEM for short, can be used to view these items. The SEM shoots a beam of very tiny subatomic particles at the surface and when they bounce back to the SEM they make a picture.

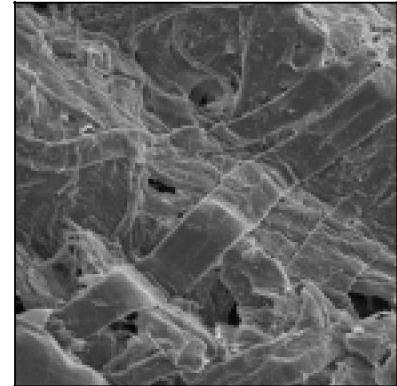
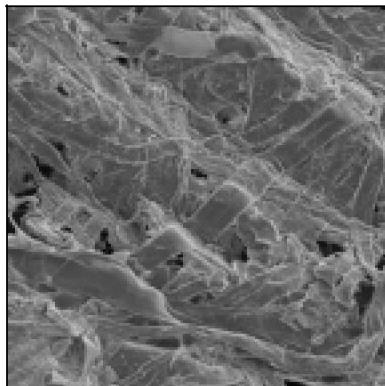
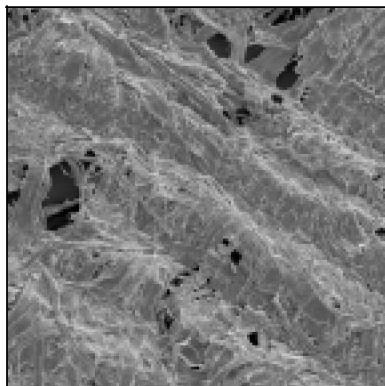
The first pictures we are going to look at are of printer or copy paper, like this page is printed on or like you use at home in the computer. See the fibers? That is the wood fiber that most paper used in the United States is made of. See the little round objects? Those are bits of calcium carbonate; it makes the paper more opaque. Do you remember what opaque means?



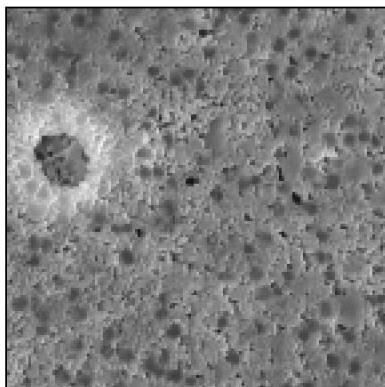
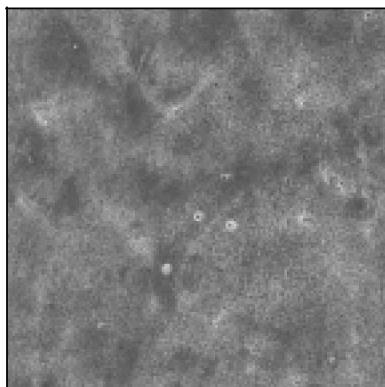
The next set of pictures we are going to look at is currency, or paper money. See the long fibers? Those are cotton and linen. See the little pieces of fiber that come out all over? Those are called *fibrils*. This is where the pulp has been beaten so much the fibers are very separate. Note how smooth this paper appears compared to our next example.



Can you guess what this paper is? See how it is rippled? This is toilet paper. When toilet paper is made, a razor is scraped down the length to give it the ripples, which are called *crepin*. This makes the toilet paper soft. Toilet paper is also made from wood pulp.



The last example is coated paper. Magazines and business cards are made of this kind of paper. Can you see any fibers? A clay or calcium carbonate coating is over the entire surface, which makes it water resistant and shiny.





The Technology of Paper Observation Charts

Torn Edge Observations

Note Book Paper	
Newsprint	
Paper Towel	
Printer Paper	
Magazine Paper	
Toilet Paper	

Microscope Observations

Note Book Paper	
Newsprint	
Paper Towel	
Printer Paper	
Magazine Paper	
Toilet Paper	

Tape Test Observations

Note Book Paper	
Newsprint	
Paper Towel	
Printer Paper	
Magazine Paper	
Toilet Paper	

Wet Test Observations

Note Book Paper	
Newsprint	
Paper Towel	
Printer Paper	
Magazine Paper	
Toilet Paper	

Pulled Wet Paper

Observations

Note Book Paper	
Newsprint	
Paper Towel	
Printer Paper	
Magazine Paper	
Toilet Paper	

Robert C. Williams Museum of Papermaking

500 10th Street NW • Atlanta, GA 30332

404.894.7840 (phone) • 404.894.4778 (fax) • paper.gatech.edu