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# Mulberry Paper Making

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NAME: \_\_\_\_\_

Biology 401: Applied Plant Science

### Mulberry Tree - Paper Making

The Chinese developed papermaking around 100 AD. The method we will use today is very similar to those used in ancient times. Bark was removed from trees like the Paper Mulberry (*Broussonetia papyrifera*). The Paper Mulberry is a native of Asia. It grows naturally and is also cultivated for in China, Japan, Korea, Laos, Cambodia, Thailand, Burma, and India. It was introduced into the United States when sericulture (silk culture) was attempted in the colonies starting in 1623. The process of raising silkworms for production and export of silk to Europe never caught on, but the Paper Mulberry trees have remained. The seeds are readily spread by birds, and indeed many trees are found under or near power or telephone lines where birds congregate.



Paper Mulberry (*Broussonetia papyrifera*)  
Family: Moraceae - Introduced tree that has naturalized.  
[commons.wikimedia.org/wiki/File:BroussonetiaPapyrifera.jpg](https://commons.wikimedia.org/wiki/File:BroussonetiaPapyrifera.jpg)

The inner bark of the Paper Mulberry is used to make Washi, a Japanese handcrafted paper that was developed in 600 AD. In the Pacific Island nations of Fiji, Tonga, Samoa and Tahiti the Paper Mulberry is used to make Tapa Cloth where it was the main material for clothing until recent times, and is still worn ceremonially.



Vintage ORIG Tapa Cloth Bark Painting South Pacific Oceanic Island Folk Art  
[http://commons.wikimedia.org/wiki/File:Siapo\\_mamanu\\_%28tapa\\_cloth%29\\_-\\_Google\\_Art\\_Project.jpg](http://commons.wikimedia.org/wiki/File:Siapo_mamanu_%28tapa_cloth%29_-_Google_Art_Project.jpg)

Paper-making involves separating useful fibers from the raw materials. In this laboratory session we will steam the Bark off of young Paper Mulberry branches. The Bark consists of all material to the outside of the Vascular Cambium. Then we will scrape the Outer Bark off of the Inner Bark. The Inner Bark is the Phloem. We will then boil the Phloem (Inner Bark) in a solution of Baking Soda that will aid in separating the individual fibers. The fibers will be beaten into pulp which will be diluted into a fiber suspension. This suspension will be drained through a screen, so that a mat of randomly interwoven fibers is created. Water will then be removed from the mat of fibers to produce the paper.



## Supply List:

- Papermaking screen and deckle
- Felt Squares (pre-cut to size of Deckle)
- 2 water tight tubs
- Colander/Strainer
- Plant presses for drying
- Baking Soda
- Paper Mulberry (stems or bark)

## Preparing the Pulp:

1. Branches of Paper Mulberry will be harvested that are close to 1 inch in diameter and about 8 feet long. The branches will be cut into lengths that will fit into a canning pot (21 quart capacity).
2. Steam the branches for 1 to 2 hours by placing the branches in a 21 quart pot with 2-3 inches of water in the bottom. Steaming causes the bark to shrink so that it will be easy to strip the Bark from the Xylem. Peel the Bark off in strips then scrape off the Outer Bark as much as possible using a dull knife. You will be left with the Inner Bark that is composed of the Phloem fibers.
3. If the branches were dried before use, soak the fibers in water for 12 hours to help remove chlorophyll.
4. Using the 21 quart pot; fill  $\frac{1}{2}$  full of water with 1 to 2 cups of Baking Soda. Dissolve the Baking Soda before adding the Mulberry bark. Cook the fibers for 1 to 2 hours at a good boil. Stir every half hour and add water as needed. This process breaks apart the fibers by dissolving the calcium pectates within the middle lamella.
5. Cool the fiber. Make sure that the fiber has been cooked sufficiently. The fibers should pull apart in your hands. Rinse the fibers several times in a large bucket of clean water.
6. Pick up a ball of the fiber in your hands the size of a softball and squeeze out all the water. Lay the ball of fibers on a plywood board and beat it into a pulp with the ax handle for 1-20 minutes. Place the beaten pulp into a large bucket water. Repeat this process until all the fiber is made into pulp.
7. Using the cement mixing tubs, mix the pulp with a small amount of water. Do this slowly. You can always add more but it is hard to take water out once mixed with the pulp. Make it into the thickness you desire for your paper.

## Forming the paper via the dipping method:

8. Prepare the Deckle by placing the Open Picture Frame on top of its matching Picture Frame with the screen.
9. Using your hand, stir the pulp in the pulp vat to evenly distribute the pulp. An even consistency of pulp results in a more even paper. Dip the Deckle into the pulp gently move it back and forth to ensure an even, thin layer of pulp. Holding the Deckle perpendicular to the vat, slide it along the back edge, then down to the bottom of the tub, then raise it fairly quickly out of the pulp tub. *You should feel a "vacuum release" when it exits the vat.* Hold the Deckle above the vat to let the excess water drain off.
10. After draining push stray pulp left on the deckle toward the inside of the screen. Carefully and gently remove the Picture Frame (top). Place the edge of the Picture Frame with the screen and pulp onto the edge of a felt square. In one motion rotate the Picture Frame so that the pulp/paper is face down on the felt with the screen facing up.
11. Place a sponge over the screen and press down on the sponge to soak up the remaining water to bind the fibers together. Repeat this step, moving the sponge each time so that the entire area of the screen has been sponged. Wring the sponge out back into pulp tub.
12. When most of the moisture has been soaked up by the sponge, gently peel back the screen from the pulp. What is left (pulp and felt) will become paper – the pulp will dry on the felt, and then can be removed from the felt.

## Drying

13. Place another piece of felt on top of the new paper to make a felt-paper-felt sandwich. Place the new paper sandwich between blotter papers of the plant press. Once all pieces of new paper are in the plant press, tighten the straps and put the plant press in a warm dry place to allow the paper to dry for a day or two.
14. Clean up all your equipment, when you are done. Use the colander/strainer to retrieve as much pulp as possible from the tubs and put it back into the buckets. If possible, dump the remaining dirty water outside on the road. Rinse off molds, deckles, and screens. Use sponges to wipe down tables, floors, and counter. Look around for extra paper bits on the ground. Excess pulp can be frozen in Zip-loc bags to store for later without getting moldy and smelly.

NAME \_\_\_\_\_

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## Paper Making

Use the World Wide Web to find answers to these questions.

1. The earliest known paper has been traced back to 100 BC in \_\_\_\_\_  
These first papers were made from what materials? \_\_\_\_\_
2. Papermaking in Europe started in 1290 where \_\_\_\_\_ was used as the material for the paper.
3. Who began the first paper mill in the United States? \_\_\_\_\_
4. The use of wood pulp for papermaking began with the development of mechanical pulping by these two people: \_\_\_\_\_  
([http://en.wikipedia.org/wiki/Paper\\_Pulp](http://en.wikipedia.org/wiki/Paper_Pulp)) in the 1840s. Chemical processing of the wood pulp followed with these three major methods: (use the following website and look for the Chemical Pulp headline [http://en.wikipedia.org/wiki/Paper\\_Pulp](http://en.wikipedia.org/wiki/Paper_Pulp))  
\_\_\_\_\_. This process entails treatment of wood chips with a mixture of sodium hydroxide and sodium sulfide. The process was developed by Carl F. Dahl in 1879. Pulp produced by this method is stronger than other process. The pulp is darker than other wood pulps, but it can be bleached.  
\_\_\_\_\_ This process produces wood pulp that is almost pure cellulose fibers by using various salts of sulfuric acid to extract the lignin from the wood chips. The salts used in the pulping process are either sulfites or bisulfites depending on the pH. The sulfite process is acidic and one of the drawbacks is that the acidic conditions hydrolyze some of the cellulose, which means that the fibers are not as strong as those from the above process.  
\_\_\_\_\_ This is a chemical process for making wood pulp with sodium hydroxide. In the process anthraquinone may be used as a pulping additive to decrease the carbohydrate degradation. This process has limited use for easy pulped materials like straws and some hardwoods. It gives pulp with lower tear strength than other chemical pulping processes.
5. In lab we used \_\_\_\_\_ trees for the source of wood pulp. The tree branches were first steamed to allow easy removal of the \_\_\_\_\_. This material was then cooked in Baking Soda to dissolve \_\_\_\_\_.  
Finally we created the pulp by doing what? \_\_\_\_\_
6. We formed the paper sheets by dipping a \_\_\_\_\_ into the pulp and lifting the pulp out of the bath.