Paper!
Paper! It’s everywhere. It’s all around us. You are looking at paper right now. No other manufactured material is so widely available, versatile, and so important to our everyday existence. We read books. We print out Web pages and computer files. We dry our hands on paper towels. We wrap gifts. We take notes. These are just a few of the ways we use paper. You may have heard that paper comes from trees, but that’s just part of the story.

HISTORICAL WRAP

The ancient Egyptians developed a paperlike substance nearly 4,000 years ago. By weaving together the reeds of papyrus plants into mats, and then pounding them, they produced a thin, tough sheet for writing on. This product was called papyrus, and our English word “paper” has its origin in that Egyptian name. Before papyrus, people used clay tablets, stones, wooden boards, cloths, animal skins, metal tablets, and even leaves to write on.

The Chinese invented the first true paper about 2,000 years ago. Their paper was made from a watery paste of ground-up mulberry bark, hemp, and cloth rags. They pressed this paste to remove the water, then sun-dried the resulting mat of compacted fibers to make a sheet of paper. It wasn’t until an invading army captured a Chinese paper mill 600 years later that the papermaking process was carried west to the Middle East, Africa, and Europe.

For many years throughout the Western world, paper was only made from discarded rags and clothing. Cotton and linen fibers produced a fine, strong paper, and the use of other plant fibers for papermaking was forgotten during the Dark Ages. However, paper was always in scarce supply due to the constant shortage of used cloth. The first paper mill in America, established outside of Philadelphia, Pennsylvania, in 1680, also used old rags to produce paper. By 1802, there were nearly 200 such mills in the United States.

During the mid-1800s, European papermakers rediscovered the use of tree fibers for papermaking. Also during this time, various types of machinery and processes were developed in Europe and America for grinding or chemically breaking down wood and producing paper. Wood was in abundant supply, and the use of wood rather than rags made it much cheaper and easier to make paper. Wood pulp is nothing more than a huge quantity of individual wood fibers with the lignin removed. The natural color of wood pulp ranges from dark brown to light gray.

SIMPLY PULP

Today, almost all paper is made from wood pulp; however, some specialty papers are still produced using cotton and linen fibers (for printing things like money and maps). But what exactly is wood pulp? When wood is broken down, either mechanically or chemically, two main things are left: fibers (composed mostly of two kinds of cellulose) and lignin. The fibers are actually the remains of the tree’s cells. They are small, about \( \frac{1}{8} \) of an inch in length and \( \frac{1}{150} \) of an inch in width (about \( \frac{1}{10} \) the thickness of a human hair). When a piece of paper is torn, you can see tiny wood fibers along the ripped edge. Lignin is the glue, or cement, that held the fibers in place in the wood.
Most of the trees used for papermaking in Pennsylvania are smaller trees that have little potential for making lumber. At the mill, the bark is removed from the trees.

Wood pulp is also made from chipped sawmill waste wood or from used paper. The recycling process for used paper is similar to making “virgin” pulp directly from wood. In recycling, the wood fibers in the paper must be separated again or “repulped” in water. It is also necessary to remove the chemicals, such as adhesives and ink, on used paper. The recycling process shortens the length of the individual fibers,
so wood fibers can only be recycled several times before they are too short for making paper. That’s why it is necessary to mix new pulp with recycled pulp to make paper products.

MODERN PAPERMAKING
The papermaking process begins by washing, bleaching (to whiten or “brighten” if necessary), and beating (to soften) wood pulp. Starches, colors, and other chemicals added at this early stage create different types of paper. After mixing the pulp and chemicals with water, this “slush” moves into large papermaking machines. Here, the slush is pumped evenly onto a fast-moving (58 feet per second), fine-meshed screen. As water drains off, the slush moves along on the screen and then through a series of heated cylinders to press, dry, and smooth it, ensuring uniform thickness. Rolls of paper are the finished product. They are usually rewound and cut into smaller rolls or packs, then shipped to printers and manufacturing plants to become products. There are thousands of different paper products—everything from coffee filters to facial tissues and magazines. Throughout the papermaking process, tests ensure paper quality. If a roll of paper does not meet quality standards for the desired finished product, it is recycled back into the process.

That’s the whole story of papermaking. Paper is material that’s similar to the air we breathe. It’s all around us, we use it continuously, and we yet we never think about it! Can you imagine a world without paper?

Paper products are all around us, including your favorite comic books and magazines, newspapers, boxes, office paper, envelopes, paper towels, toilet paper, packaging, gift wrap, and so much more.