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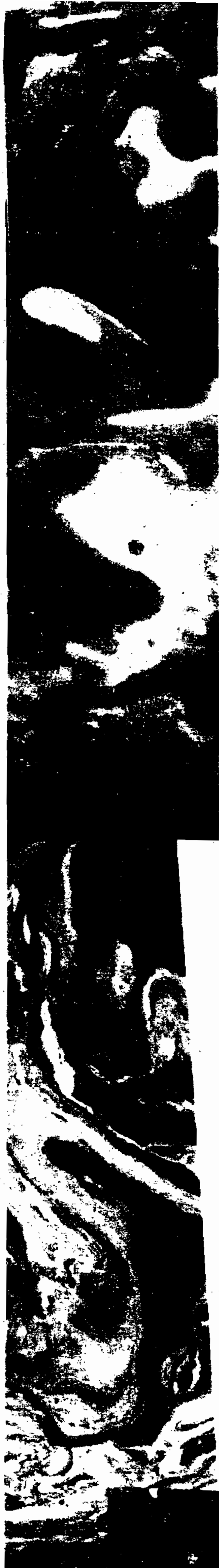

Marbleized Paper: A Scientific Art

Yes, water and oil do mix! And what you can create with this "forbidden" combination may surprise you

BY GREGORY GRAMBO

In the eighth century, the Japanese discovered that oil floats on water. Taking advantage of the concept of density, they began to produce a specialized paper using colored oils. Patterns from atop the floating oils were transferred from the water by laying a piece of paper on top of the mixture. The result was a sheet of paper with a "marble" design on it.

Marbleized paper, as it came to be called, became very popular in Persia and Turkey. By the 15th century, the art reached Europe. It peaked in the late 19th century. This period was known as *Jugendstil*, or *Art Nouveau*.

> *"Patterns from atop the floating oils were transferred from the water by laying a piece of paper on top of the mixture. The result was a sheet of paper with a 'marble' design"*

During this time, marbleized paper was used to decorate objects, such as boxes, books, lampshades, handbags and wall hangings. After years of being out of fashion, craftspeople and bookbinders have generated an awakening interest in these papers. You, too, can make marbleized paper, but it will help if you first understand the science of marbleizing.

The density factor. As the earth slowly cooled more than four billion years ago, some solid materials floated on top of others, similar to the way in which warm air floats on top of cold air. Some people think this is because lightweight materials float on top of heavier ones. But what does *lighter* mean? In space, a gravity-less environment, does *lighter* have any applications?

In warm air, energy absorption causes air to warm and the molecules to move apart: they need more space in which to move. In cool air, molecules are closer together. Cool air, therefore has more molecules per unit volume than hot air does.

Because cool air has more molecules per unit volume, it seems to weigh more than warm air. This closeness of molecules, their compactness, is called *density*. Density, not "weight," is the key to hot air rising and cool air sinking. Hence, density also explains why one type of rock floats on top of another during the earth's cooling process. But why do things sink?

Will it sink or float? If you release a ball of paper, what happens to it? Sir Isaac Newton said objects fall downward. But which way is down? Is down the same anywhere you stand on Earth? If it is, then down is towards the center of our planet, right?

Where very dense objects are concerned, gravity (the force that pulls all things towards that center) has more molecules to pull on, causing them to be tugged beneath the less dense objects. To prove this to students, fill a glass with water, and ask them to predict what will happen when you drop a penny into it. Answers will include that it sinks, it floats and it splashes.

These hypotheses are important for scientific discovery. These opinions allow experimentation that will prove the correctness of

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the hypothesis. Experimentation yields that a penny is more dense than water because it sinks when placed in water.

How about wood? Wood seems fairly heavy. For instance, you can't really lift a 20-foot tree. When placed in water though, it floats. Wood, then, is less dense than water.

Do these properties of density work with other items, such as liquids? If you put alcohol, water and corn oil together, will it form layers of varied densities, or will the three liquids mix? This is why oil spilled in the ocean floats on the water. Oil feels thick, but it's actually less dense than water, so it floats. If colored oils are placed in water, they float, too.

A splash of color. When the Japanese discovered that colored oil floats on water, they probably didn't have your curriculum in mind, but thanks to their observations, your students can benefit from this integrated scientific art lesson.

You'll need a disposable basin or an aluminum foil roasting pan and some colored oil-base inks. (Flo-Master brand inks work best, but you can use oil-base paints that have been thinned.) You may choose to wear gloves to keep the oil off your hands. Be sure to cover the table you're using and watch out for spills. Oil-based ink can be difficult to clean up.

Dab several different colored inks on the water's surface, and then use toothpicks or popsicle sticks to blend and swirl the colors. You might also want to try combs, nails, or straight pins as mixing tools to create interesting patterns. Then, place a sheet of paper on top of the water. The colored oils, which are floating on the water, will adhere to the paper. Lift the paper off the water and place it between sheets of newspaper to dry.

There are many marbleizing styles; they range from stone, wavy and vein patterns, to those that like flower bouquets, or the tail feathers of a peacock. Marbleizing takes time and experimentation. At first, you may produce sheets you don't like; you'll need patience and imagination. Try experimenting with different types and colors of paper, and try different inks or paints, too.

It's impossible to control everything about the floating oils, so, like snowflakes, designs can never be replicated. This is the beauty of marbleizing paper; it's an ancient scientific art that can never be duplicated. ⚘

__Though they may__ not be able to "control" their designs at first, students (at right) quickly learn that marbleizing is an art that's full of surprises.

__Popsicle sticks__ [illegible] great tools for stirring the ink and [illegible], the more "wild" the stirring, the more [illegible] the result!