

Flying Cloud Institute | Where Science Meets Art

Kitchen Chemistry: Exploring Polymers

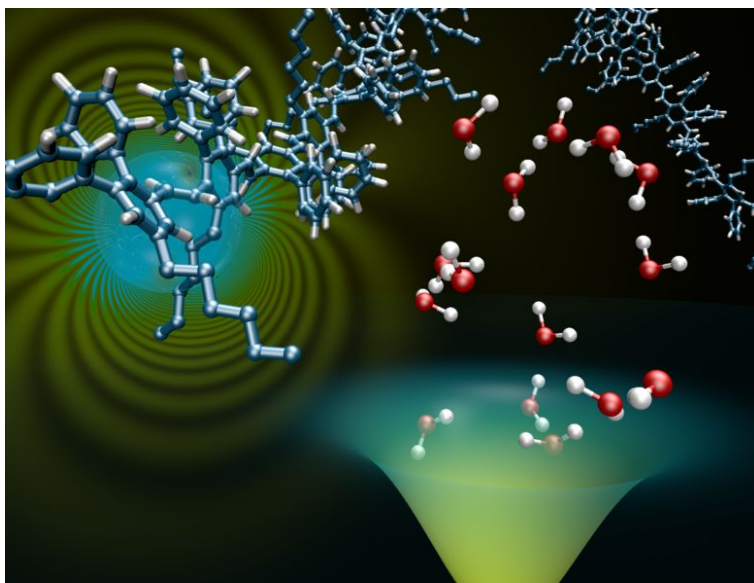
Polymer Clay Formula

Exploration

Today I'd like to share my formula for Polymer Clay! It's great for making little sculptures, has a nice plasticity, dries super hard, and can be painted, sanded and drilled. This clay hardens best when left to air dry, but can also be baked at a very low temperature to quicken the dry time.

Let's look at the ingredients. We are using Cornstarch, White (PVA) Glue, and Lemon Juice. When mixed together and heated they form a polymer bond.

A **Polymer** is when the molecules of different materials get together and bond in long repeating chains. There are two types of bonds. A **covalent bond**, also called a molecular bond, is when the molecules come together so strong that the atoms share electron pairs. A **noncovalent bond** is when large molecules bond together temporarily without sharing electrons. There are organic (nature made) polymers like clay, and synthetic (man made) polymers like plastics.



The Questions

What is a Polymer?

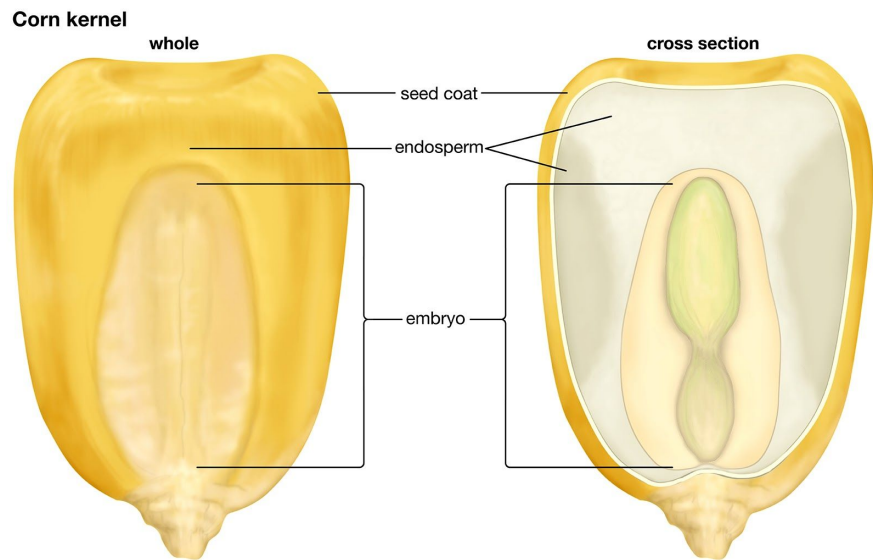
What is the difference between a covalent and noncovalent bond?

What is White PVA Glue?

PVA stands for poly vinyl acetate. It is a synthetic polymer resin. Our PVA glue is going to bond with the cornstarch, making it strong and keeping it a solid.

What is Cornstarch?

Cornstarch is a powdered starch derived from the kernel, or seed, of the corn plant. The starch is actually the **Endosperm** of the seed.



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Cornstarch has a very interesting property. It can become a **Non-Newtonian fluid** when mixed with liquid, which means it can rearrange itself to be a solid or a liquid...Oobleck! Most materials can change forms of matter (solid, liquid, gas) through the application of heat, but Oobleck changes states with the application of pressure. Pressure (rolling, hitting, squeezing) causes the molecules to get close together becoming solid.



Why Lemon Juice?

Lemon juice has a concentrate of **citric acid**, making it sour and acidic. Acids oxidize and break apart proteins. Lemon juice is anti-bacterial because most bacteria can't survive in such acidic conditions!

The Formula

Materials:

1 Cup Cornstarch

$\frac{3}{4}$ Cup Glue

2Tbs Oil (vegetable or mineral)

1Tbs Lemon Juice (or 1/2tsp citric acid mixed in 1Tbs water)

Non-stick pot

Spoon to stir

Extra oil to coat hands for kneading

Process:

(You can double this recipe if you need to)

1. Mix 1 Cup Cornstarch and $\frac{3}{4}$ Cup Glue in the non-stick pot.
2. Add in the 2Tbs of Oil and 1Tbs Lemon Juice, Mix.
3. On medium heat, continuously stir the mixture. It will start to thicken and pull away from the pot. When it becomes hard to stir, like thick mashed potatoes, remove from heat and let cool.
4. Once it's cooled a bit, scoop it out onto a surface. (I scoop it onto parchment paper). It's still hot on the inside, so be careful!
5. Oil your hands and knead the clay till smooth.
6. Sculpt away! Pieces can be left to air dry for a day till completely hard. Store your unused clay in an airtight container or double wrapped in plastic wrap.



What's Happening?

The chemical reaction between the materials caused a molecular polymer bond to form. We made Polymer Clay!

Game

You can play “Polymer/Not Polymer”. With a group, each person takes a turn calling out “Polymer” or “Not Polymer”. When “Not Polymer” is called everyone takes their own unique pose. When “Polymer” is called the caller makes a pose that everyone needs to copy AND connect together in a chain.



Artful Extra

Creature/Habitat/Biome

You can use your Polymer Clay to create imaginative creatures, then craft your creature a home habitat (immediate surroundings) and biome (larger ecosystem, like desert, woodland, marine). For example, my Swarthy creature lives in a mossy cave habitat and only eats round things. Her cave is in a woodland biome with lots of trees and plants.

