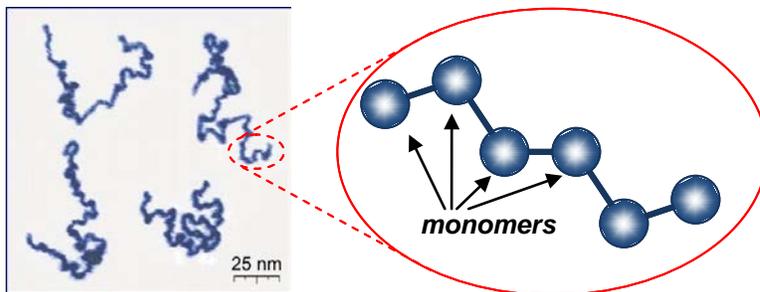


## What is a polymer?

**Poly** = “many” **Mer** = “parts”

A polymer is a chemical compound with repeating structural units (“monomers”). Usually, the monomer is some kind of carbon, silicon, or phosphorous.



## Polymers have some cool properties and find many uses!

### Deformable Liquids and Solids

*viscoelastic behavior*

When you mix cornstarch and water, you obtain a strange goo that flows like a liquid but can be made to act like a solid. Cornstarch is a polymer whose chains get entangled if you stress it too quickly. Pour it slowly and it acts like a liquid. Push hard on it, and it acts more like a solid. Silly Putty<sup>®</sup> is a commercial toy based on this idea. It bounces, but breaks when you give it a sharp blow and can flow like a liquid. Silly Putty<sup>®</sup> is made of a silicone polymer, but the secret ingredient is *boron* (atomic number 5 on the periodic table), which cross-links the polymer chains to make it act both like a viscous liquid and an elastic solid – such a material is called **viscoelastic**.

### Gel Beads and Worms

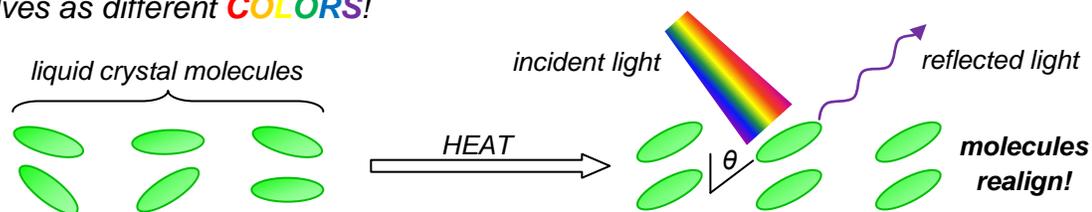
*cross-linking chains*

Polymer chains have the ability to **cross-link**, restricting their movement in solution. This can change a liquid polymer into a “gel”, with properties of a solid. Cross-linking is important in toughening rubber, for instance in car tires. The “Gel Beads” demo uses a set of alginate polymers that have been extracted from kelp (brown seaweed). These long, alginate polymers crosslink via calcium ions. We will combine a drop of solution of these alginates with a solution of calcium chloride, and produce a solid!

### Cholesteric Liquid Crystals

*temperature-sensitivity*

Cholesteric liquid crystal polymers are polymers that are **very sensitive to changes in temperature**. Depending on the temperature, these polymers align themselves into different layers, with the aligned direction of each layer differing by an angle. This angle governs which wavelength of light is reflected – that is, *different temperatures will reveal themselves as different **COLORS!***



This type of polymer is more popularly seen in mood rings, where the ring inset changes color as a response to body temperature. In this workshop, we will use a blend of cholesteric polymers to make liquid crystal thermometers that change color.