Rubber vs plastic vs thermoset (15 min)

**Summary:** Similar to polymer vs…, but now honing in on the wide scope of properties exhibited by different types of polymers.  We probably want a few different examples from each category.  Ask them to think about why each material was chosen for the given use, how it might be disposed of, or what alternative materials from the previous activity might be used instead.

ILOs:

1. Define the differences between a rubber (elastomer), (thermo)plastic, and thermoset.
2. Give examples of products made from each.

**Equipment list:**

All materials: one per group

* A thermoplastic polymer: polypropylene, polystyrene, polyvinyl chloride, wax that melts on the hand, lower melting point polymer
  + Small plastic cups of PLA work well to demonstrate the softening effect above TG
* Thermoset polymer
* Uncured rubber (silly putty, water and cornstarch mixture)
* Cured rubber (bouncy ball, eraser)
* Bowl for warm water (ceramic works well)
* Tweezers (to place and remove samples from boiling water)

Water Kettle to boil water for softening activity

**Intro:** As we’ve seen, polymers have a wide variety of properties. In this experiment we will analyze some polymers with respect to resistance to temperature and deforming forces, and understand how their structures are correlated with the properties. Some introduction to forces: stress, compression, sheer.

**Procedure:**

1) Explore the properties of the materials. Do they bend? Do they bounce? Are they brittle?

2) Focusing on the thermoplastic: Bend the thermoplastic - how does it feel to bend it?

3) Place the thermoplastic, the thermoset and, and cured rubber in the hot water. Do you observe any changes?

4) Remove the samples from the water, and briefly let them cool so they can be touched. Do you notice changes in how they feel? Has the stiffness changed in some rather than others?

**Discussion questions/debrief:**

How were the materials different? How were they the same?

What causes (from a chemical structure perspective!) the materials to behave differently?

Why are some materials affected by temperature and others not? What does the temperature change about the material?

**Lab handout needed?**

No, but paper is recommended for encouraging the students to take notes.