



Warping Utensils for Children with CIPA

SPLICED

Setting



Consumption of Hot food



The Problem



Those affected with CIPA are unable to:

- feel **pain**
- sense **temperature**

This means that:

- they may **unknowingly get burned** by the food they are consuming
- they must be **fed** and **monitored** by caretakers

Burning

Tongue and Hard Palate

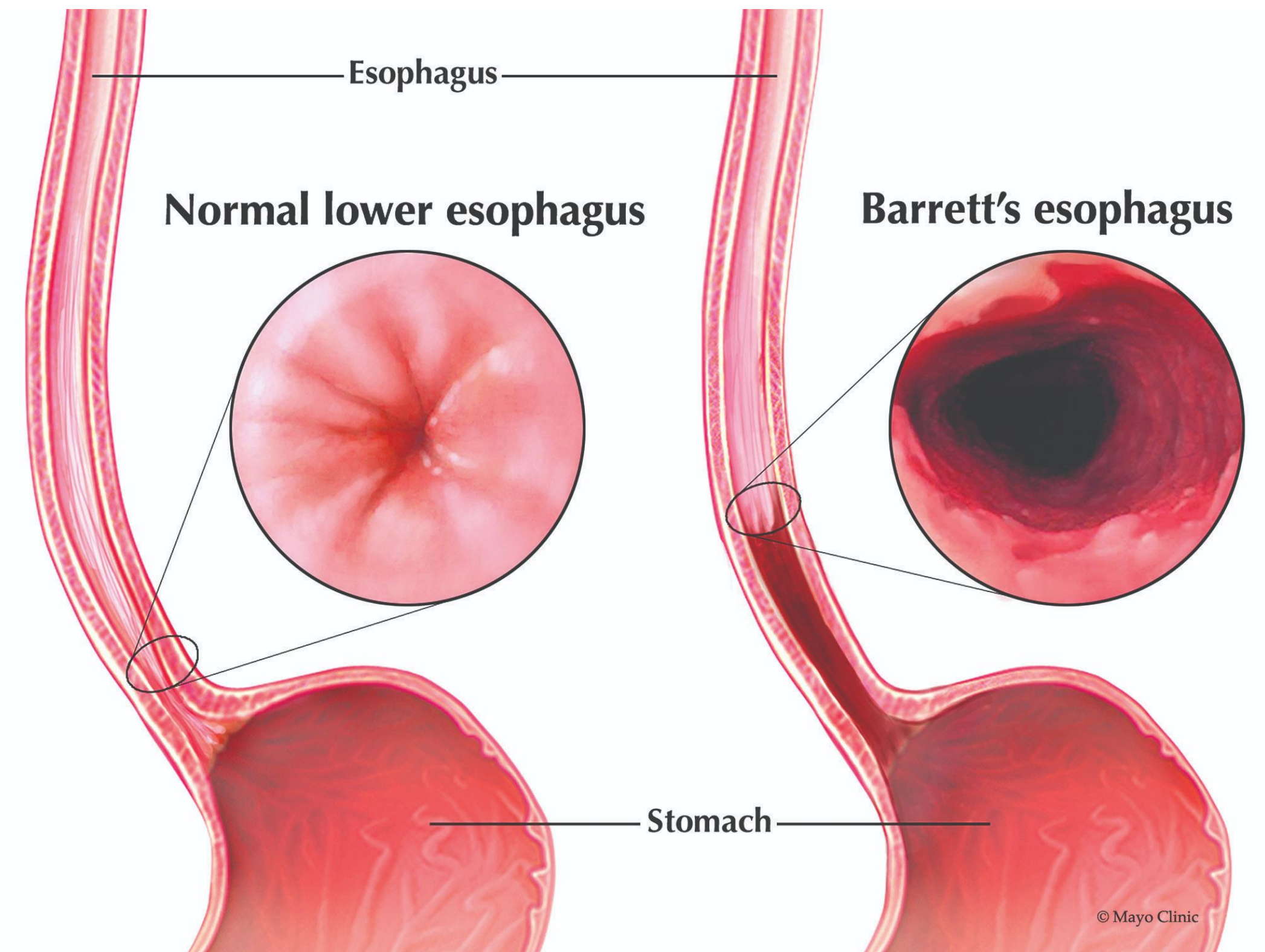
- Average coffee/tea temperature can cause instant burns (71-85 degrees)
- Food and liquids at **45 degrees** can cause burns at an exposure time of around 5 minutes
- Continued exposure can cause significant **deterioration of tissue**



Burning

Esophagus

- Persistent acid reflux (heartburn)
- Repeated exposure of the esophagus to stomach acid can cause a condition caused **esophagitis**
- Can lead to **esophageal cancer** in some cases
- Contributing factors that lead to acid reflux are **out of the control** of children with CIPA due to their physical limitations



The Big Idea

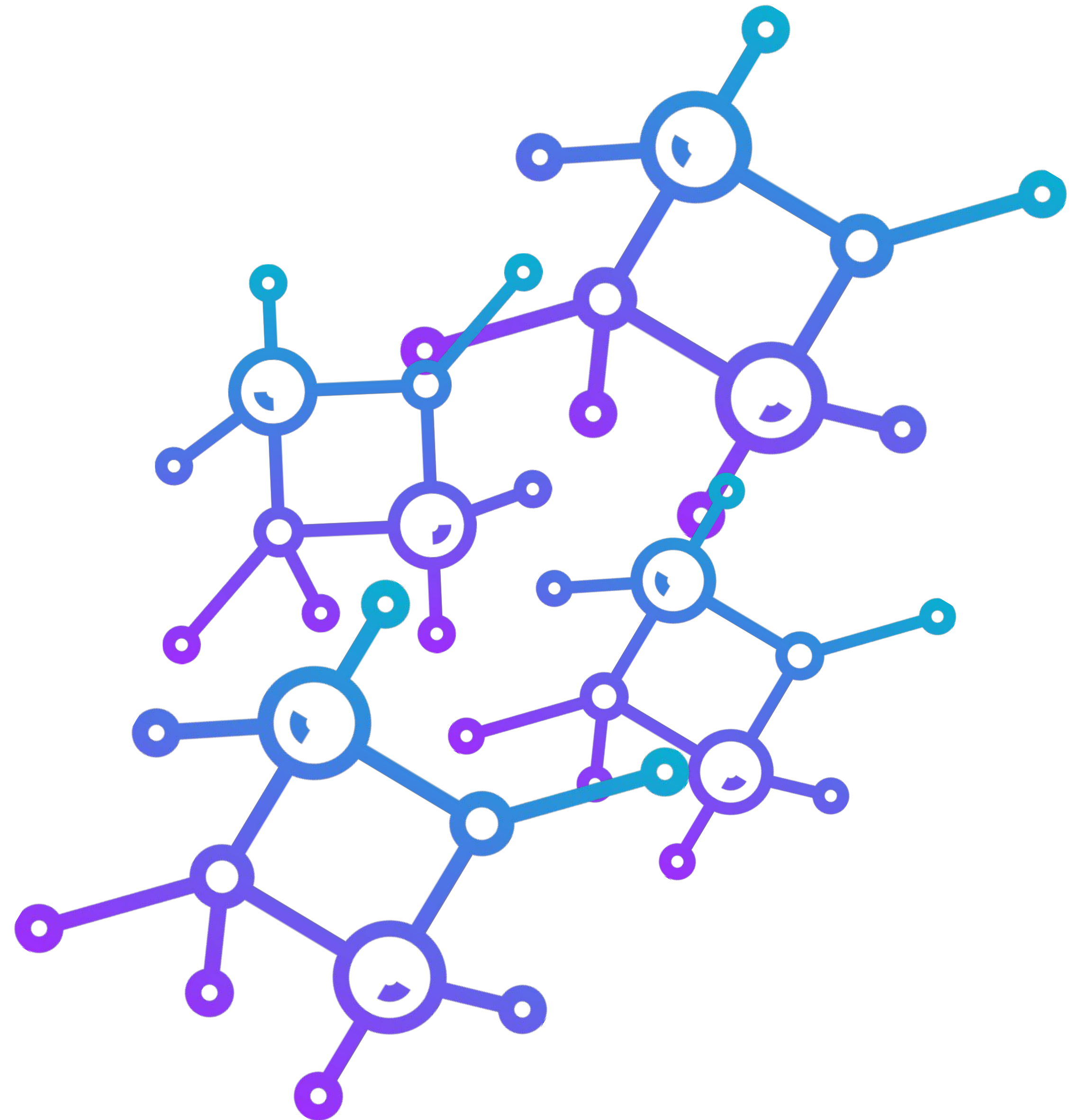


Warping Utensils



Liquid Crystalline Elastomers (LCEs)

- A biomaterial that can **change form** based on the temperature
- Can be programmed to **return to original form**



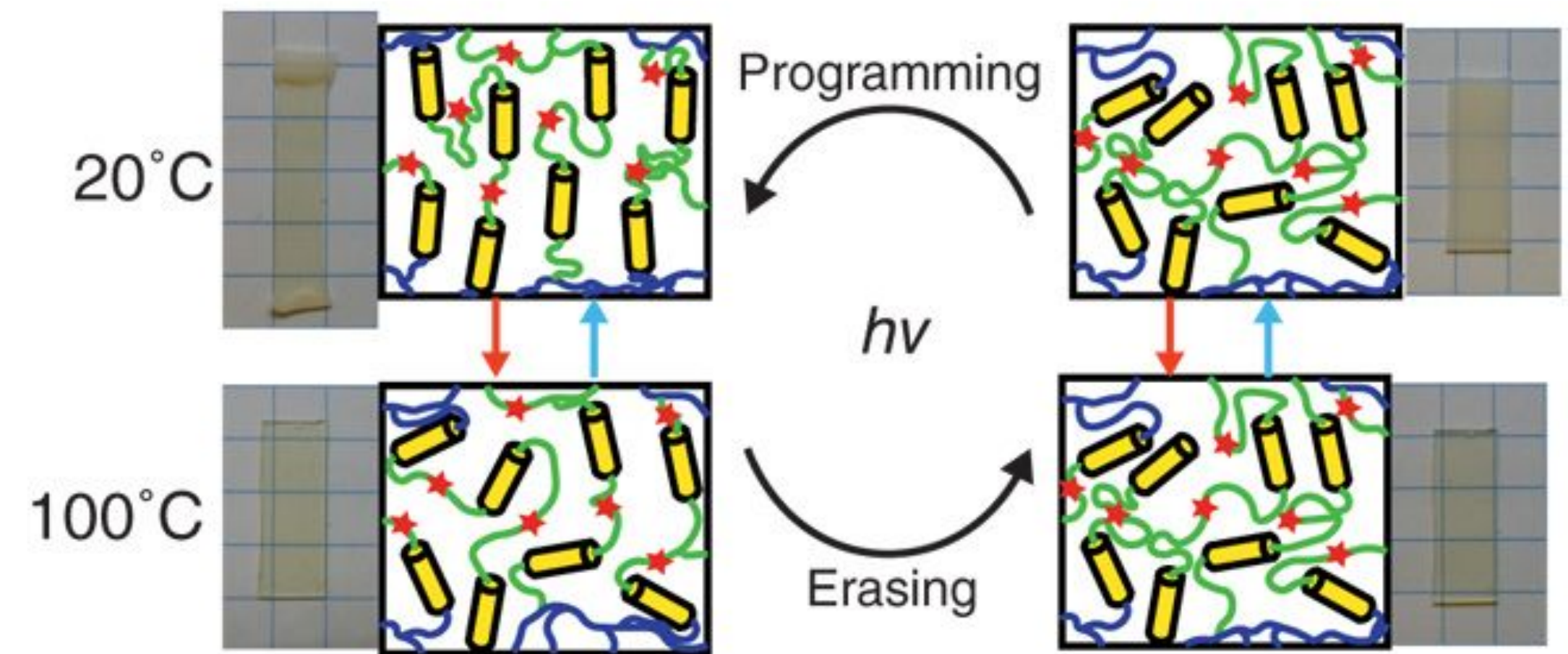
How will the LCEs Work?

When Heated

- i) **Partial melting** of the semi crystalline networks occurs
- ii) Melting-induced **contraction**

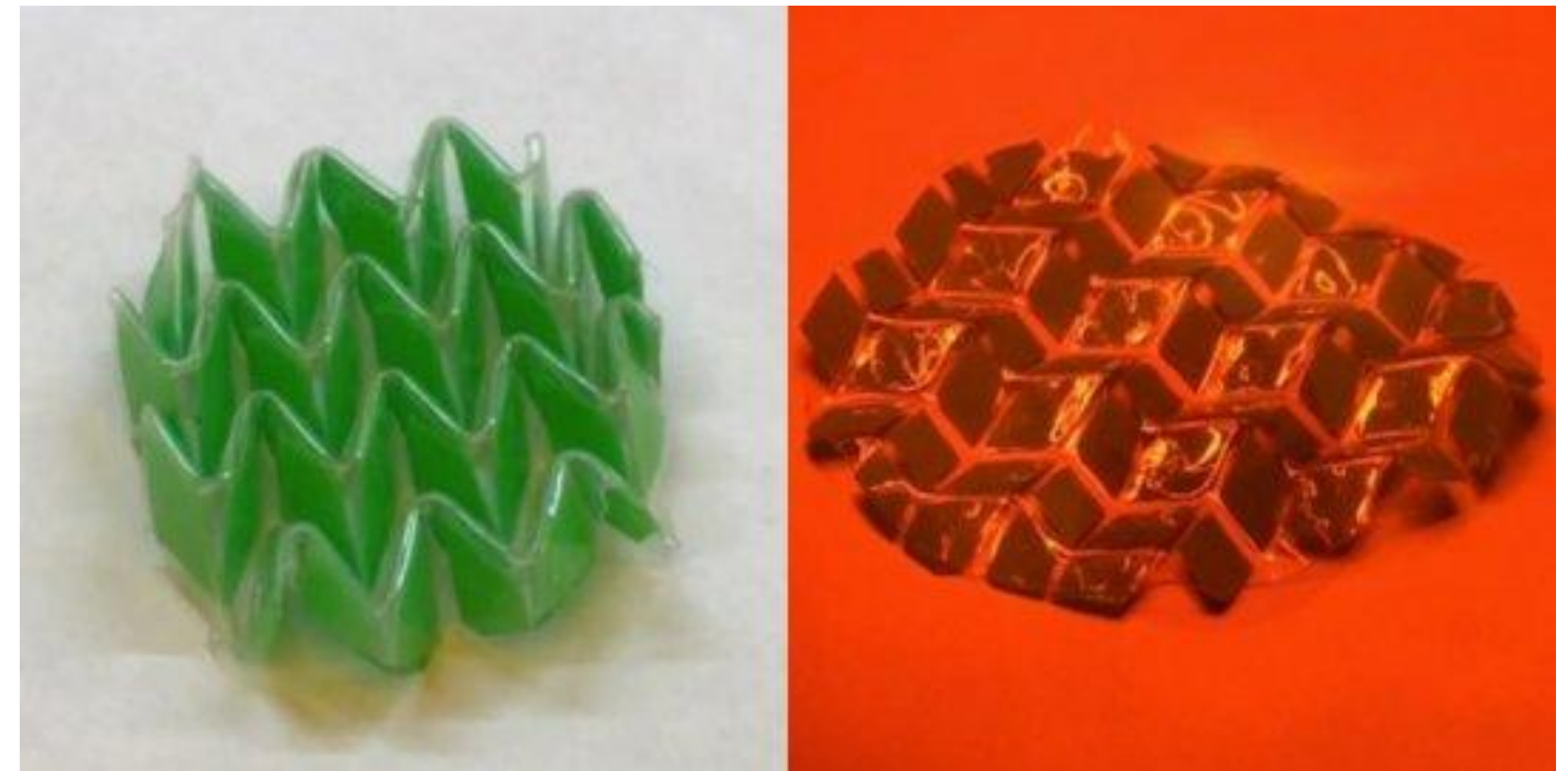
When Cooled

- i) **Recrystallization** occurs
- ii) Crystallization-induced **elongation**



How long will it take to shift?

- LCEs are composed of **2 types** of network bonds: elastic and flowing bond
- The concentration of **flowing bonds** determine the rate of shape shifting
- The time LCEs take to shift is **“programmable,”** lasting from seconds to hours

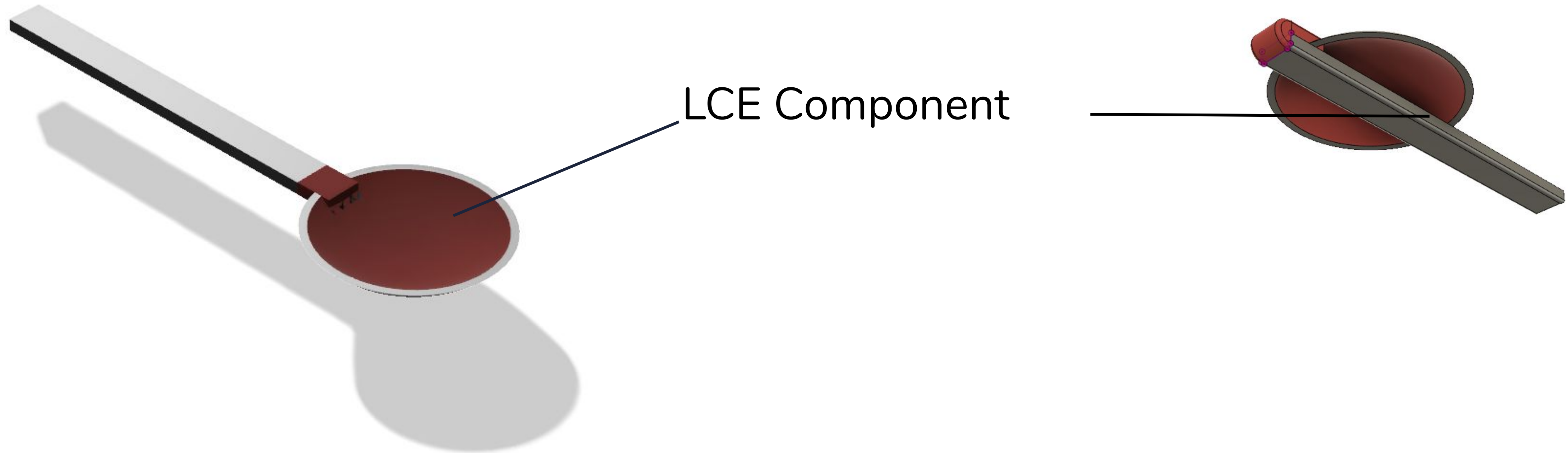


LCEs and Utensils: How it Works

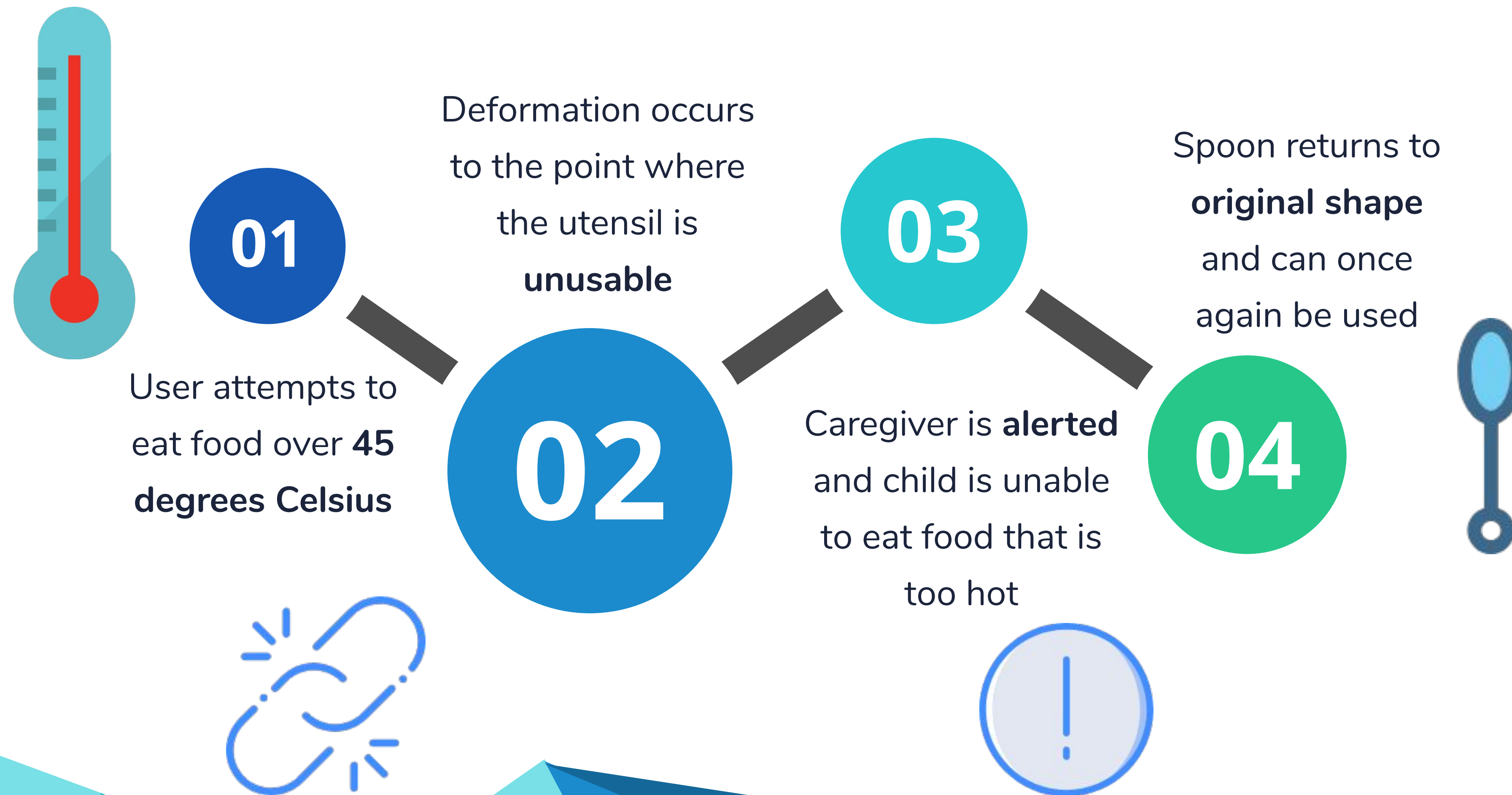
1. **Build utensils using LCEs** that respond to higher temperatures
2. Food with temperatures that is too hot will **cause a shift in the shape** of the spoon, making it **unfunctional**, prohibiting those affected with CIPA from eating the food
 - a. When food comes in **contact** with the utensil
3. Once the food is removed, the utensil will **revert back** to its original shape
4. If the utensil does not change shapes, the food is at an appropriate temperature to be eaten



LCE Utensil Prototype



User Protection



Benefits of Incorporating LCEs into Utensils



Safe

LCEs are non toxic and use on utensils will not be a threat towards children



Obvious Indication of Danger

A change in form warns users that the food is too hot



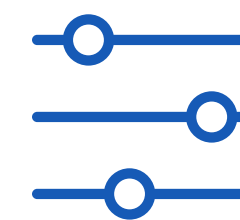
Allows for Independence

Parent is not required to watch over the child while they are eating



Quick

LCEs can be programmed to morph quickly



Flexible

Shapes can be pre configured to be a variety of shapes



Thanks!

