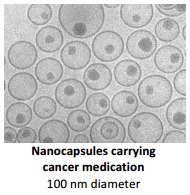
**Gummy Capsule Activity**

**Connection to NGSS**

* HS-PS1-5. Apply scientific principles and gather evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

**Introduction**

Self-assembly is a common technique used in nanoscale science and technology in order to assemble nanoparticles into well-defined configurations. The arrangements of these structures can be used in a wide variety of materials. Self-assembly of nanoparticles has been used to build sensors to detect chemical and biological molecules. It has also been used to create smaller computer chips with more computing power.

Nanocapsules are one way in which scientists use self-assembly to fight diseases. Self-assembly is used to make liposome structures which have an outside shell and a hollow interior that can be used to store medicine. This can allow for targeted delivery in which the medicine is brought selectively to the tumor cells. This allows for less medicine to be used and fewer negative side effects.

In this activity, a chemical reaction takes place once the liquid droplets come in contact with the solution. A polymer is formed which means that a chain-like molecule with repeating units is formed. As the sodium alginate, a polysaccharide, is added to the solution, the short polymers of the alginate are bound into longer chains by the solution creating a capsule similar to a nanocapsule.

**Safety/Disposal**

* DO NOT eat the capsules (they are not food grade).
* Liquid waste can be poured in the bucket provided (to be poured down the drain).
* Solid waste can be thrown in the trash bucket.

**Materials**

* Sodium alginate liquid
* Calcium chloride
* Sodium chloride (table salt)
* Sugar
* Sodium hydrogen carbonate (baking soda)
* Corn starch
* Water
* Vinegar
* Bowls
* Spoons
* Sieve
* Hot Plate
* Ice
* Paper Towel

**Procedure**

Experiment with the different items given to you to make gummy capsules. Your goal is to determine what conditions are needed to make the gummy capsules.

Be ready to briefly explain to the class the experiment/s you did and what you found.

**Questions to Consider**

1. What different conditions did you try?
   1. What did you find out?

1. What factors do you think played a role in the self-assembly of the gummy capsules?
2. What role does composition and motion play in self-assembly?
3. Once the gummy capsules were made, what did they feel like?
   1. What happened when you squeeze them?
   2. Why do you think this is?
4. How does this activity help you better understand nanoscale science and technology?
5. How does this concept relate to the concepts we have covered so far (size and scale, surface-area-to-volume ratio, forces and size-dependent properties)?

**References**

\*\*http://www.nisenet.org/sites/default/files/catalog/uploads/8879/fabricationgummy\_guide\_31oct11.pdf **(This website will explain the science behind the gummy capsules)**

http://blog.khymos.org/2007/03/30/first-experiments-with-sodium-alginate/

(this website shows you how to make the sodium alginate solution)