Delivery Capsules

Communities for Immunity
Participating Museum

Activity Outline

Invitation

- "Would you like to make capsules that scientists use to deliver vaccines?

Activity Steps

1. Place the sieve into the bowl of saltwater (calcium chloride solution).
2. Gently squeeze the bottle of sodium alginate so that individual droplets of liquid fall into the sieve.
3. Lift the sieve out of the bowl.
4. Feel the droplets. Are they still liquid? Try squeezing one. What happens?

Setup

- Strainer
- Bowl or other shallow container
- Calcium chloride solution (0.75 M in water)
- Sodium alginate solution in dropper bottles (3% in water, with food coloring)

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What's going on?

When the liquid droplets come into contact with the salt water, a chemical reaction takes place and creates a polymer.

A polymer is a long chain-like molecule made up of many repeating units linked together.

The polymer forms on the outside surface of the droplets, where they touch the salt water, creating a shell around the liquid interior. The salt water is a solution of calcium chloride. The liquid in the squirt bottle is sodium alginate, a polysaccharide with many short polymer molecules.

The calcium ions in the salt water cross-link (bond) these short polymer molecules into longer strands, turning the sodium alginate liquid into a thick gel.

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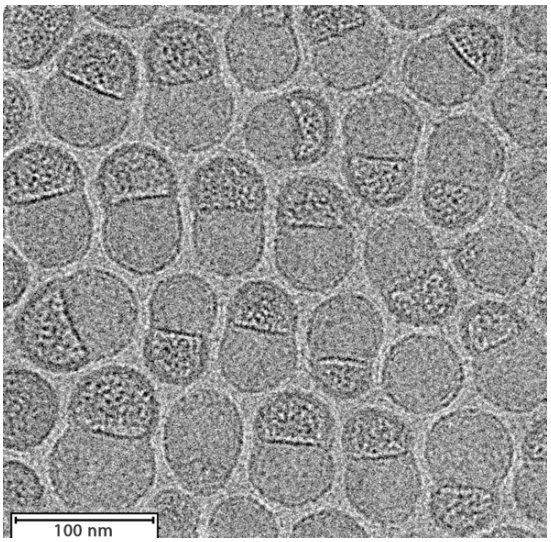
How is this related to vaccines?

The Pfizer-BioNTech and Moderna COVID-19 vaccines are both made using lipid nanoparticles. These are tiny particles with a protective shell of lipid (oil-like) molecules and an interior that can be filled. In these COVID-19 vaccines, the interiors of the nanoparticles are filled with mRNA molecules, which give our cells instructions for how to make a harmless protein that is unique to the virus. This triggers a protective immune response and the creation of antibodies, which protects us against the real virus.



Lipid Nanoparticles with mRNA molecules (darker shapes on one side of the particles). Magnified approximately 1 million times. Image used with permission from doi.org/10.1016/j.ijpharm.2021.120586

The mRNA molecules in the vaccines are very delicate and would degrade too quickly to be effective without this protective lipid coating. Nanoparticles can be made from a wide variety of substances (not just lipids) and can be used to deliver medicine to diseased parts of the body, bypassing healthy parts.

Scientists have been studying and developing vaccines that use mRNA and lipid nanoparticles for decades because they can be safely produced faster than with other methods of making vaccines.

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