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Spherification

How do you get juice inside an edible bubble?

BEST FOR GRADES
5-9

ESTIMATED TIME
60 Minutes

You Will Need

- ❑ 1 cup low-acid juice, such as apple or white grape
- ❑ 2 grams or 1/2 teaspoon food grade sodium alginate (a food thickener/gelling agent available online)
- ❑ ½ teaspoon food-grade calcium chloride **must be food-grade (not de-icing salt)*
- ❑ 1 cup water
- ❑ Additional water for rinsing
- ❑ Eye dropper, clean squeeze bottle, or pipette
- ❑ Two bowls
- ❑ One small cup or jar for mixing
- ❑ Spoon
- ❑ Paper towels

Saftey Instructions for Families

- ❑ Only use **food-grade** calcium chloride. Industrial or de-icing calcium chloride is *not safe* to eat
- ❑ Wash hands before and after the activity.
- ❑ Do not taste anything until the spheres have been rinsed in clean water.

Directions

Watch the Popping Boba Balls Video from https://science-u.org/ and then let the investigation begin.

Prepare the Juice + Alginate Mixture

1. In a cup, combine 1 cup low-acid juice with 2 grams (about ½ teaspoon) of sodium alginate.
2. Mix until smooth. It is easiest to use a blender or you can use a whisk. Sodium alginate hydrates slowly- if using a whisk, give it 10 minutes or so to absorb. If using a blender, let it sit in the fridge over night so the bubbles disappear.

When you are ready to start - prepare the Calcium Bath

3. Pour 1 cup of water into a bowl.
4. Add ½ teaspoon food-grade calcium chloride.
5. Stir until completely dissolved.

Practice dropping technique

6. Use an eye dropper, pipette, or syringe to draw up a small amount of the juice mixture.
7. Practice squeezing out one drop at a time back into the cup.

Form the Spheres

8. Hold the dropper 3-5 inches above the calcium bath.
9. Gently squeeze out 5-10 drops into the bath.
10. Let the drops sit for 60 seconds to form a gel shell.

How to Tell When It's "Just Right"
Your alginate mixture should be smooth, pourable, slightly thicker than juice, but not syrupy, able to drip cleanly from a spoon. If it glops instead of drips, it's too thick.

Rinse and taste

11. Use a spoon to scoop the spheres out of the calcium bath.
12. Transfer them into a second bowl filled with clean water to rinse.
13. Remove and gently pinch to test the texture and taste.

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Spherification
Discovery Questions & Keywords

Discovery Questions

Beginning the Experiment

Which foods are acidic, neutral, or basic?

During the Experiment

What do you observe happening to the drops in the calcium bath?

After the Experiment

How do sodium alginate and calcium chloride interact to form a gel shell?

Keywords

Molecular Gastronomy

Gastronomy is the study of preparing food; molecular gastronomy looks at the molecules in food and how they change.

Spherification

The process of liquid food reacting with a liquid solution to create a gelatinous sphere.

pH

A scale that measures how acidic or basic a solution is. An acidic pH is below 7, such as lemon juice. A neutral pH is 7, such as water. A basic pH is above 7, such as bleach.

Ions

An atom or molecule that has an electrical charge, such as electrons and protons, so negative or positive charge.

How does it work?

Spherification happens because sodium alginate and calcium chloride react when they meet. Sodium alginate comes from seaweed. When you mix it with water, the alginate spreads out into the liquid as long, flexible molecules.

When drops of this alginate mixture fall into the calcium chloride solution, something special happens:

- The calcium releases positively charged calcium ions
- The alginate has negatively charged parts
- The calcium ions act like tiny “connectors” that link alginate molecules together

Because each calcium ion can attach to two alginate molecules at once, the outside of the drop quickly turns into a soft gel. The inside stays liquid because the reaction happens fastest at the surface.

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Spherification

Discovery question answer key for parents and teachers

Beginning the Experiment

Which foods are acidic, neutral, or basic?

Most fruit juices are acidic (pH below 7) — lemon and lime juice are very acidic, while orange, apple, and grape juice are mildly acidic. Pure water is neutral (pH 7). Truly basic foods (pH above 7) are less common, but egg whites and a pinch of baking soda dissolved in water are good examples. This matters for the experiment: very acidic juices don't spherify as well, which is something students can test in the extensions below.

During the Experiment

What do you observe happening to the drops in the calcium bath?

Answers will vary, but most scientists will notice that each drop starts out completely liquid, and within a few seconds a thin, jelly-like skin forms on the outside while the inside stays liquid. After the 60 seconds in the bath, the spheres are firm enough to scoop with a spoon, yet they still "pop" with a liquid center when pinched or bitten. Scientists may also notice that the longer a sphere sits in the calcium bath, the thicker and firmer the gel becomes.

After the Experiment

How do sodium alginate and calcium chloride interact to form a gel shell?

The calcium chloride supplies positively charged calcium ions (Ca^{2}), and the sodium alginate supplies long, negatively charged alginate molecules. Each calcium ion can grab onto two alginate molecules at once, linking them together into a network — this is called cross-linking, and it forms a gel called calcium alginate. The reaction happens fastest right where the drop meets the bath, so a thin gel shell forms on the outside while the juice inside stays liquid. That's what gives you a sphere that holds its shape but still pops.

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