



Prize Winner

Scientific Inquiry

Year 5-6

Casper Saint-Saens

Stirling East Primary School



Questioning and Predicting:

Question

How are good popping pearls made (good means the popping pearls have extremely thin skins and are held together so they don't break instantly and nicely fit up a bubble tea straw) and under what conditions are "good" popping pearls formed?

Aim

My aim is to determine the best way to make popping pearls, and the advantages and disadvantages of making them vs. buying them

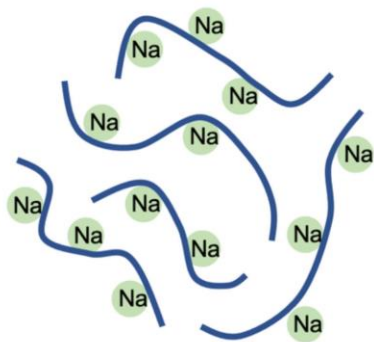
Hypothesis

My hypothesis is that the length of time the pearls are in the calcium chloride solution will change the way the pearls are formed and how good they are.

Before beginning my experiment I first need to learn what spherification is:

Spherification happens when the sodium alginate molecules run into the calcium chloride molecules and it creates calcium alginate.

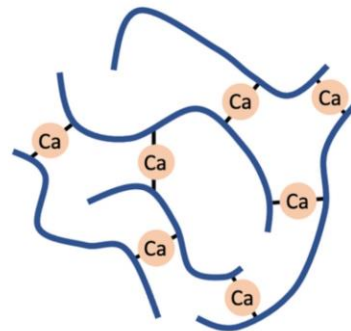

Sodium alginate



liquid

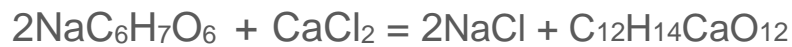
Calcium alginate

Calcium

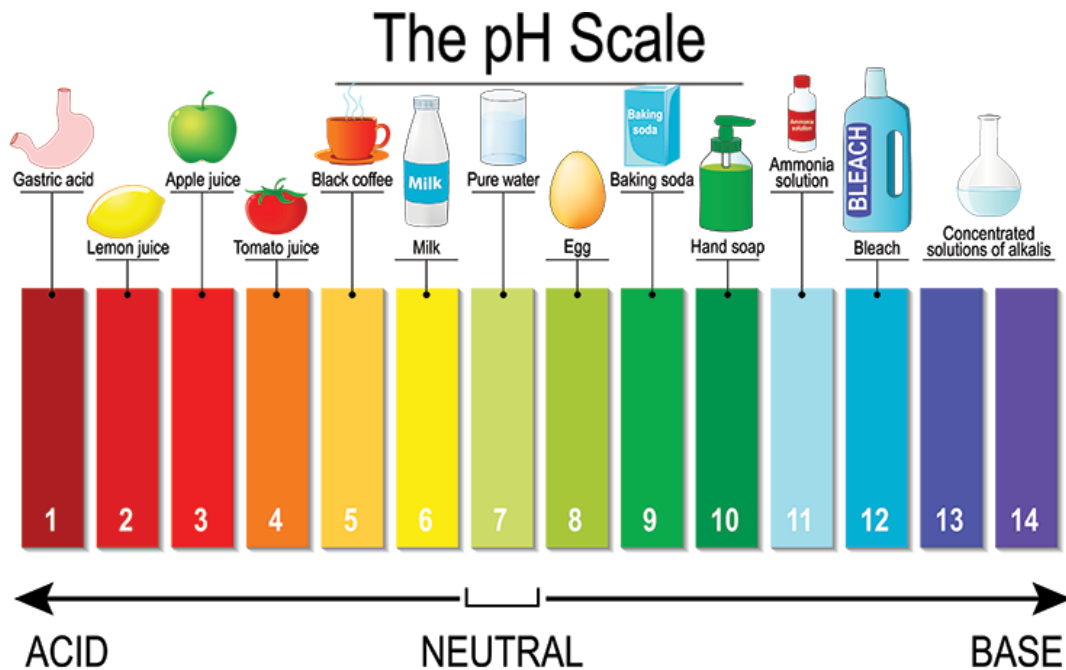


gelatinous

Image Credit: Svenja Lohner, Science Buddies / Science Buddies



Calcium alginate is a gelatinous molecule like jelly. This is what the skin of the popping pearl is made of and seeing as you only leave the popping pearl in for a minute or two, the calcium chloride can't react with all of the sodium alginate causing the popping effect. Spherification can also be affected by the pH of the liquid. If the pH is too low then the acidity of the liquid will cause it to dissolve.



For my experiment we want the liquid to be a pH of 4 or above.

Planning and conducting:

Ingredients and equipment

- Sodium alginate
- Calcium chloride
- Hershey's syrup (strawberry)
- Water (to mix with calcium chloride)
- Metal bowl
- Syringe
- Cup
- iPad
- Paper towel
- Water (to dilute syrup)
- Scale
- Sieve
- 1 cup scoop

Variables

Change (Cows) - My independent variable is the length of time I leave the popping pearls in the solution.

Observe (Often) - The dependant variables that I will be looking for in my popping pearls to make them “good” include:

- Thin skin around the outside of the pearl
- When squeezed, the pearl pops easily
- A bright taste
- Roughly 8.5mm in diameter
- Fits in a standard boba straw

Measure (Moo) - The dependent variable that I will measure is the percentage of “good” popping pearls that I can make (see definition of “good” above).

Same (Softly) - The things that I will keep the same (which are the control variables) throughout this experiment include:

- The recipe of the solution
- The syrup to water ratio
- The pipet I squeeze the syrup out of

I chose this experiment because I am interested in opening a bubble tea market stall at the Stirling market as there hasn't been one before. To buy popping pearls for my drinks costs 60 dollars for 6 kg and that made me wonder: “Can I make these?” So I am conducting this experiment to see whether or not to buy them. I know that store bought popping pearls are roughly 8.5 millimeters in diameter and very nice and shiny so I will compare my results to the actual popping pearls.

Method

1. Put 250 ml of fruit syrup in a cup (Hersheys strawberry)
2. Add 250 ml of water to the syrup
3. Add 2 grams of sodium alginate to the cup and blend/stir until sodium alginate dissolves
4. Put fruit solution in fridge for 1 - 5 hrs to remove air bubbles
5. While solution is in the fridge, in a new bowl add 2 cups of water
6. Add 2 grams of calcium chloride to the bowl
7. Stir the solution using a clean spoon until calcium chloride has completely dissolved (set aside)
8. After 1 - 5 hrs take the syrup solution out of the fridge and use a plastic syringe to suck up some liquid

9. Get the calcium chloride solution that was set aside before and put one drop of syrup into the calcium chloride solution
10. Leave in solution for an amount of time, given by the experiment, and then remove pearl with a strainer
11. Clean the pearl with water and give it a try!

Processing and analyzing data and information:

Popping pearl scoring system

- 1/5 - Doesn't pop at all or pops without contact and is an odd shape, doesn't fit up a boba straw or taste right
- 2/5 - Only pops after lots of squeezing or pops too easily, barely fits up a boba straw or too small and doesn't look right
- 3/5 - Pops okay and fits up boba straw, may be a bit small/big but looks and tastes right
- 4/5 - Pops well and has a good shape, fits up a straw without a fuss and looks great
- 5/5 - Pops easily in the mouth and gives you a bang of flavour, fits up boba straw and is shiny and spherical

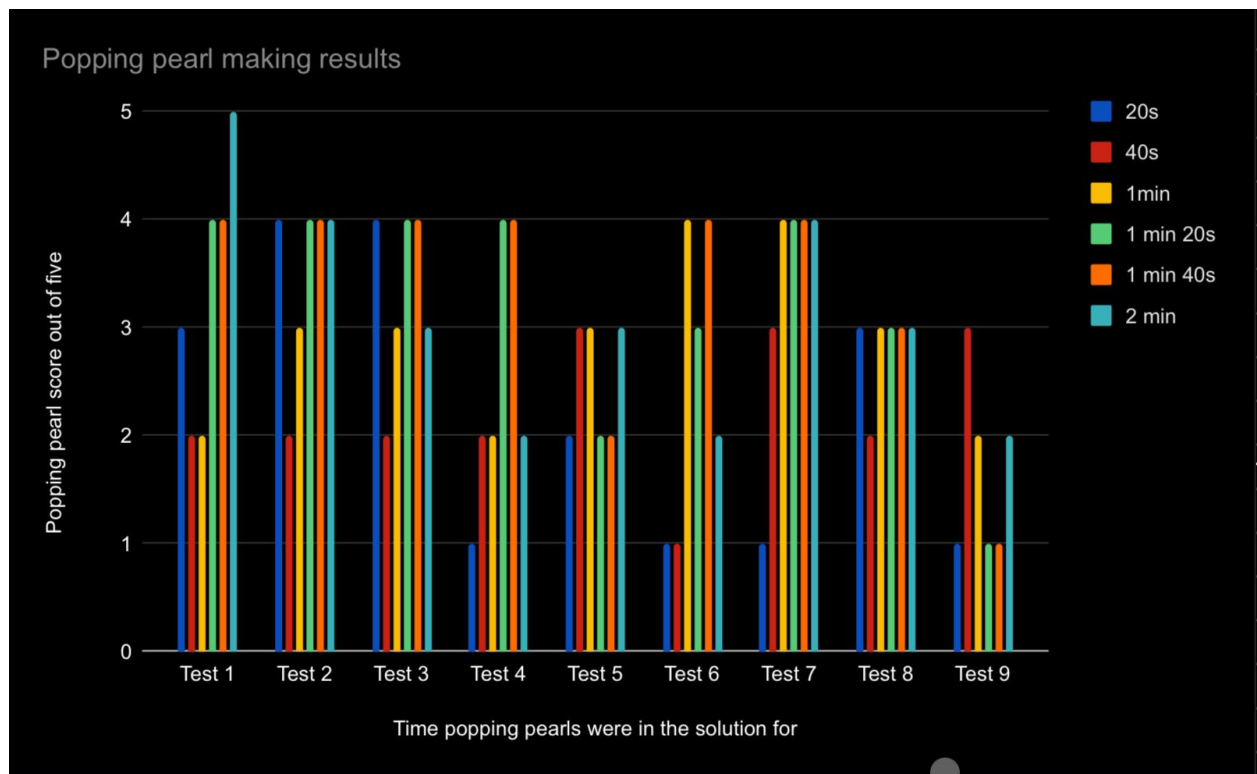
Category 4 and 5 are considered “good” popping pearls.

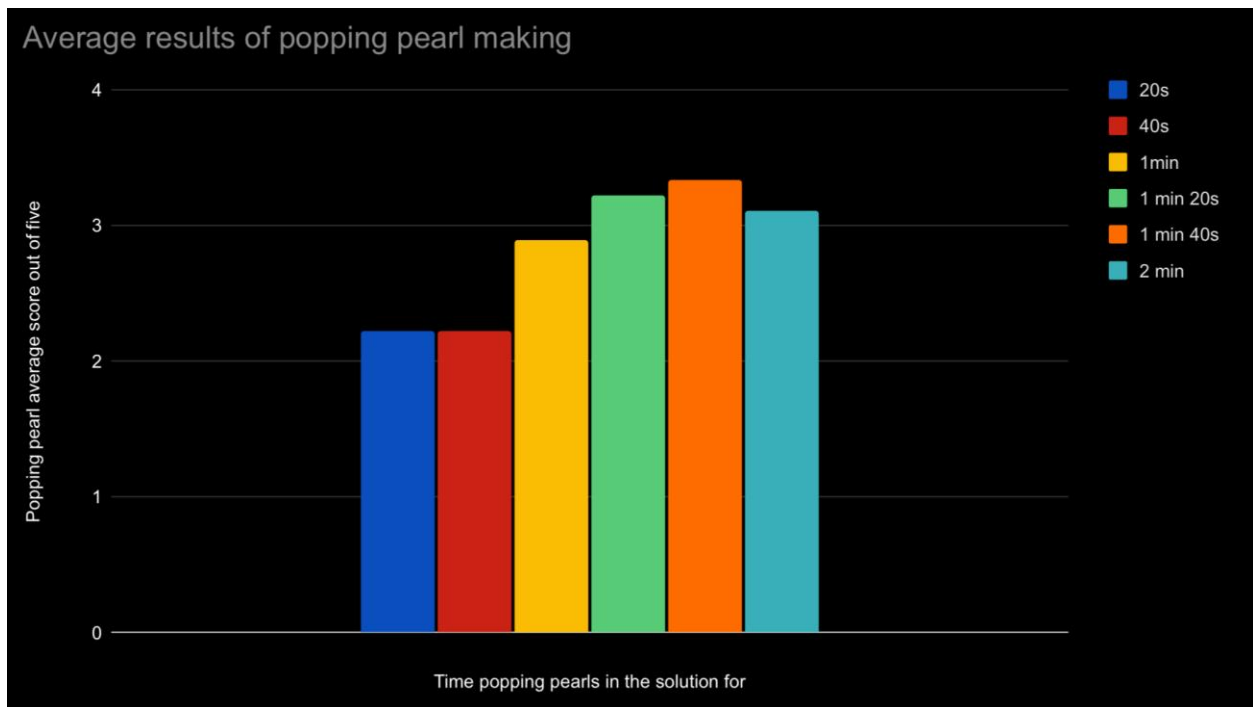
Tables of results of popping pearl making

Using recipe from <https://www.sciencebuddies.org.au>

	<u>20s</u>	<u>40s</u>	<u>1min</u>	<u>1min 20s</u>	<u>1min 40s</u>	<u>2min</u>
<u>Test 1</u>	3	2	2	4	4	5
<u>Test 2</u>	4	2	3	4	4	4
<u>Test 3</u>	4	2	3	4	4	3
<u>Test 4</u>	1	2	2	4	4	2

<u>Test 5</u>	2	3	3	2	2	3
<u>Test 6</u>	1	1	4	3	4	2
<u>Test 7</u>	1	3	4	4	4	4
<u>Test 8</u>	3	2	3	3	3	3
<u>Test 9</u>	1	3	2	1	1	2
<u>Average</u>	<u>2.2</u>	<u>2.2</u>	<u>2.8</u>	<u>3.2</u>	<u>3.3</u>	<u>3.1</u>





I tweaked the popping pearl scoring system so the pearls need to fit up any straw, not a boba straw as the syringe I bought doesn't make the right sized drops. However, I think with the right sized syringe, the pearls will be fine.



Overall I didn't really like the results and thought I would try again, this time with a special book

my teacher (Mrs Finney) leant me.

Attempt 2 of popping pearl making

Ingredients and equipment

- Sodium alginate
- Calcium chloride
- Hershey's syrups (strawberry)
- Water (mix with calcium chloride)
- Metal bowl
- Pipette
- Cup
- iPad
- Paper towel
- Water (to dilute syrup)
- Scale
- Sieve
- 1 cup scoop

Method

1. Blend together 2 g of sodium alginate into 1 cup of Hershey's strawberry syrup and 1 cup of water



2. Let the preparation sit for at least 15 minutes in the fridge to allow the air bubbles trapped within the solution following the brewing of the preparation to escape



3. Prepare a calcium chloride bath by dissolving 5 g of calcium chloride, with 4 cups of water

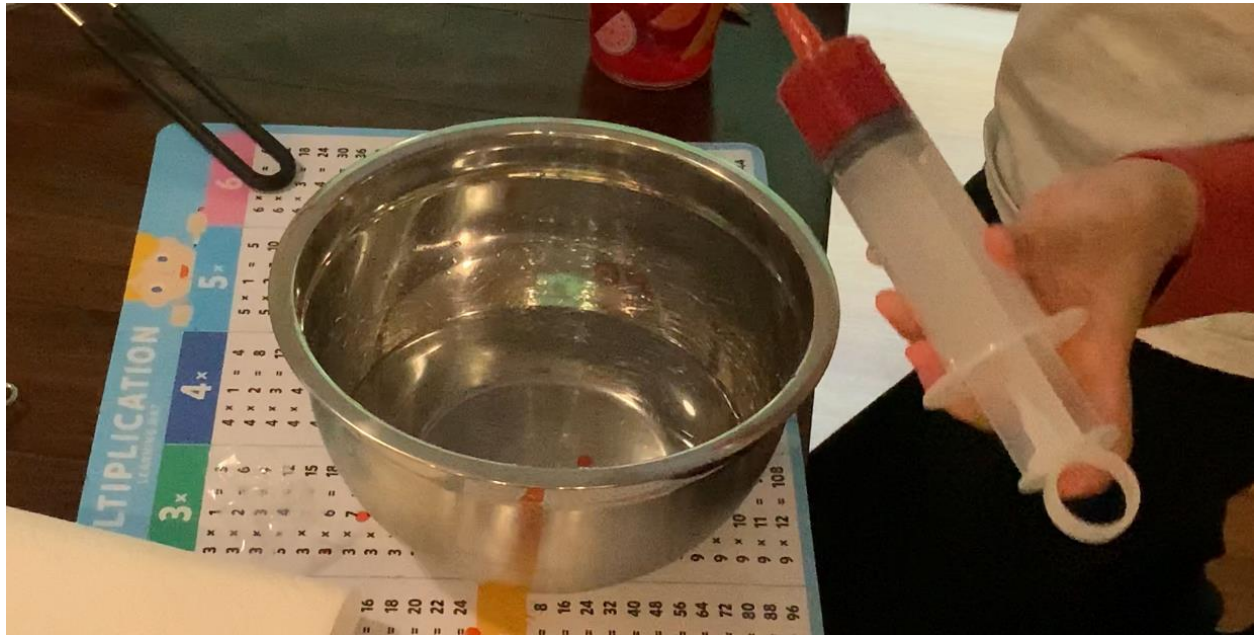




- Suck up some of your strawberry solution with a syringe. (I switched the bowls here so the sieve would fit in the bowl)



- Using a syringe, push drops of liquid into the solution until syringe is empty



- Leave for ___ amount of time
- Using a sieve, take the pearls out of the solution and wash for 20 seconds

8. Rank the popping pearls using the popping pearl scoring system

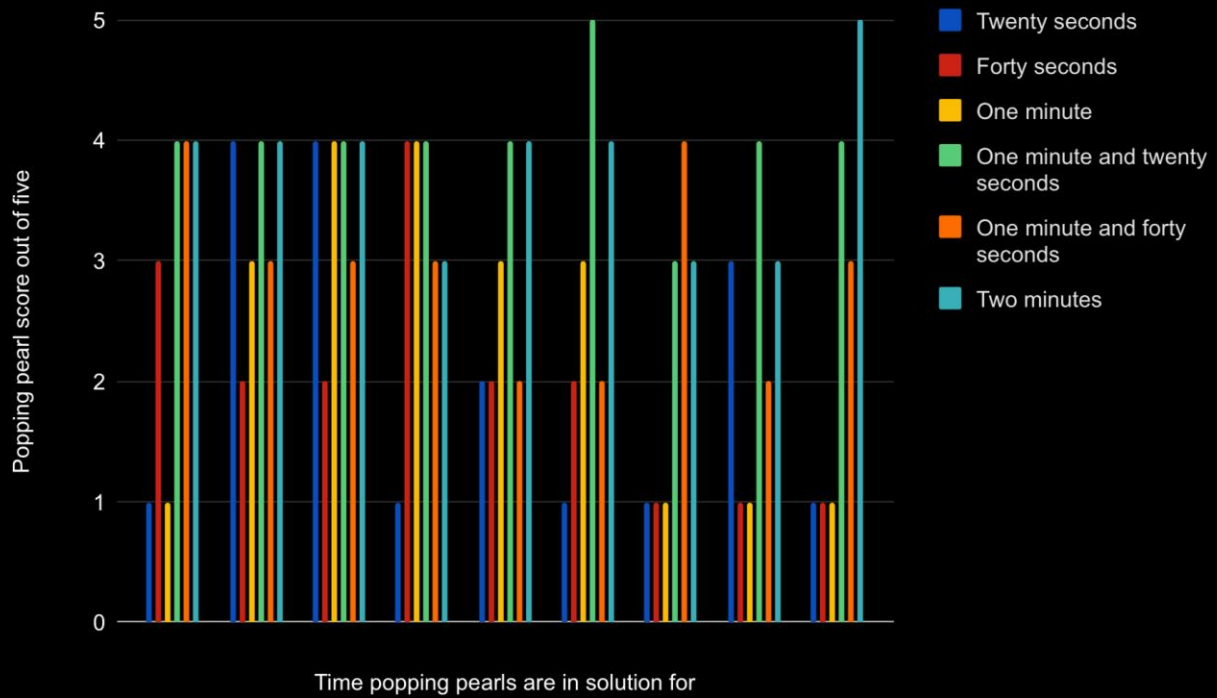
Tweaked popping pearl scoring system

- 1/5 - Doesn't pop at all or pops without contact and is odd shape, does not fit up a boba straw or taste right
- 2/5 - Only pops after lots of squeezing or pops too easily, barely fits up a boba straw or too small and doesn't look right
- 3/5 - Pops okay and fits up boba straw, may be a bit small or big but looks and tastes right
- 4/5 - Pops well and has a good shape, fits up a straw without a fuss and looks great
- 5/5 - Pops easily in the mouth and gives you a bang of flavour, fits up a straw and is shiny and spherical

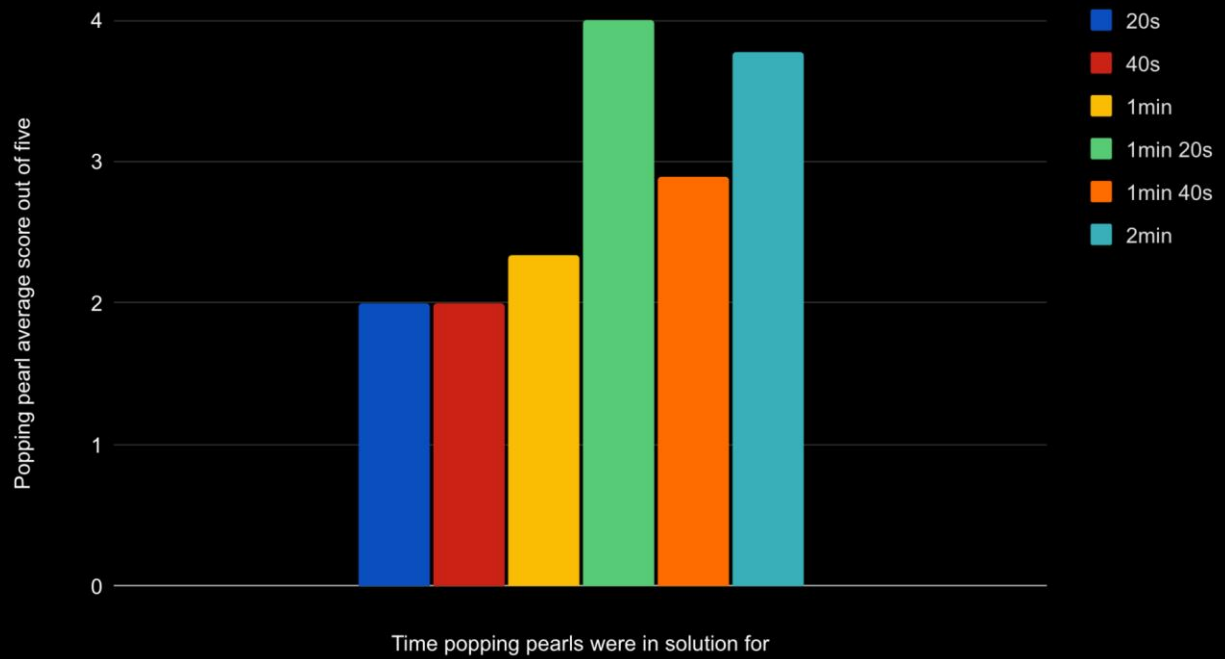
	<u>20s</u>	<u>40s</u>	<u>1min</u>	<u>1min 20s</u>	<u>1min 40s</u>	<u>2min</u>
<u>Test 1</u>	1	3	1	4	4	4
<u>Test 2</u>	4	2	3	4	3	4
<u>Test 3</u>	4	2	4	4	3	4
<u>Test 4</u>	1	4	4	4	3	3
<u>Test 5</u>	2	2	3	4	2	4
<u>Test 6</u>	1	2	3	5	2	4
<u>Test 7</u>	1	1	1	3	4	3
<u>Test 8</u>	3	1	1	4	2	3

<u>Test 9</u>	1	1	1	4	3	5
<u>Average</u>	<u>2</u>	<u>2</u>	<u>2.3</u>	<u>4</u>	<u>2.8</u>	<u>4.2</u>

Popping pearl making results



Average results of popping pearl making







Though getting better results, I found that the pearls would completely congeal if I didn't eat them 5 minutes after making them which is not ideal as the market goes for six hours and most people like the popping sensation of the pearls.

Concluding and evaluating

Conclusion

In conclusion I found that the conditions of popping pearl making are a bit too precise for me to recreate perfectly at home and I would have to make each pearl one by one so it would take 200 minutes to make 100 pearls (which is not feasible)

Evaluating

I think my experiment was a fair test as I judged everything with the same scoring system and the same person judged my pearls. The people who would be interested could be boba lovers that want to make the pearls, boba shops that might want to start making pearls by hand or scientists that might be studying popping pearls. I would say my experiment was pretty accurate although I had to refresh the solution once or twice. I think my experiment was valid as I was able to compare my results to the store bought ones by measuring the diameters and also repeated the experiment 9 times for every test.

Things I could improve:

- Replacing the solution each time I ran the test to ensure each popping pearl got the same treatment
- Using a larger syringe to make bigger pearls
- Physically putting store bought pearls in front of my created pearls
- Spotting differences between the pearls physically
- Doing 10 tests instead of 9.

Science 2024 Logbook

19th of March 2024

My question is - How are good popping pearls made (good means the popping pearls that have extremely thin skins and are held together so they don't break instantly and nicely fit up a bubble tea straw) and under what conditions are the "good" popping pearls formed?

21st of March 2024

Today we wrote our aim and hypothesis for our experiment. Tonight I will be looking at the different types of syrup to decide and figure out how much to spend.

3rd of April 2024

Today I didn't really do anything experiment-wise but decided to make bubble tea to see the rough diameter of the pearls and to see how hard you need to squeeze to pop them (but mainly as an excuse to have bubble tea).

5th of April 2024

I will be figuring out how I'm going to conduct this experiment and placing my order for ingredients so they will hopefully arrive in time for the school holidays. I am aiming to spend about \$50. I'm also now trying to find the equipment I need by looking online

7th of April 2024

Today I have figured out the cost of all ingredients which will probably be around \$50 - \$55 (that may seem a bit close to buying them in the first place but if I were to order them in only the quantity that I need, it would cost less than \$30) I will hopefully place all of my orders tomorrow, so they can come in time for the school holidays. I also had a talk with my mum and she entered me into the competition and we looked at some of the websites I could buy from.

8th of April 2024

I placed my order for everything except for the sodium alginate as I can't find any cheap food grade ones and the one I did before is out of stock.

19th of April 2024

Everything arrived for the experiment and I was super excited! I celebrated with a bubble tea and hoped to do my experiment soon.



7x

7 x 1 =	7
7 x 2 =	14
7 x 3 =	21
7 x 4 =	28
7 x 5 =	35
7 x 6 =	42
7 x 7 =	49
7 x 8 =	56
7 x 9 =	63
7 x 10 =	70
7 x 11 =	77
7 x 12 =	84

8x

8 x 7 =	56
8 x 8 =	64
8 x 9 =	72
8 x 10 =	80
8 x 11 =	88
8 x 12 =	96

9x

9 x 1 =	9
9 x 2 =	18
9 x 3 =	27
9 x 4 =	36
9 x 5 =	45
9 x 6 =	54
9 x 7 =	63
9 x 8 =	72
9 x 9 =	81
9 x 10 =	90
9 x 11 =	99
9 x 12 =	108

10x

10 x 1 =	10
10 x 2 =	20
10 x 3 =	30
10 x 4 =	40
10 x 5 =	50
10 x 6 =	60
10 x 7 =	70
10 x 8 =	80
10 x 9 =	90
10 x 10 =	100
10 x 11 =	110
10 x 12 =	120

11x

11 x 1 =	11
11 x 2 =	22
11 x 3 =	33
11 x 4 =	44
11 x 5 =	55
11 x 6 =	66
11 x 7 =	77
11 x 8 =	88
11 x 9 =	99
11 x 10 =	110
11 x 11 =	121
11 x 12 =	132

12x

12 x 1 =	12
12 x 2 =	24
12 x 3 =	36
12 x 4 =	48
12 x 5 =	60
12 x 6 =	72
12 x 7 =	84
12 x 8 =	96
12 x 9 =	108
12 x 10 =	120
12 x 11 =	132
12 x 12 =	144

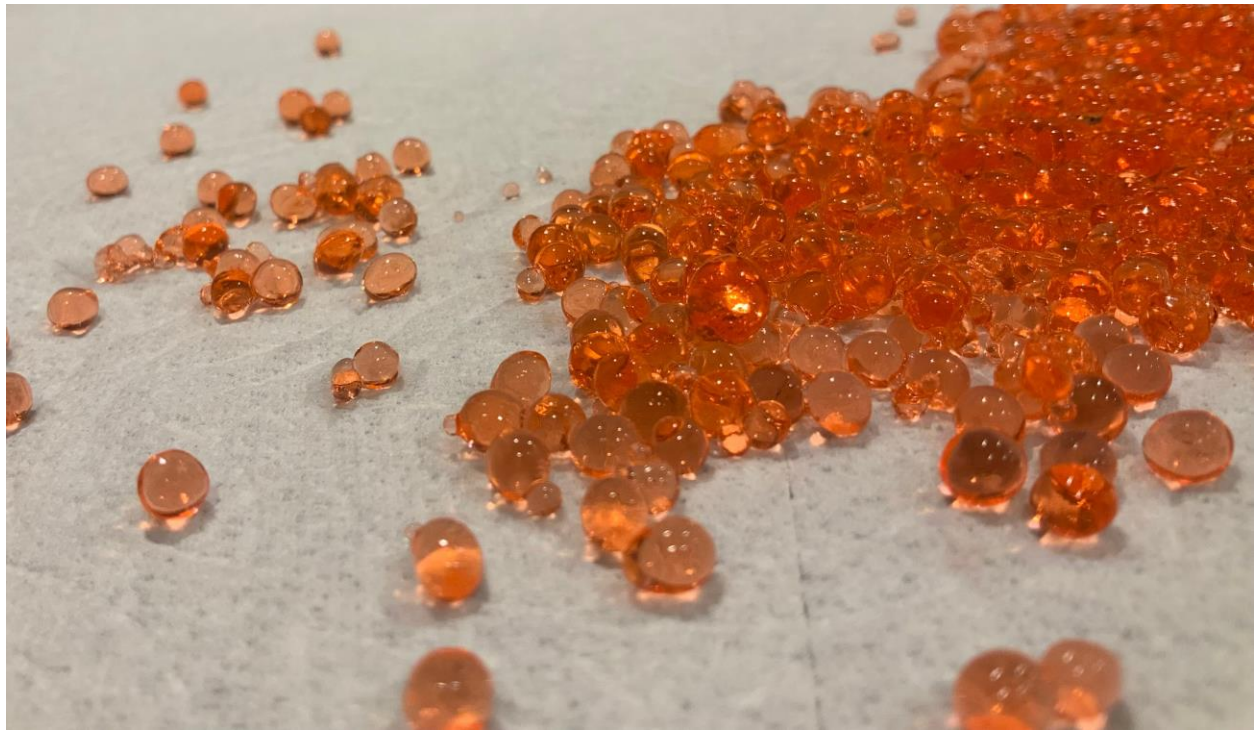


21st of April 2024

I am going to start my experiment today and draw up my graph. I am really excited to play with this equipment to make popping pearls!

21st of April 2024

I didn't really like the results of the popping pearls and I don't know what to do. However, we still had some fun drinks with dinner!



8th of May 2024

My teacher (Mrs Finney) lent me a book with a recipe for popping pearls in it (MOLECULAR GASTRONOMY BY MOLECULE-R AN INTRODUCTION TO THE SCIENCE BEHIND 40 SPECTACULAR RECIPES). She told me to try again this time using the recipe from the book.

12th of May 2024

In hopes that it will work out, I will try my experiment again today. This time using the recipe from the book.

12th of May 2024

I still can't get the popping pearls to work out as the syringe doesn't make the right sized drops while the popping pearls will completely congeal due to the calcium chloride molecules sticking on the pearl (causing the chemical reaction to continue). I don't think I can do the experiment again, as I am running low on ingredients



6th of June 2024

Today I wrote my results and made my graph for my experiment. Although disappointed that I didn't get positive results, I am still happy I did the experiment. I now know that I need to buy them instead of making them

16th of June 2024

I am now finishing up by writing the conclusion and evaluating my results. I will be figuring out what I can do to make the test better, as well as showing how my results were valid and concluding my experiment

30th of June 2024

Finally finished, I will get my family to proof read it ready to upload

Bibliography

Information from websites and books

[MOLECULAR GASTRONOMY BY MOLECULE-R AN INTRODUCTION TO THE SCIENCE BEHIND 40 SPECTACULAR RECIPES](#)

- One method to making pearls
- One definition of spherification

<https://www.amazon.com.au>

- Buying syringe
- Buying syrup
- Buying calcium chloride
- Buying sodium alginate

<https://www.sciencebuddies.org.au> Rowland, Teisha. "Make Popping Boba Balls Out of Your Drinks." Science Buddies, 22 Nov. 2023

- How to make popping pearls (look in Conducting the Experiment section).
- average price of making - the average price of making popping pearls is \$80, however, I think I can do it in \$50 dollars as it depends where you get the ingredients from.
- one spherification definition

<https://pearllemonboba.com/what-are-popping-boba-made-of>

- What are popping pearls made of? - popping pearls are made of juice mixed with sodium alginate to create a skin around the outside. The calcium chloride mixed with the sodium alginate causes this reaction.

<https://www.researchgate.net>

- What chemical reaction do calcium chloride and sodium alginate cause - they will form a jelly like substance called calcium alginate (the skin of a popping pearl)

<https://kitchen-theory.com/sodium-alginate-spherification/>

- One definition of spherification

<https://spoonuniversity.com/lifestyle/what-happened-when-i-tried-spherification-at-home-and-what-that-actually-means>

- Someone else's thoughts on the experiment

<https://kitchen-theory.com/sodium-alginate-spherification/>

- One definition of spherification

<https://pearllemonboba.com/how-to-make-popping-boba-at-home/>

- Learning about the pH scale

[https://www.oliphantscienceawards.com.au/event_information/award_categories/scientific inquiry](https://www.oliphantscienceawards.com.au/event_information/award_categories/scientific_inquiry)

- Comparing my work to the judging rubric

https://www.oliphantscienceawards.com.au/participant_information/online_project_submission

- Uploading my work

Help from people

[Talk with mum](#)

- What websites to buy from
- Convincing her to enter me

[Help from Mrs. Finney](#)

- Helping me write my report
- Helping me lay it out nicely

[Help from Dad, Courtney \(Step Mum\) and Nat \(Dads Cousin\)](#)

- Help with blending the ingredients together (Dad).
- Proof reading it (All of them)
- Marking my work and leaving notes on how I can improve (Nat)

OSA RISK ASSESSMENT FORM

for all entries in Models & Inventions and Scientific Inquiry

This must be included with your report, logbook or entry. One form per entry.

STUDENT(S) NAME: Casper Saint - Saëns ID: 0694-030

SCHOOL: Stirling East Primary School

Activity: Give a brief outline of what you are planning to do.

I am planning to make popping pearls out of chemicals to see whether it is cheaper to buy them from a store or make them at home by hand. I will be ranking each pearl with a scoring system that i will make up myself. I will also be comparing my pearls to store bought ones to see the similarities between the two

Are there possible risks? Consider the following:

- Chemical risks: Are you using chemicals? If so, check with your teacher that any chemicals to be used are on the approved list for schools. Check the safety requirements for their use, such as eye protection and eyewash facilities, availability of running water, use of gloves, a well-ventilated area or fume cupboard.
- Thermal risks: Are you heating things? Could you be burnt?
- Biological risks: Are you working with micro-organisms such as mould and bacteria?
- Sharps risks: Are you cutting things, and is there a risk of injury from sharp objects?
- Electrical risks: Are you using mains (240 volt) electricity? How will you make sure that this is safe? Could you use a battery instead? **Only batteries can be used for Models & Inventions entries*
- Radiation risks: Does your entry use potentially harmful radiation such as UV or lasers?
- Other hazards.

Also, if you are using other people as subjects in an investigation you must get them to sign a note consenting to be part of your experiment.

Risks	How I will control / manage the risk
<u>• The Chemical could spill on me</u>	<u>• Make sure to put the chemicals near the middle of the table.</u>

(Attach another sheet if needed.)

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): Casper Saint - Saëns

SIGNATURE(S): Casper

By ticking this box, I/we state that my/our project adheres to the listed criteria for this Category.

TEACHER'S NAME: Sarah Finney

SIGNATURE: Sarah Finney DATE: 30.6.24