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Scientific Inquiry

Year 9-10

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OLIPHANT SCIENCE AWARDS 2022

A-salt on snot – An investigation into saline decongestants

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Background Information

Having a cold and nasal congestion, I wondered how I could get relief and expel the thick mucus as fast as possible. Mucus is a lubricant that keeps tissues in your airways moist and is a line of defence. "Mucus is very important for filtering out materials that you breathe in through your nose, such as dust and allergens and microorganisms," says Dr. Andrew Lane, an ear, nose, and throat expert at Johns Hopkins University.

Airways become congested when blood vessels enlarge. Breathing is difficult and excess mucus is trapped. Decongestants constrict blood vessels. There are two types: saline and drug-based. Saline decongestants contain sterilised water and salt (sodium chloride). Salt draws water out of swollen blood vessels in a process called Osmosis. Water moves through membranes until moisture levels are equal on both sides of the membrane. The salt also makes the mucus thinner by pulling water out of the proteins.

Drug-based decongestants can become addictive especially when used for more than one week. They become less effective, so more is used to gain relief. This is a worldwide issue. *'In Germany, at least 100,000 persons are affected by a nasal spray addiction (rhinitis medicamentosa). Many experts estimate that the number is even closer to a million.'* … 'they damage the nose's cleansing system in the long term'. *(*Cegla Medzintechnik). Drug-based decongestants are not suitable for children. Saline decongestants are safe.

Mucus is made of proteins called mucins with sugars branching off them. This investigation uses imitation mucus (gelatine (protein) and corn syrup (sugar)) – see log book entry 18/04/23.

Questioning and predicting

Question: How does the concentration of salt solution effect the amount snot (mucus) thins so it can be removed from airways by blowing your nose?

Aim
To investigate the effect of salt solution concentration on the thinning of mucus.

Prediction/Hypothesis
As the concentration of salt solution increases, the mucus become thinner because salt draws water out of the proteins(gelatine). My prediction is that the mucus will steadily get thinner with increased concentration.

Planning and conducting:

Recipe 1 (Appendix) quoted rough quantities such as teaspoon and cup measures. This produced inconsistent mucus. Quantities were converted e.g. 7 teaspoons of gelatine became 14 g. The corn syrup was too thick to drain from a measuring cylinder so a small beaker was used.

Figure 1 and Figure 2 show the mucus (Appendix recipe 2). It looked and had the consistency of real mucus but in some trials, not all of the gelatine mixed with the water leaving lumps (Figure 3)

Figure 1


Figure 2


Figure 3

Initially light from a torch was passed horizontally through the mucus in a darkened room but the light was too bright. The variation in intensity was very low. The results were better in a well-lit room but

- Every batch of mucus was different
- The initial intensity of light was not the same for all trials
- Thick clumps of mucus were not distributed evenly so the light intensity would depend on where the sensor was placed.

The difference in light intensity before and after the salt solution was added was therefore measured through the bottom of the beaker at 5 positions (X)(Figure 4 and 5).

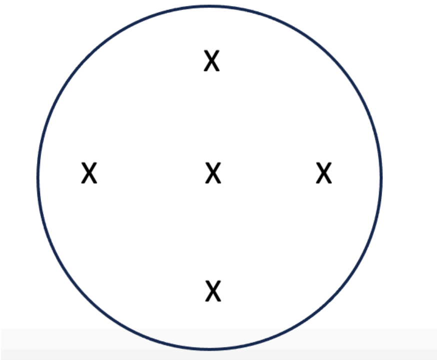


Figure 4

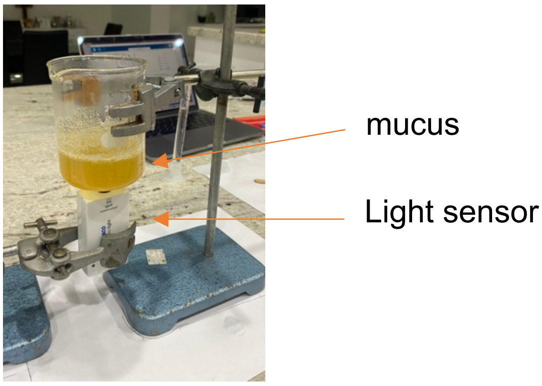


Figure 5

Flow rate of the mucus was also calculated by measuring the mass flowing into a conical flask in a given time (Figure 6).

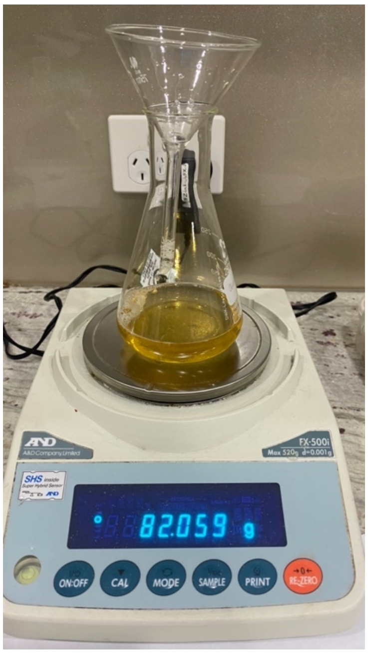


Figure 6

The recipe was adjusted to half quantities to save materials.

Final recipe (snot/mucus)

1. Add 50 mL of boiling water to a beaker.
2. Add 14 g of gelatine.
3. Gently pat and stir the gelatine into the water with a fork.
4. Allow to cool (1 minute).
5. Add 20 mL of corn syrup.
6. Stir gently with a fork.

Independent variable
The concentration of the salt solution. This was changed by adding different amounts of concentrated salt solution to tap water (total volume was 10 mL).

Concentration %	Volume of water /mL	Volume of concentrated salt solution /mL
0	10	0
20	8	2
40	6	4
60	4	6
80	2	8
100	0	10

Dependant variable
The thinning of the mucus by measuring the

1 change in light intensity passing through the mucus
2 flow rate of the mucus

A fair test –variables kept constant

Variable kept constant	How it was kept constant	Why it needed to be kept constant
Corn syrup/gelatine brand	The same brands were used throughout the experiment.	Different brands may create different mucus consistencies causing variation in the light intensity. Reduces reliability.
Quantities used in making mucus	The same recipe was used for every trial.	The consistency/thickness varies with different quantities. Intensity values will be unreliable.
Type of salt	Table salt was used for every trial.	Different salts may have particles of different sizes thinning the mucus differently. Light intensity will vary.
Type of water (mucus/salt solutions).	Tap water was used for all trials.	Different water has different or a different number of particles e.g.

		deionised water has minerals and ions removed.
The temperature of the water for making the saturated solution and mucus	Tap water, from the same tap, was used for all trials.	More salt will dissolve in hotter water thinning the mucus, making the intensity unreliable.
Volume of mucus/beaker size	The same recipe and beaker size was used for all trials – depth of the mucus did not change.	Deeper mucus absorbs more light causing scatter in the intensity.
Type/brand of beaker	The same brand glass beakers were used for all trials.	Some glass is less transparent/scratched or thicker. More light is absorbed creating variation/unreliable results.
Light sensor brand	The same light sensor and software was used for all trials	Different sensors may measure light differently or have a different sensitivity. Results will be less consistent/unreliable.
Distance between sensor and beaker	The sensor almost touched the beaker.	Ensures that only light passing through mucus is recorded. Reduces scatter.

The funnel and electronic scales used to measure flow rate were the same for all trials. A wider funnel will allow mucus to flow faster. Different electronic scales may measure mass differently. The results would be inconsistent.

Apparatus

- Kettle
- 14 g of Gelatine powder for each trial (total 1260 g)
- 20 mL of Corn Syrup for each trial (total 1800 mL)
- 6 metal forks
- salt 100 g
- Electronic scales
- 7 x 20 ml beakers
- 6 x 250 ml beakers
- 6 x 10 mL measuring cylinder
- 50 mL measuring cylinder
- 2 retort stands
- Stopwatch
- 6 x 250 mL conical flasks
- 6 x glass filter funnels
- Teat pipette
- Computer

Method

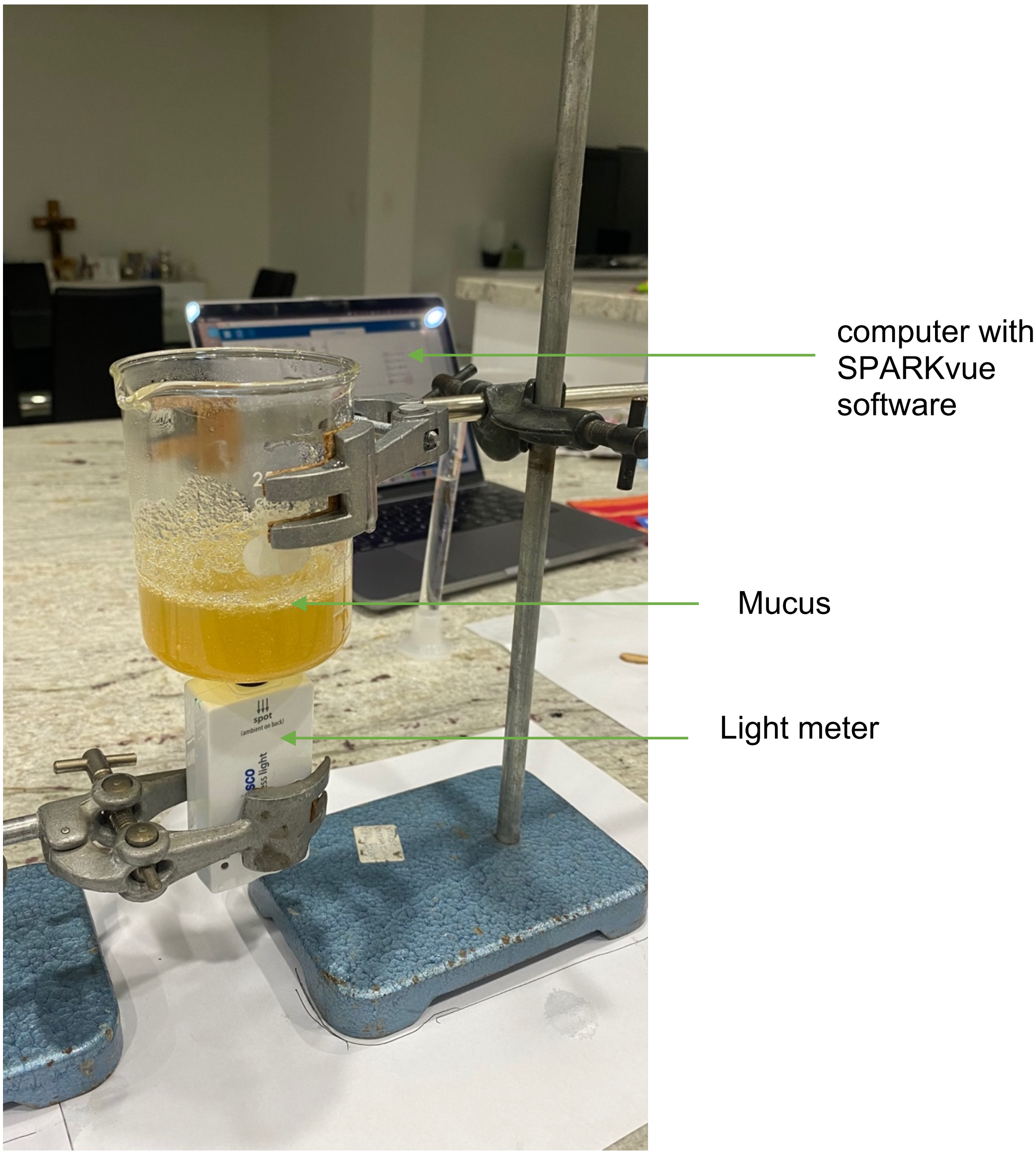


Figure 7 – set up

1. A concentrated salt solution was made (see appendix)
2. The light sensor was turned on and connected to the computer (wireless). White light was chosen.
3. The light sensor was placed in the clamp of one retort stand.
4. A 20 mL beaker was filled with tap water and used to transfer water to a 10 mL measuring cylinder. A teat pipette was used to ensure 10 mL was measured as accurate as possible.
5. Mucus was made (recipe 3) in a 250 mL beaker.
6. The beaker was placed in the clamp of the other retort stand just above the sensor (at the centre of the beaker).
7. The software was used to record 10 s of data.
8. The software tool was used to get the mean light intensity passing through the mucus.

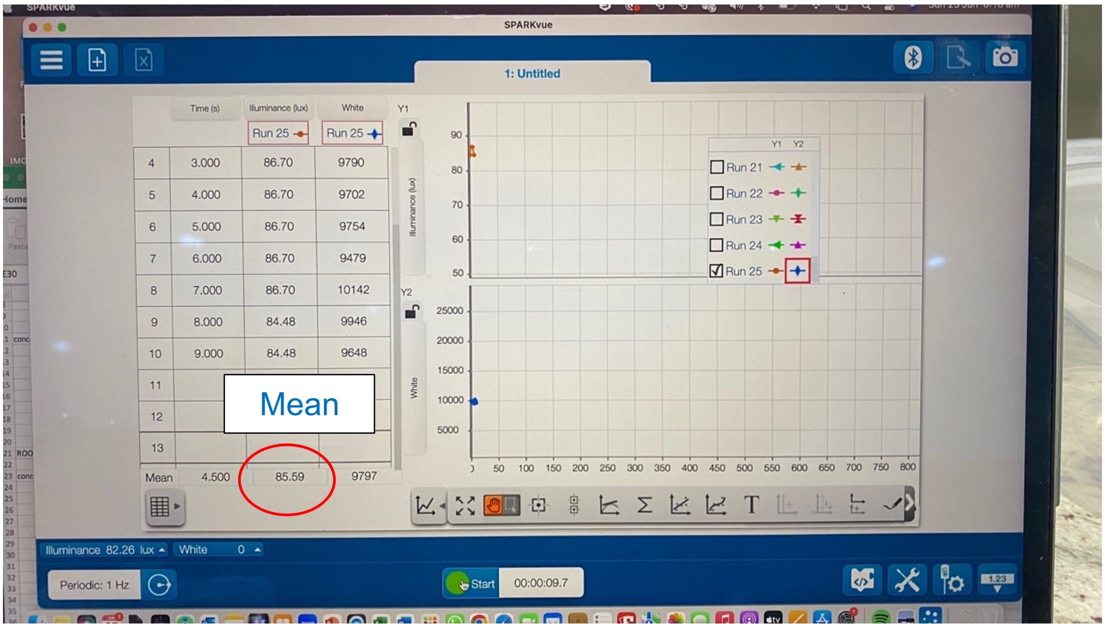
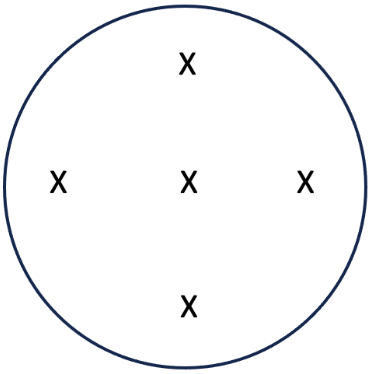


Figure 8 – 10 seconds of data – mean recorded

9. Step 7 and 8 were repeated at 5 positions (X) under the beaker.



10. 10 mL of water was added to the mucus and stirred gently with a clean metal fork.
11. Steps 7 to 9 were repeated.
12. The average light intensity passing through the mucus before and after the water was added was calculated and the difference found.
13. Steps 5 to 11 were repeated with each concentration (see independent variable on how to make up solutions).
    Clean equipment was used for each trial.
14. The experiment was repeated two times and the average difference in light intensity was calculated.
15. An empty conical flask was placed on electronic scales. A glass filter funnel was placed in the flask. The scales were zeroed.
16. Mucus was made (recipe 3) in a 250 mL beaker.
17. 10 mL of water was added to the mucus and stirred gently. The mucus was poured into the funnel and a stopwatch was used to time 10 s. The mass of mucus at the 10 s mark was recorded.
18. Steps 16 and 17 were repeated for the other concentrations. If the mucus drained faster than 10 s the time taken and mass were recorded.
19. Steps 16 to 18 were repeated twice.

Design decisions

1 The light sensor was placed as close to the bottom of the beaker as possible so that only light passing through the mucus was detected.
2 Tap water was used so a recommendation can be made to the community (In a home, tap water would be used)
3 For the same reason, table salt was used to make the saturated salt solution.
4 10 mL of saline solution was selected as it is an amount that would be suitable to flush out your nose.
5 The light intensity at 5 positions under the beaker was tested because the thick mucus was not evenly spread. Five positions covered most of the mucus in the beaker.
6 The experiment was repeated three times and averaged to make the data more reliable.
7 Six concentrations were tested so a clear graph could be drawn.
8 The mucus solidified after 20-30 minutes. It was placed in a plastic container with lid and placed into the general waste bin to prevent it solidifying in drains and blocking them.

Safety

- Risk of splashing boiling water/mucus in your eyes. Wear safety glasses.
- Risk of gelatine powder blowing into your eyes. Wear safety glasses.
- Risk of burns from boiling water spills/hot glassware. Wear a lab coat and cotton gloves.
- Risk of cuts from smashed glassware. Work away from the bench edges and wear closed shoes to protect feet.

Processing and analysing data/results:

Observations

With greater concentration of salt solution

1 The mucus was thinner and watery.
2 Clumps of mucus disappeared.
3 The flow rate increased.

Also
4 Some batches had froth and lumps producing more variation in the results.

Figure 7 Mucus with some lumps and froth

Figure 8 A typical sample of mucus

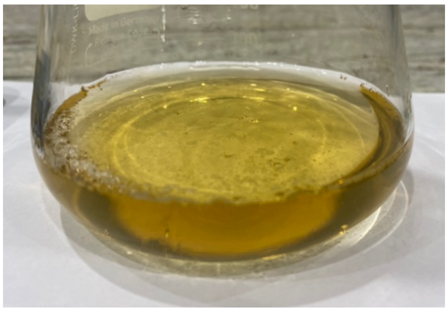


Figure 9 shows the clarity of the mucus with a salt concentration of 100%

Table 1: Trial 1 - A table showing the intensity of white light passing through mucus before and after different concentrations of salt solutions were added – table for trial 2 and 3 in appendix.

Percentage of saturated solution / %		Light intensity / Lux						
		Position 1	**Position 2**	**Position 3**	**Position 4**	**Position 5**	**Average**	**Difference**
0	Before	76.2	76.5	77.1	75.9	74.8	76.1	
	After	78.2	76.9	77.0	77.4	76.0	77.1	1.0
20	Before	74.0	75.9	75.3	74.8	75.0	75.0	
	After	76.8	76.9	76.0	76.0	75.8	76.3	1.3
40	Before	75.8	75.3	76.2	75.1	75.6	75.6	
	After	77.6	77.4	77.8	77.9	76.8	77.5	1.9
60	Before	75.9	76.8	77.2	76.1	74.5	76.1	
	After	81.0	82.1	80.3	80.7	78.9	80.6	4.5
80	Before	78.0	77.5	77.4	77.7	76.9	77.5	
	After	86.0	86.5	86.2	86.4	85.9	86.2	8.7
100	Before	76.9	77.5	77.8	77.6	78.7	77.7	
	After	92.1	92.4	91.9	92.4	91.2	92.0	14.3

Table 2: FINAL RESULTS

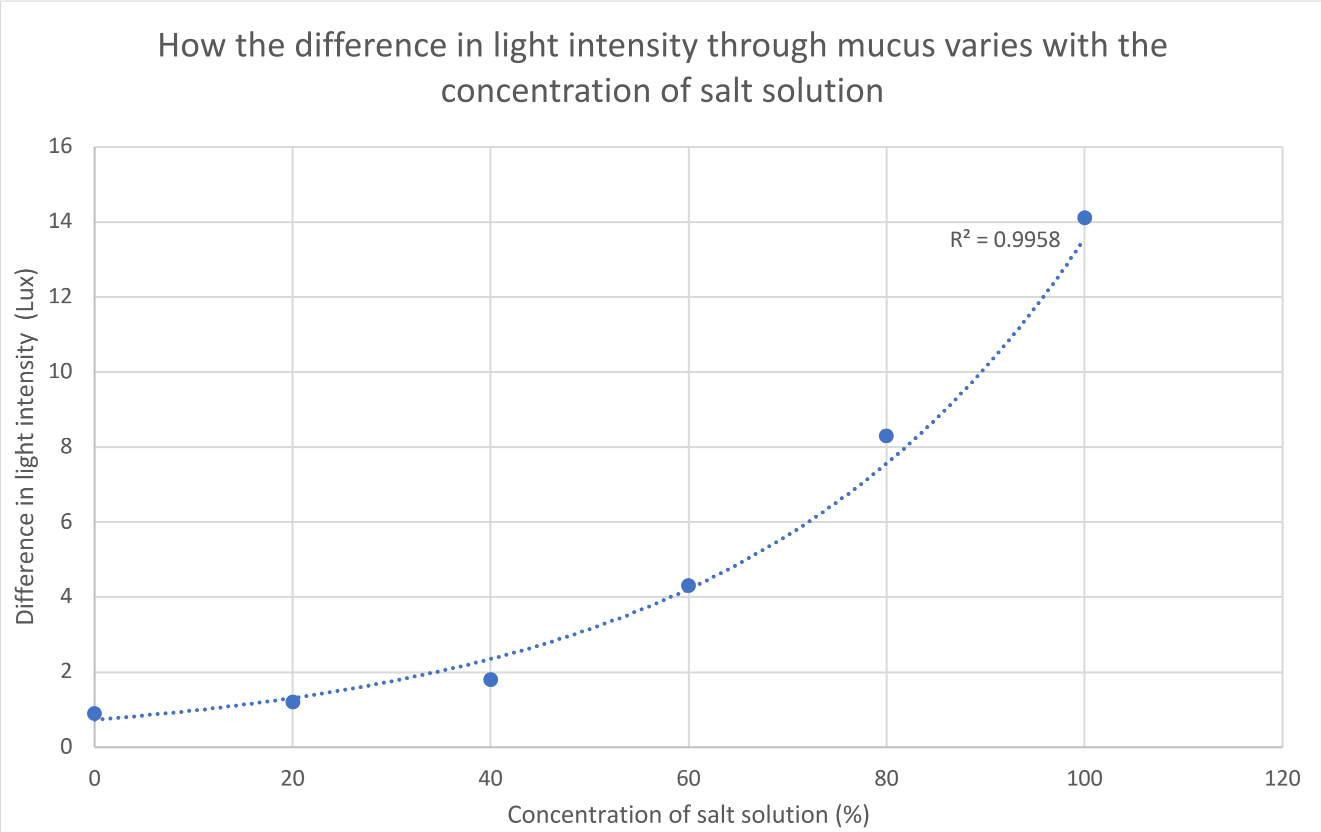
A table showing the average difference in intensity of white light passing through mucus before and after different concentrations of salt solutions were added.

Percentage of saturated solution / %	Average difference in light intensity /Lux			
	T1	T2	T3	Average
0	1.0	0.8	0.9	0.9
20	1.3	1.0	1.3	1.2
40	1.9	2.1	1.4	1.8
60	4.5	4.8	3.6	4.3
80	8.7	8.1	8.1	8.3
100	14.3	14.0	14.2	14.1

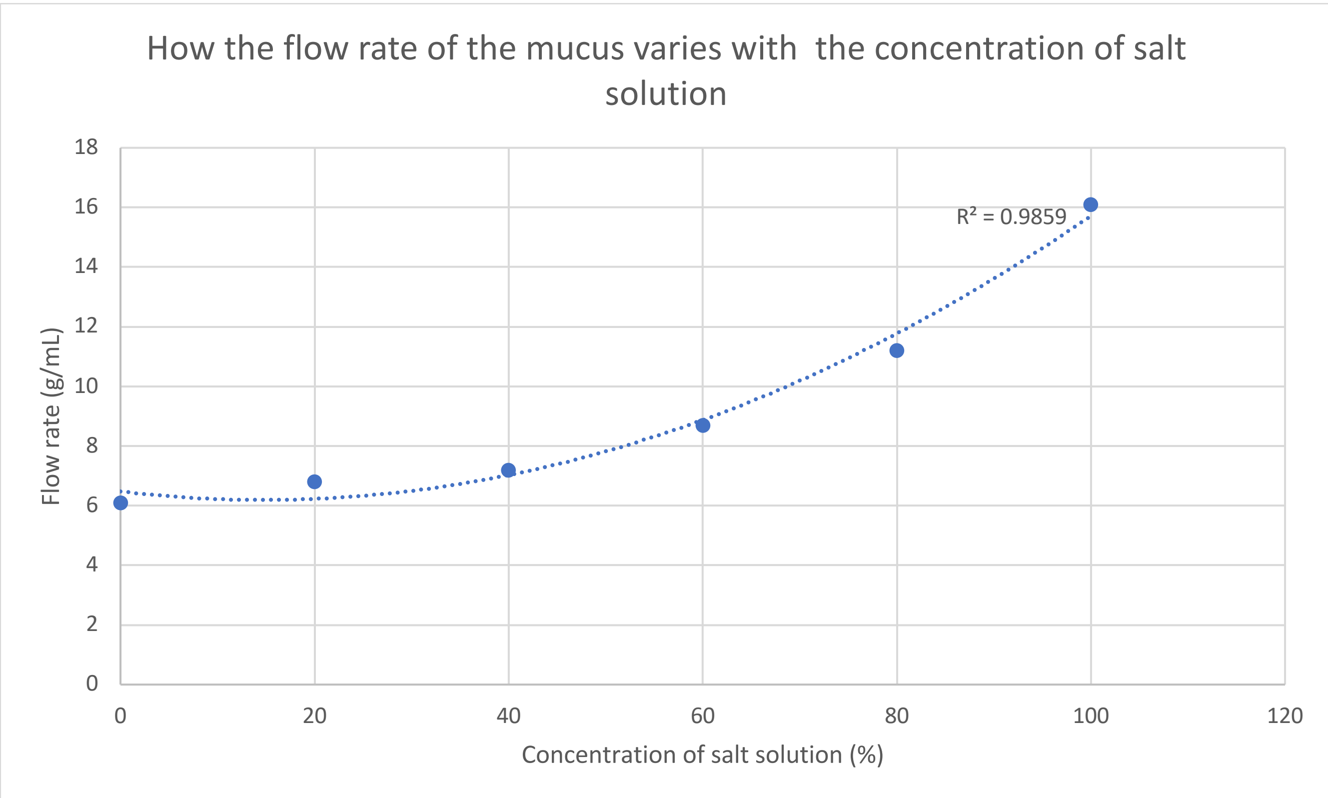
Table 3: A table showing the average flow rates for mucus when different concentrations of salt solutions were added.

Salt solution concentration %	Mass g				Average Time s	Average flow rate g/s
	1	2	3	Average		
0	57.8	63.2	62.0	61.0	10.0	6.1
20	71.2	63.4	70.6	68.4	10.0	6.8
40	68.4	72.5	75.1	72.0	10.0	7.2
60	82.0 (1.2 s)	82.1 (9.3 s)	82.8 (9.0 s)	82.3 (9.5 s)	9.5	8.7
80	83.4 (7.0 s)	81.9 (7.5 s)	81.9 (7.4 s)	82.4 (7.3 s)	7.3	11.2
100	83.8 (5.1 s)	83.2 (5.2 s)	83.8 (5.3 s)	83.6 (5.2 s)	5.2	16.1

Graph 1: A graph showing how the difference in light intensity through mucus varies with salt solution concentration.



Graph 2: A graph showing how the flow rate of mucus varies with the concentration of salt solution.



Analysis

The graphs show that the difference in light intensity through the mucus and the flow rate increases with salt solution concentration. The mucus therefore becomes thinner with increased salt solution concentration.

Even plain water produces a small difference in light intensity because the mucus becomes more watery. With increased salt solution concentration, the difference in light intensity increased slowly then more quickly. From 60%, the difference rose faster (maximum concentration is 100%). The water content of the solution plus the salt drawing water from the protein (gelatine) made the mucus thinner fast. The graphs indicate the concentration needs to be at least 50% before the difference in intensity and flow rate starts to rise significantly. This would be the minimum concentration for fast decongestant results.

Conclusion:

The trend was clear and repeated trials produced fairly consistent data. The results are reliable, showing that the greater the concentration of salt solution the thinner the mucus becomes making it easier to expel. The prediction that the mucus would thin steadily with increased salt solution concentration was refuted. The difference in intensity and mucus flow rate increased slowly and then very quickly, especially for concentrations greater than 60%. This is directly related to how the mucus thins. The minimum recommended salt solution concentration is 50%.

Evaluating:

Source of error	*Why it was an issue*	*Effect on data*	*Possible improvement*
Mucus consistency	Each batch differs. If the water was too hot, links break making the mucus watery. Lumps formed in some.	Lumps block light reducing intensity. If too many links break, the mucus is watery increasing intensity.	More trials e.g. 10 instead of 5
Clumps of mucus not evenly spread	Some parts of the mucus were thicker	Thicker mucus blocks more light. Creates scatter in the results.	Test more positions under the beaker e.g. 10 instead of 5 and average
Measurement of corn syrup Volumes of water and saturated solutions	Corn syrup adhered to the beaker. Hard to get accurate volumes while trying to work quickly.	The syrup gives the mucus its thickness. The water and salt solution thin the mucus. Causes scatter in light intensity.	More trials as above.
Flow rate	Lumps got stuck in the funnel slowing flow.	Inconsistent intensities and scatter result.	More trials as above
Froth	Different amounts formed. Was not evenly spread on the surface.	Light is blocked by froth creating scatter in the intensity values.	Tap the beaker on the table to burst froth.

Other improvements

Testing a greater range of concentrations e.g. 2 %, 5 %, 10% for a more reliable trend line.

Limitations

The trend is limited to one recipe and the brands used. Real mucus may not produce the same trend. The mucus was in a beaker not surrounded blood vessels. The trend may differ.

Other questions that could be investigated

- Are drug-based decongestants more effective than saline?
- Does real mucus thin in the same way as imitation mucus?
- Should drug-based decongestants need a prescription?

How can this information be useful to others?

A recommendation to the community is to avoid drug-based decongestants due to potential addiction. Making a concentrated salt solution is cheap and easy. Diluting it to 50% means adding equal amounts of water. A syringe can be used to administer the salt solution and relieve congestion. Public awareness could be raised through campaigns on television and posters.

Acknowledgements:

My mother for supervising/helping with clean up. My school for lending me experiment.

Appendix

Snot/Mucus recipe 1

1. Add half a cup of boiling water to a beaker
2. Add 3 packets of gelatine (about 7 teaspoons)
3. Gently pat and stir the gelatine into the water with a fork
4. Allow to cool for a minute
5. Add ¼ cup of corn syrup
6. Stir gently with a fork

Snot/Mucus recipe 2

1. Add 100 mL of boiling water to a beaker
2. Add 28 g of gelatine
3. Gently pat and stir the gelatine into the water with a fork
4. Allow to cool for a minute
5. Add 40 mL of corn syrup
6. Stir gently with a fork

Making a concentrated salt solution

1. Add 200 mL of water to a beaker.
2. Add a teaspoon of salt and dissolve.
3. Continue adding and dissolving salt until no more can dissolve.

Table 4: Trial 1 - A table showing the intensity of white light passing through mucus before and after different concentrations of salt solutions were added

Percentage of saturated solution / %		Light intensity / Lux						
		Position 1	Position 2	Position 3	Position 4	Position 5	Average	Difference
0	Before	76.2	76.5	77.1	75.9	74.8	76.1	1.0
	After	78.2	76.9	77.0	77.4	76.0	77.1	
20	Before	74.0	75.9	75.3	74.8	75.0	75.0	1.3
	After	76.8	76.9	76.0	76.0	75.8	76.3	
40	Before	75.8	75.3	76.2	75.1	75.6	75.6	1.9
	After	77.6	77.4	77.8	77.9	76.8	77.5	
60	Before	75.9	76.8	77.2	76.1	74.5	76.1	4.5
	After	81.0	82.1	80.3	80.7	78.9	80.6	
80	Before	78.0	77.5	77.4	77.7	76.9	77.5	8.7
	After	86.0	86.5	86.2	86.4	85.9	86.2	
100	Before	76.9	77.5	77.8	77.6	78.7	77.7	14.3
	After	92.1	92.4	91.9	92.4	91.2	92.0	

Table 5: Trial 2 - A table showing the intensity of white light passing through mucus before and after different concentrations of salt solutions were added

Percentage of saturated solution / %		Light intensity / Lux						
		Position 1	Position 2	Position 3	Position 4	Position 5	Average	Difference
0	Before	76.3	76.7	71.1	76.9	80.0	76.2	0.8
	After	77.2	77.9	77.0	77.2	76.7	77.2	
20	Before	76.0	75.8	76.1	74.9	77.2	76.0	1.0
	After	77.1	76.9	77.0	77.4	76.6	77.0	
40	Before	76.8	76.5	76.2	76.9	76.1	76.5	2.1
	After	78.8	77.9	78.1	78.9	78.8	78.5	
60	Before	76.4	76.2	77.0	76.3	75.6	76.3	4.8
	After	81.0	80.2	80.7	81.2	80.9	80.8	
80	Before	76.8	77.3	77.4	77.1	77.4	77.2	8.1
	After	84.8	86.0	85.2	85.4	85.1	85.3	
100	Before	77.2	76.0	76.1	76.5	76.2	76.4	14.0
	After	90.9	90.3	90.3	90.4	90.1	90.4	

Table 6: Trial 3 - A table showing the intensity of white light passing through mucus before and after different concentrations of salt solutions were added

Percentage of saturated solution / %		Light intensity / Lux						
		Position 1	Position 2	Position 3	Position 4	Position 5	Average	Difference
0	Before	76.0	75.8	76.0	76.1	76.1	76.0	0.9
	After	76.9	77.1	77.0	76.7	76.8	76.9	
20	Before	75.0	75.7	75.6	75.6	75.1	75.4	1.3
	After	76.8	76.7	76.7	76.5	76.8	76.7	
40	Before	76.7	75.9	75.8	75.8	75.3	75.9	1.4
	After	77.0	77.4	77.4	77.3	77.4	77.3	
60	Before	76.5	76.8	76.8	76.8	76.1	76.6	3.6
	After	79.9	80.1	80.3	80.4	80.3	80.2	
80	Before	75.0	75.3	75.0	75.7	75.5	75.3	8.1
	After	83.4	83.3	83.3	83.4	83.6	83.4	
100	Before	77.3	74.9	75.9	74.7	75.7	75.7	14.2
	After	90.1	90.7	89.9	89.1	89.7	89.9	

Table: Trial 1,2 and 3 results - Tables showing the average difference in intensity of white light passing through mucus before and after different concentrations of salt solutions were added.

Percentage of saturated solution / %	Average difference in light intensity /Lux			
	T1	T2	T3	Average
0	1.0	0.8	0.9	0.9
20	1.3	1.0	1.3	1.2
40	1.9	2.1	1.4	1.8
60	4.5	4.8	3.6	4.3
80	8.7	8.1	8.1	8.3
100	14.3	14.0	14.2	14.1

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OSA RISK ASSESSMENT FORM

for all entries in (✓) ☐ Models & Inventions and ☐ Scientific Inquiry

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

STUDENT(S) NAME: Cristina Parletto ID: 0765-090

SCHOOL:

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

I am planning to make 'fake' or imitation mucus. This involves using boiling water, gelatine and corn syrup

I will use the imitation mucus to perform an experiment to determine the effect that the concentration of salt solution has on on its ability to thin the mucus which can then be expelled out of the nose easier

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?
- 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
Gelatine blowing into the eye. Boiling water and/or mucus splashing into the eye	Safety glasses were worn
Burns from hot water spills and hot glassware	Handle hot glassware with cotton gloves. Wear a lab coat.
Cut from smashed/falling glassware	Work in the middle of the bench away from the edges. Glassware less likely to fall and smash. Wear closed shoes to protect your feet.

(Attach another sheet if needed.)

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): Cristina Parletto

SIGNATURE(S):

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

TEACHER'S NAME: Dr Nick Head

SIGNATURE: NJ Head DATE: 26/6/2023

Journal logbook

OLIPHANT SCIENCE AWARDS 2023

Cristina Parletto

Walford Anglican School for Girls

A-salt on snot - An investigation into saline decongestants

ID: 0765-090

<table>
<tr><th>Date</th><th>Photos and Comments</th></tr>
<tr><td>18/04/23</td><td>I have a cold. This prompted me to research mucus.

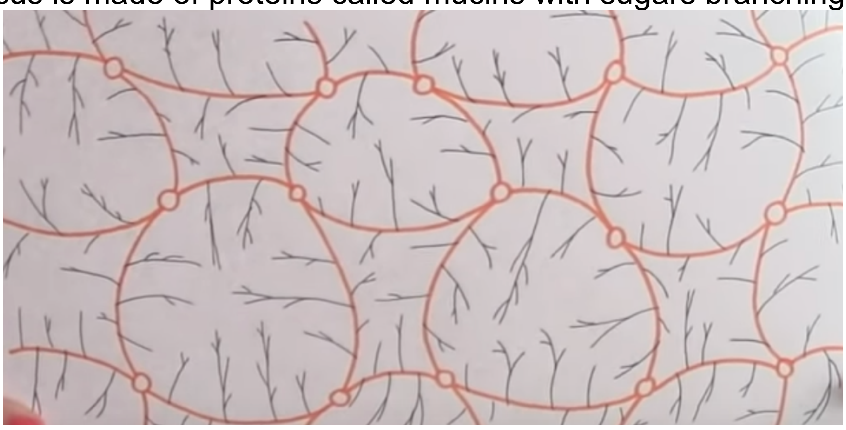
Mucus is described as a gelatine like substance.

I wondered whether fake mucus could be made.

Found a great video about making fake mucus and why the recipe works.

https://www.google.com/search?client=safari&rls=en&sxsrf=APwXEdftyOhlKt_KdC3DVBle6VntRmMquA:1687651808527&q=fake+snot&tbm=vid&sa=X&ved=2ahUKEwi417T0kN3_AhVhZmwGHRYyCFcQ0pQJegQIDBAB&biw=1440&bih=750&dpr=2#fpstate=ive&vld=cid:e33ba274,vid:pEZHLjXg4XU

Why the recipe works:

Gelatine softens in the hot water and the water molecules bind to the gelatine. Real mucus is made of proteins called mucins with sugars branching off them


Gelatine is also a protein</td></tr>
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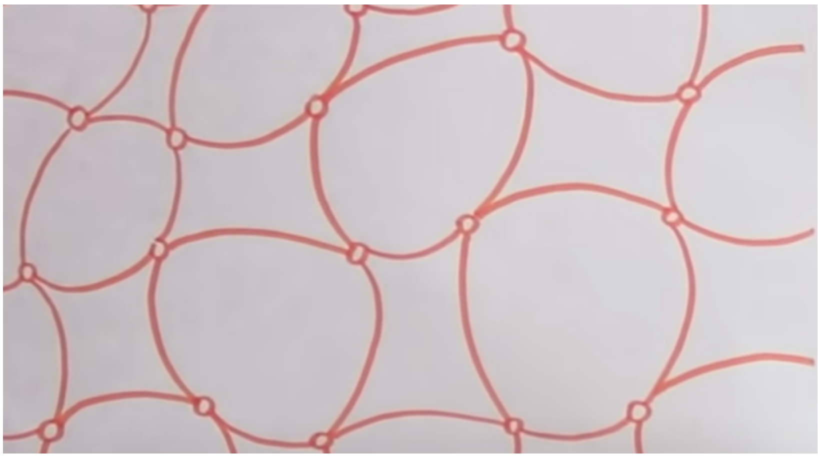
	Adding water cause the gelatine to cross link If the water is too hot it will break the protein links  Corn syrup is a sugar When added to the protein mixture it forms a substance that is very similar to mucus
20/04/23	Nasal spray was researched –how they work. Found out there were two types – saline and sprays with drugs. Both reduce swollen blood vessels. When the vessels swell they block nasal passages and extra mucus gets trapped. Found out that steroid and other decongestants that contain drugs can be quite addictive. Problem in Germany and around the world. Just like normal drugs – they work fast but then you need more and more as they become less effective.
29/04/23	Found several recipes for mucus. They are all similar to the original video I found – some added colour – some are more like slime. Websites with examples https://www.sciencelearn.org.nz/resources/196-making-snot https://littlebinsforlittlehands.com/fake-snot-edible-gelatin-slime-science-activity/
30/4/23	Purchased ingredients for making mucus. Gelatine (12 g packets and 100 g container) Corn syrup 473 mL bottle

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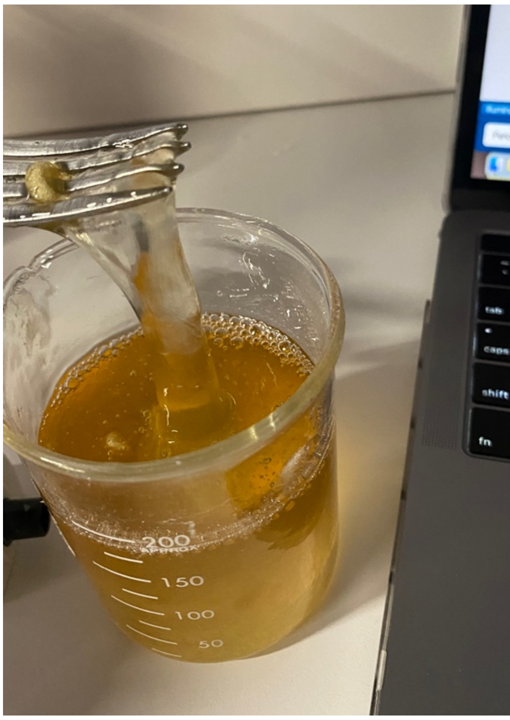
<tr><td>6/05/23</td><td>

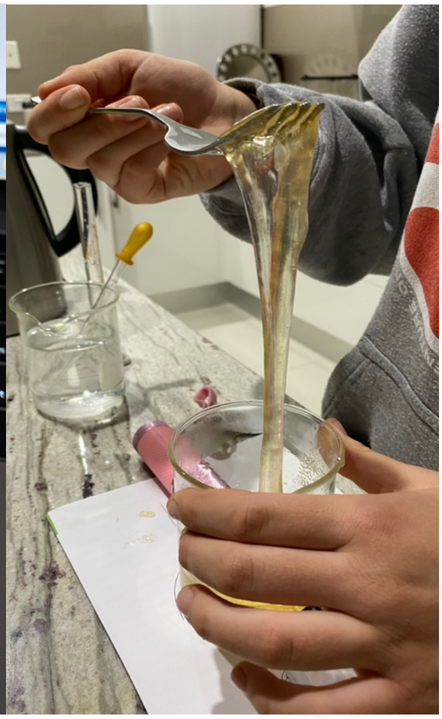
Preliminary trial #1

The imitation mucus was made using the following recipe.

1. Add half a cup of boiling water to a beaker
2. Add 3 packets of gelatine (about 7 teaspoons)
3. Gently pat and stir the gelatine into the water
4. Allow to cool for a minute
5. Add ¼ cup of corn syrup
6. Stir gently with a fork

Each time the mucus was made, the consistency varied but it looked like real mucus.





It was thick in parts that stretched like real snot produced when you have a cold.

In some trials the gelatine remained as lumps. Too much stirring made the mucus too runny. Practise made it more consistent.
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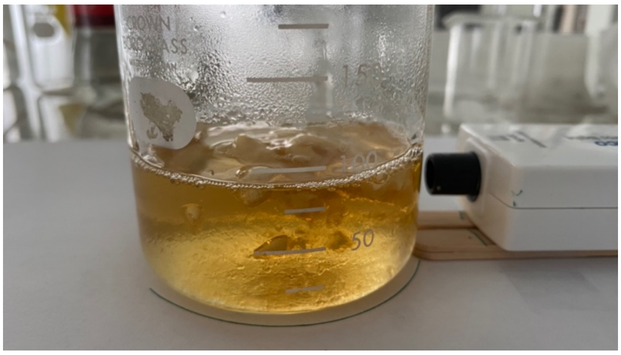
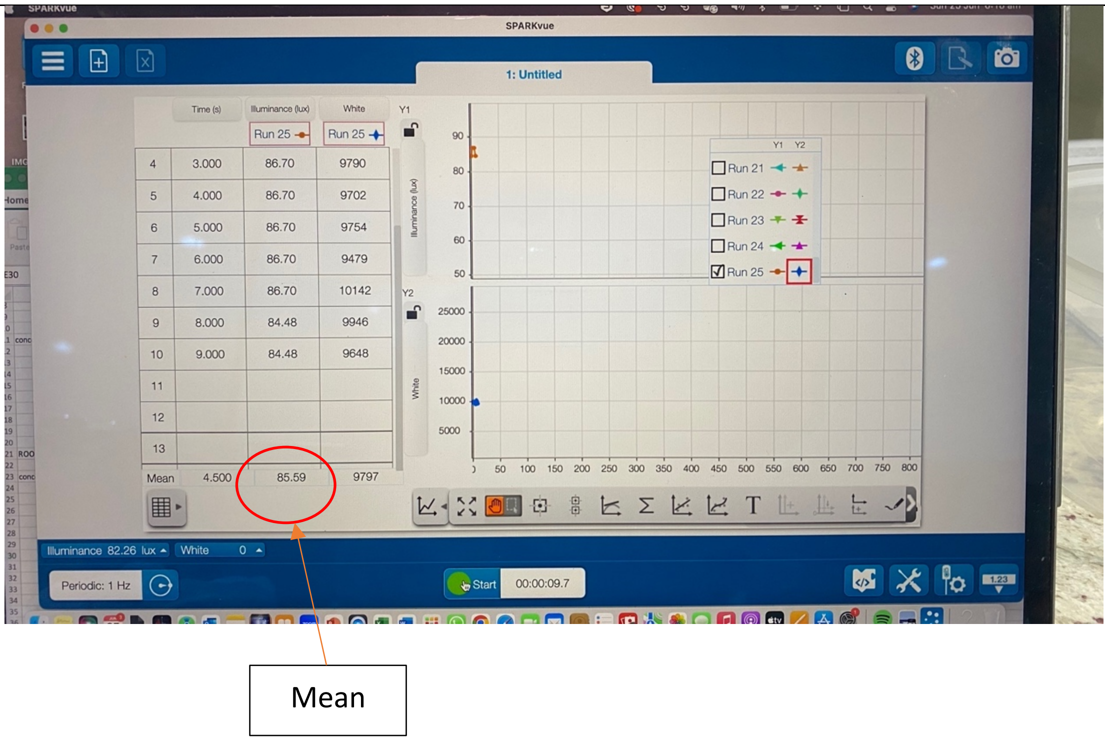
	 The experiment was messy. The bench became sticky. Mum helped with clean up and the mucus after being left to stand became solid. The solid jelly like material was removed from the beakers with a fork and disposed of.
7/5/23	Purchased more ingredients for make the mucus.
13/5/23 And 14/5/23	Converted the recipe to measurable quantities eg 7 teaspoons to 28 g, half cup to 100 mL **Recipe**: 1. Add 100 mL of boiling water to a beaker 2. Add 28 g of gelatine 3. Gently pat and stir the gelatine into the water 4. Allow to cool for a minute 5. Add 40 mL of corn syrup 6. Stir gently with a fork **Preliminary trial #2** Mucus was made – much better consistency each time the mucus was made. Some preliminary data for light passing horizontally through the mucus was taken. Mucus was made and 10 mL of saturated salt solution was added. The mucus was stirred gently twice. A torch was used to pass light through the mucus.in a darkened room. A light sensor and SPARKvue software was used to measure light intensity. The torch was too bright for the sensor and the variation in light intensity was very low. This was repeated several times.

The process was repeated in a well lit room without the torch. The sensor was set to detect white light. The sensor measured the intensity every second (frequency 1 Hz). The values fluctuated even though the equipment was not moved but the drop in intensity was notacible.



I found that the software allowed data to be collected in a table instead of just a single digital readout. A tool bar allows the mean to be displayed. I played around with the readouts and found the data could be collected for 10 s and a mean displayed – see photo below



Four preliminary tests were conducted – concentration of salt solution - 20%, 40%, 80% and 100%

The concentrations were made by first making a saturated solution. Add salt to 200 mL of water and stir. Keep adding salt until no more salt will dissolve.
A concentration of 20% was achieved by adding 2 mL of saturated salt solution to 8 mL of plain tap water.
Similarly the other concentrations were achieved by adding varying amounts of saturated salt solution to water so that the total volume was 10 mL.

40% - 4 mL of saturated salt solution to 6 mL of plain tap water.
60% - 6 mL of saturated salt solution to 4 mL of plain tap water.
80% - 8 mL of saturated salt solution to 2 mL of plain tap water.

The mucus was made and the various concentrations of salt solution were added.

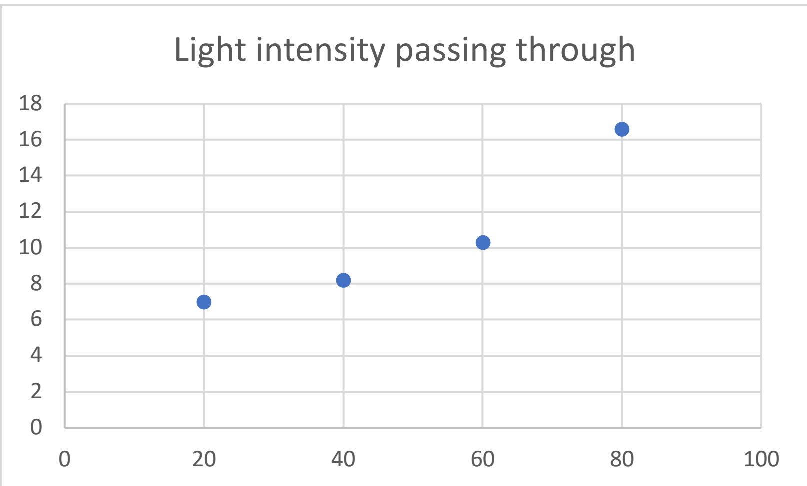
There was a visible difference in the mucus after the salt solutions were added– see photo below – From left to right 20% 40% 60% and 80%

The intensity of the light passing through the mucus decreased. It became thinner and more like water.

20% approximate intensity of light passing through 76 Lux
40% approximate intensity of light passing through 78 Lux
60% approximate Intensity of light passing through 82 Lux
80% approximate intensity of light passing through 86 Lux

The mucus was poured into a plastic container with a lid and disposed of in general waste. Pouring it down the sink may block the drain then if it solidifies.

A mock graph produced what looked like a curve. This showed promising results.



Issues:

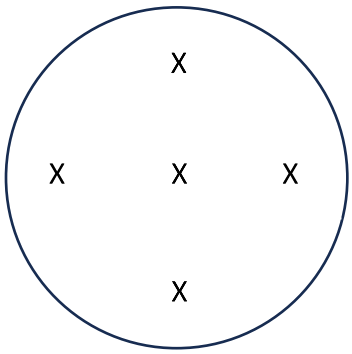
The initial intensity of the room was assumed to be the same for all trials as was the initial intensity of light passing through the mucus before the salt solution was added as the recipe was the same. I researched the PASCO sensor and found out that it only measured light reaching the round area of the sensor.

Was the trend reliable?

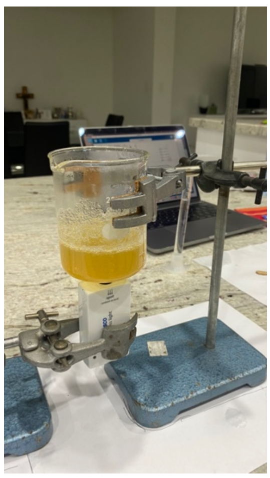
I decided that it would be better to measure the intensity of light passing through the mucus before and after the salt solution was added. More concentrations would also need to be tested.

It was also noted (see photo) that the thick clumps of mucus were not distributed evenly. Thicker parts would block more light from reaching the sensor. An average would be needed.

I decided that I would test the light passing through from the bottom of the beaker and select 5 positions (see X marks).



Set up:



	Used most of my supplies will need more.
23/5/23	Talking to my teacher, it was suggested that flow rate may give meaning to the data. If the mucus is thinned by the salt solution, it should flow faster.
25/5/23	Purchased more ingredients for make the mucus.
27/5/23	**Preliminary trial #3** Due to the large amount of material being used, I decided to half the recipe. **Final recipe** 1. Add 50 mL of boiling water to a beaker 2. Add 14 g of gelatine 3. Gently pat and stir the gelatine into the water 4. Allow to cool for a minute 5. Add 20 mL of corn syrup 6. Stir gently with a fork The following concentrations were tested for flow rate. The mucus was made and poured through a funnel into a conical flask which rested on electronic scales. The scales were set to zero before pouring the mucus through the funnel. The flow rate was notably faster for the mucus that had larger concentrations of salt solutions in them. Originally I timed until all the mucus was in the conical flask. Then I noted that some mucus got stuck in the funnel or adhered to the glass. I decided to repeat and time for 10 seconds. **Problems** • It was noted that some gelatine did not mix with the water when making the mucus in some trials and got stuck in the funnel. • The mucus with greater concentrations of salt solution were completely drained before the 10 s mark. I decided to try timing for 10 s for the thicker mucus and until the mucus completely drained for the thinner mucus.

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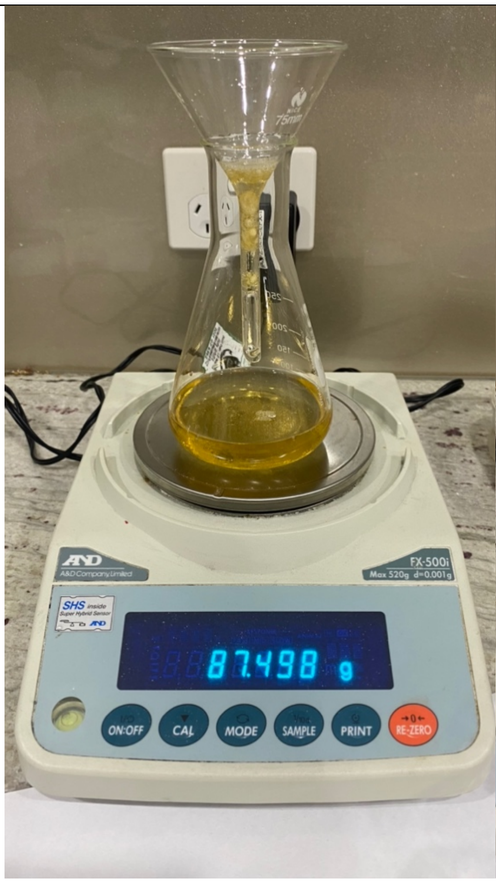
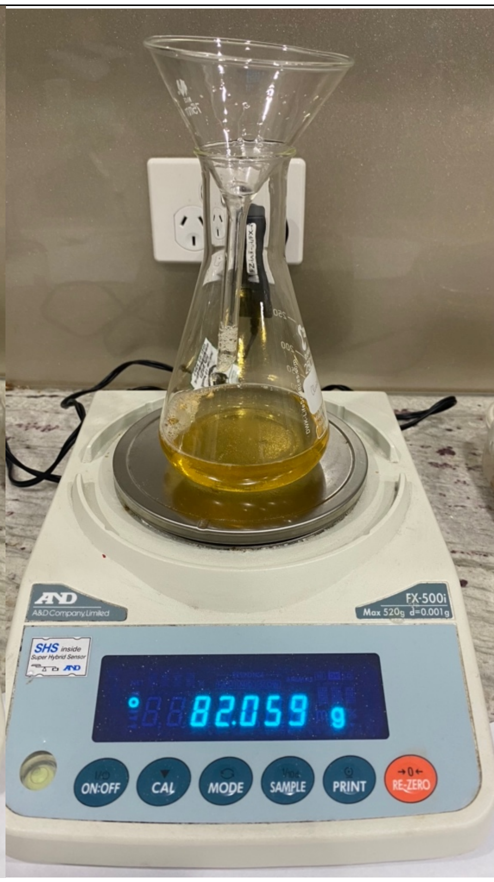
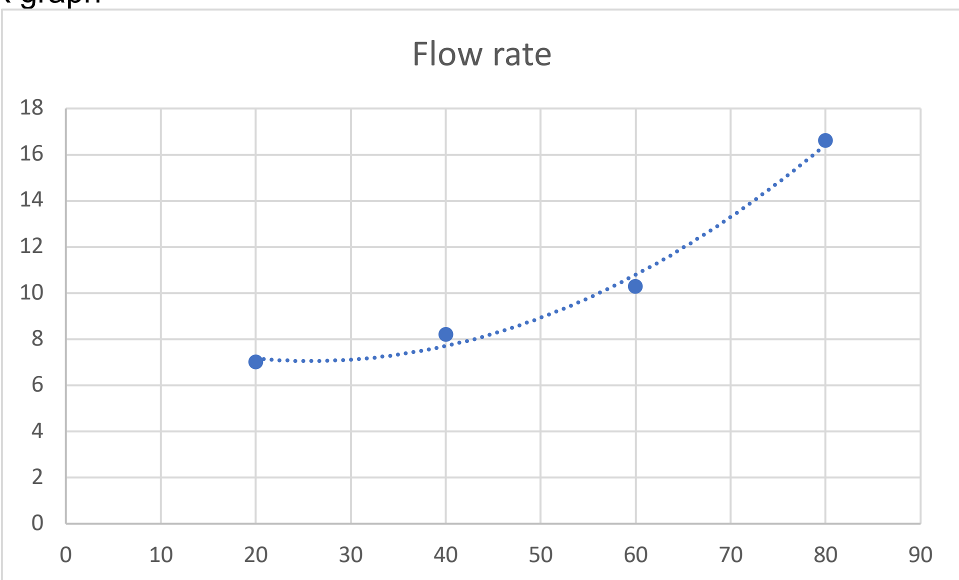




Gelatine stuck in the funnel *Mucus fully drained through the funnel*

20% approximate flow rate 70 g in 10 seconds – flow rate 7 g per second
40%. approximate flow rate 82 g in 10 seconds – flow rate 8.2 g per second
60%. approximate flow rate 83 g in 8 seconds– flow rate 10.3 g per second
80% approximate flow rate 83 g in 5 seconds– flow rate 16.6 g per second

Mock graph



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<tr>
<td>3/6/23</td>
<td>Performed experiment and collected data.

Took most of the afternoon.</td>
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8/6/22	Started the report with the graphs. Both graphs produced clear curve so I proceeded to write up the rest of the report.
11/6/22 -26/6/23	Work on writing the report for this experiment