

Shelby McIlvaney

St John Bosco (2MC)

## YOUNG SCIENTIST



**Which Liquid Freezes Faster?**

# Which Liquid Freezes Faster?

I chose this question because I wondered which liquid would freeze the fastest.

I am going to investigate:

- What type of liquids I will use?
- What composition does each liquid have?
- What is the freezing point of each liquid?
- What containers will I use to freeze the liquids?

Liquids That I Will Use:

- Soft drink



- Cordial (undiluted)



- Methylated spirits (alcohol)



- Milk



- Fruit juice



- Water



## Composition (Research)

A **soft drink** has carbonated water, a sweetener (sugar, high-fructose, corn syrup, fruit juice, sugar substitutes) and flavouring.

**Cordial** has sugar, water, fruit juice from concentrate (apple 48%, blackcurrant 2%). Food acid (citric acid). Natural flavours, fructose, natural colour (anthocyanins). Preservatives (sodium benzoate, sodium metabisulphite). Thickener (sodium carboxymethylcellulose).

**Methylated spirits** is a mixture of ethyl alcohol (95%) and methyl alcohol (5%).

**Milk** is homogenised and pasteurised reduced fat milk.

Apple juice has 90% apple juice and 10% water.

Water is 2 parts Hydrogen and 1 part Oxygen (H<sub>2</sub>O).

## Liquid Freezing Points

1. Freezing point of soft drink is 0`c
2. Freezing point of cordial is -25`c
3. Freezing point of methylated spirits is -97`c
4. Freezing point of milk is -0.5`c
5. Freezing point of juice is -1.69`c
6. Freezing point of water is 0`c

## Containers

These are the containers I looked at to use to freeze the liquids:

- Glass jar
- Small plastic tub
- Medium plastic tub
- Large plastic tub



I chose the medium plastic tub because:

1. Glass will shatter if liquid expands in the freezing process.
2. Freezing may take longer if I use a large tub, and
3. A small tub won't hold enough liquid for the experiment.



## Hypothesis

I think that out of the 6 liquids, water, soft drink, milk, cordial syrup, fruit juice (apple), and methylated spirit (alcohol) that milk will freeze the quickest.

I found that liquids with higher sugar amounts will have lower freezing temperatures, so soft drink, cordial syrup and fruit juice might take longer to freeze as they have more sugar than the other liquids I will test.

Methylated spirit has a very low freezing temperature (-97°c) because of the alcohol in it. I don't think this liquid will freeze because my freezer only gets to -14°c.

I think that water and milk will be the closest to freeze as they both have no sugar or alcohol compared to the other liquids. I think milk will win because it is thicker.

## Procedure

Steps:

1. Set up the materials and equipment.
2. Pour the 6 liquids into containers, each weighing 50 grams.
3. There are 3 clear liquids – water, lemonade, and methylated spirits. Label the containers to identify which one is which.
4. Place the 6 containers in the freezer with stirring sticks (short straws).
5. Set the count down time for 20 minutes.
6. Every 20 minutes we check the frozen state of each liquid and record our observations.
7. Repeat step 6 until all liquids are frozen (noting that methylated spirit and cordial spirit won't freeze).

## Photos of Experiment

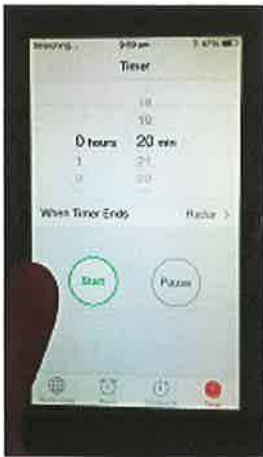
Setting up the equipment.



Protective glasses and gloves for handling chemicals (with parent supervision).



A timer to count 20 minute intervals.



Scales to weigh the liquids.



Pouring the liquids.



Ready to go!



Taking the temperature of the freezer.



Starting the experiment.



Recording ongoing observations.



## Observations and Results

20 mins

|                   |                       |
|-------------------|-----------------------|
| Water             | Frozen on surface.    |
| Apple juice       | Forming ice crystals. |
| Soft drink        | Forming ice crystals. |
| Methylated spirit | No change.            |
| Milk              | Forming ice crystals. |
| Cordial syrup     | No change.            |

40 mins

|                   |   |
|-------------------|---|
| Water             | About 40% solid. Frozen on surface.           |
| Apple juice       | About 50% slush.                              |
| Soft drink        | About 50% slush.                              |
| Methylated spirit | No change.                                    |
| Milk              | About 50% solid. Frozen on surface and sides. |
| Cordial syrup     | No change.                                    |

60 mins

|                   |   |
|-------------------|---|
| Water             | About 60% solid. Frozen on surface.           |
| Apple juice       | About 60% slush.                              |
| Soft drink        | About 70% slush.                              |
| Methylated spirit | No change.                                    |
| Milk              | About 80% solid. Frozen on surface and sides. |
| Cordial syrup     | Forming ice crystals around edges. 5%.        |

80 mins

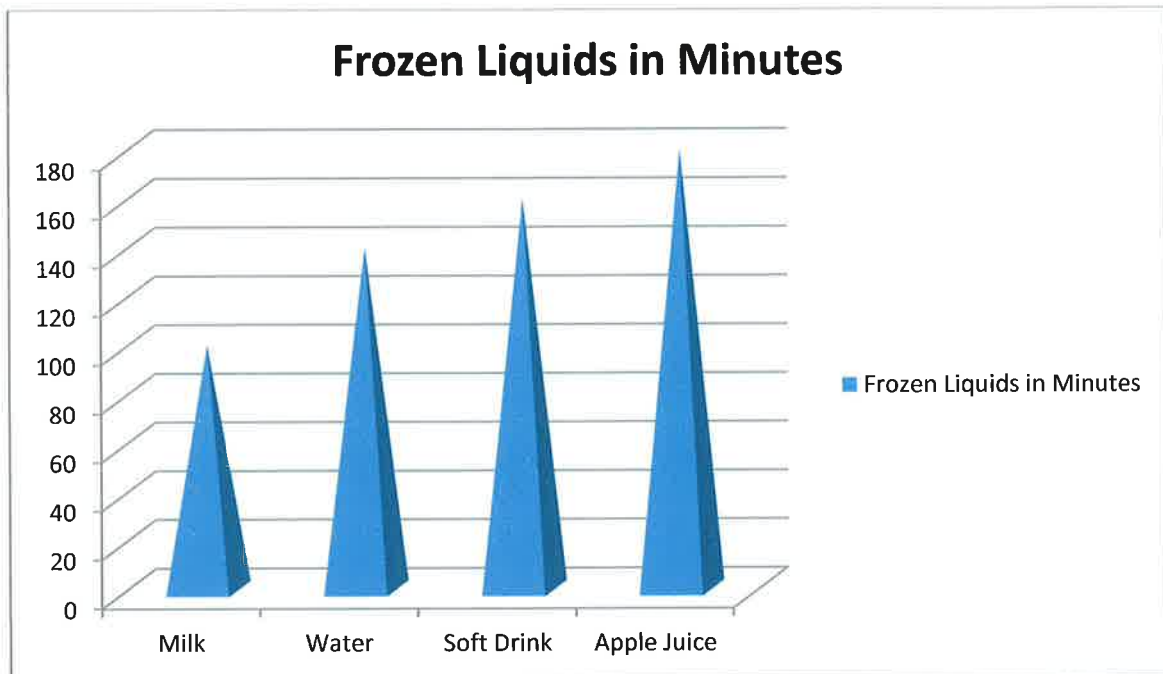
|                   |  |
|-------------------|--|
| Water             | About 70% solid. Frozen on surface.                |
| Apple juice       | About 70% solid. Frozen on sides, slush in centre. |
| Soft drink        | About 70% solid. Frozen on sides, slush in centre. |
| Methylated spirit | No change.   |
| Milk              | About 90% solid. Frozen on surface and sides.      |
| Cordial syrup     | Forming ice crystals around edges. 15%.            |

100 mins

|                   |   |
|-------------------|---|
| Water             | About 70% solid. Frozen on surface and sides.                     |
| Apple juice       | About 80% solid. Frozen on sides, slush in centre.                |
| Soft drink        | About 85% solid. Liquid moving through frozen air bubble pockets. |
| Methylated spirit | No change.  |
| Milk              | 100% frozen. <b>First.</b>  |
| Cordial syrup     | Ice crystals gone. Going backwards.                               |



## Results/Graph



## Conclusion

What I said in my hypothesis is true because milk froze first out of all the test liquids. The experiment showed me liquids with sugar in them take longer to freeze. It also showed me liquids with alcohol in them will not freeze. Milk froze first because it's thicker, has no sugar and has low water content.

## Recommendations

This was a fun experiment. It would be easy for other young scientists to do if they are interested in freezing liquids. I would recommend that other young scientists time the freezing process every 10 minutes instead of 20 minutes like I did. If you time every 10 minutes you will get more information and be able to view the frozen state of the liquids more often during the experiment.