

# The Effect of Salt on the Freezing Point of Water



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# Research Question

Does salt affect the freezing point of water?

- Chosen science question
- Experiment tries to prove it correct or incorrect

# Scientific Terms

Freezing point - the temperature at which a liquid turns into a solid when cooled

Melting point - the temperature at which a given solid will melt

Mole - the SI unit of amount of substance, equal to the quantity containing as many elementary units as there are atoms in 0.012 kg of carbon-12

Molar mass - the mass (in grams) of one mole of atoms of a given element or compound

Molar concentration - the number of moles of a substance in one liter of solution

# Background Information

Salt molecules block water molecules from packing together when temperature is lowered. It then prevents them from becoming ice. More water molecules leave the solid phase than the ones entering the solid phase.

Freezing point depression occurs when the freezing point of the liquid is lowered by addition of solute.

# Hypothesis

If the salt concentration is increased, then the freezing point of the water will decrease more.

- Educated guess as to what the experiments will show
- Was proved correct after experimentation

# Materials

Wegmans salt

4 test tubes

1 basin

tap water

freezer

4 Taylor thermometers

ice cube trays

digital weighing scale

Sharpie markers

sticky notes



The materials needed to complete the experiment and prove the hypothesis.

# Procedure

1. Create an ice bath in the basin by freezing a salt solution (200 grams of salt in one liter of tap water) poured into ice cube trays and kept overnight in the freezer.
2. The next day, label the test tubes with a marker as 0.5M, 1M, 1.5M, and 2M.

## Procedure (contd.)

3. Prepare salt solutions with 0.5M (2.9 grams salt in 100 mL water), 1M (5.8 grams salt in 100 mL water), 1.5M (8.7 grams salt in 100 mL water), and 2M (11.6 grams salt in 100 mL water) and pour them into the respective test tubes filled halfway up.

4. Place the ice cubes into the basin.

5. Place the 4 thermometers into the 4 test tubes.

Place the test tubes into the ice bath.





## Procedure (contd.)

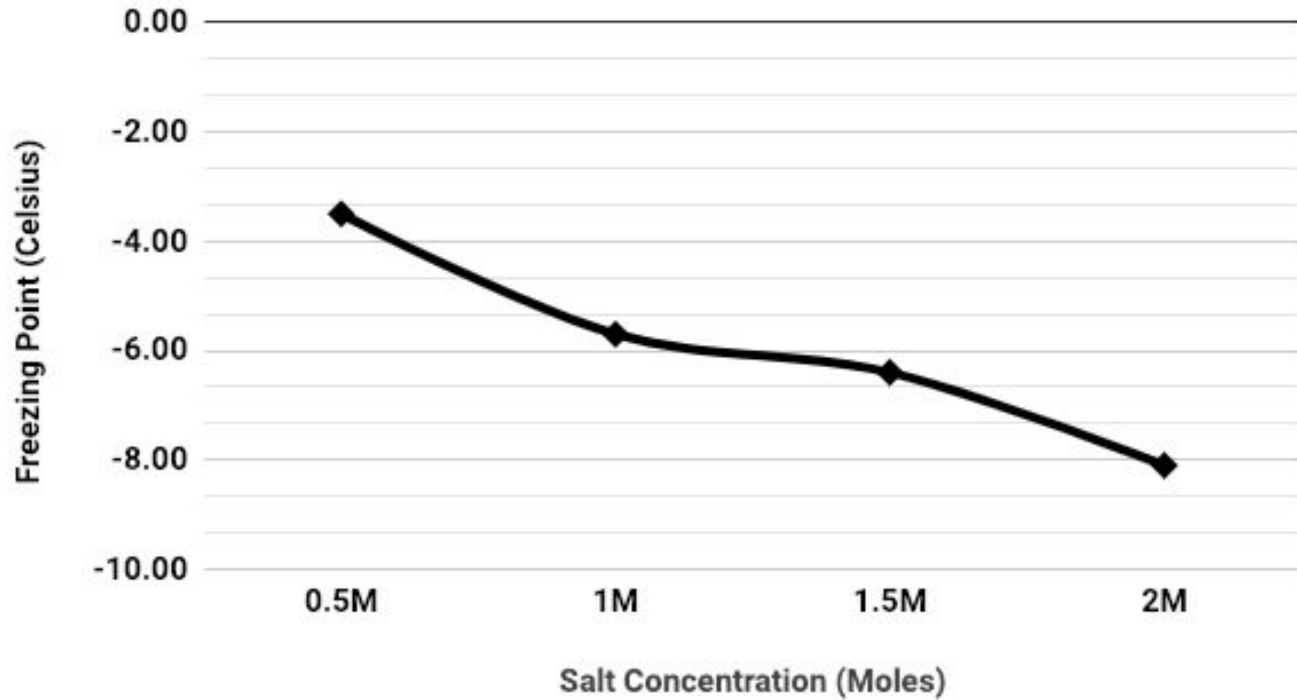
6. Place the test tubes into the ice bath.
7. Observe the formation of ice crystals in each test tube, and record the temperature of each test tube.

# Data

	<b>Experiment 1</b>	<b>Experiment 2</b>	<b>Experiment 3</b>	<b>Experiment 4</b>	<b>Experiment 5</b>	<b>Average</b>
	Freezing Pt in C	Freezing Pt in C	Freezing Pt in C	Freezing Pt in C	Freezing Pt in C	
<b>0.5M</b>	-3.3	-4	-4.4	-3.9	-2.1	<b>-3.50</b>
<b>1M</b>	-6.1	-6.1	-6.3	-5.8	-4.2	<b>-5.70</b>
<b>1.5M</b>	-6.1	-6.8	-7.1	-6.1	-6.1	<b>-6.40</b>
<b>2M</b>	-7.5	-7.4	-8.4	-8.7	-8.4	<b>-8.10</b>
<b>Distilled Water</b>	Control					<b>0.1</b>

# Chart

## Freezing Point vs Salt Concentration



# Data Analysis

## Data Analysis:

The line graph showed that the higher the salt concentration (Moles) was, the lower the freezing point of the water (Celcius) was. The lowest salt concentration, 0.5M, had an average freezing point of  $-3.50^{\circ}\text{C}$ . However, the highest salt concentration, 2M, had an average freezing point of  $-8.10^{\circ}\text{C}$ . The data showed a different interpretation of the line graph. Distilled water was also used in the experiment to determine the accuracy of the thermometers. The temperature (Celcius) when the distilled water was frozen was  $0.1^{\circ}\text{C}$ . Overall, both the line graph and the data both proved that the higher the salt concentration (Moles) was, the lower the freezing point (Celcius) was.

- Distilled water was included as control (freezing point  $0.1$  deg. C)
- Average freezing point of salt solution showed a negative linear relationship with salt concentration, as seen on the graph

# Conclusion

Does salt affect the freezing point of water? If the salt concentration is increased, the freezing point of the water will decrease more. The data proves the hypothesis correct. As shown in the data and line graph, the higher the salt concentration, the lower the freezing temperature became. Suppose salt is placed into water and then frozen. The freezing temperature of that would be higher if salt was placed.

The principles stated in the background information related to the results of this experiment. The salt molecules blocked the water molecules so that fewer water molecules entered the solid phase. So, more water molecules leave rather than becoming solid.

There was room for many errors in this experiment. Since frozen, distilled water was  $0.1^{\circ}\text{C}$ , it can be stated that the thermometers were not 100% accurate. Water may have spilled into other test tubes, and extra salt could have been added to the measuring cups. Extra water also could have been added. The test tubes could have been separated farther apart so no water would spill. Also, water could have more carefully been added to the measuring cups.

The hypothesis was proven correct. It was learned that if the salt concentration was increased, then the freezing point of the water will decrease. The experiment is beneficial to society because my hypothesis is why people put salt on the roads when it snows. People put salt on the roads so ice does not form. The only way ice would form, is if it got very cold. Another experiment that could have been conducted, is using other liquids, like soda, juice, lemonade, or coffee.

- Freezing point temperature is directly related to salt concentration
- An implication is the reason why people put salt on the ground

# Issues that occurred during the experiment

- Freezer dial was set to normal freezing temperatures, however colder temperatures were required
- The digital weighing scale was wrongly calibrated

# Summary

- Proved my hypothesis correct
- Learned scientific terms such as Mole and molar concentration
- Understood freezing point depression
- Understood why people put salt on the roads before snow falls

Any questions?

