

Temperature Effects on Water's Surface Tension

Sophia Zhong
Mr. Bauer
Springhouse Middle School

Research Question

How does the temperature of water affect its surface tension?

Background Information

Independent variables: hot water(97.2°C), warm water(30.3°C), cool water(19.7°C), cold water(4.1°C).

Dependent variables: amount of drops until the water spills over the penny

Control group: type of water(filtered), same dropper, same surface(the pennies).

Background Information

Terms and Vocab

Surface Tension: the tension of the surface film of a liquid caused by the attraction of the particles in the surface layer by the bulk of the liquid.

Temperature: the degree or intensity of heat present in a substance or object, especially as expressed according to a comparative scale and shown by a thermometer or perceived by touch.

Background Information

Scientific Theories and Processes

Molecular Theory of Surface Tension: cohesive forces among liquid molecules are responsible for the phenomenon of surface tension.

Process of Cohesion: the tendency of similar or identical particles/surfaces to cling to one another

Background Information

This project was chosen because of an interest in chemistry and properties of water. The researcher wanted to test surface tension because she wanted to see which would be more efficient for washing clothes in a washing machine.

Hypothesis

If the researcher changed the temperature of water to find out which temperature would make the surface tension the highest, then the cold water would have higher surface tension. This is because hot water has a weaker cohesive force because the water molecules are set into motion. Colder water molecules are slower and therefore their surface tension would be higher.

Hypothesis

According to www.usgs.gov/special-topic/water-science-school/science/, water molecules tend to cling to each other, but at the surface of the water droplet, there are no more molecules for them to cling to, so the water molecules at the top cling harder to the molecules under them, causing surface tension. However, when water is heated up, the molecules are thermally agitated, and it is harder for the molecules to cling to each other. As a result, the cohesive attractive forces are lessened.

Materials

- Eyedropper
- Thermometer
- Pennies (8, one for each trial)
- Paper towels
- Water (59.1 milliliters)
- Microwave
- Fridge
- Ice



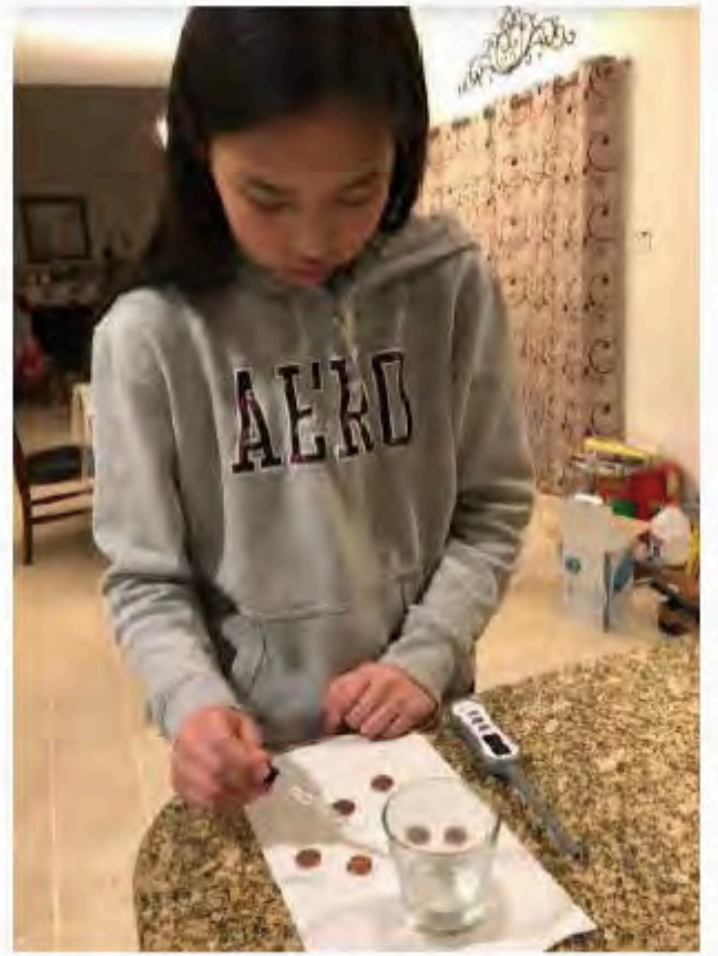
Procedure

- 1) Place the pennies on the paper towel.
- 2) Heat 2 ounces of water in the microwave for around a minute.
- 3) The temperature should be about 97.2°C .
- 4) Using an eyedropper, carefully drop water drop by drop onto a penny. Be sure not to touch the water on the penny with the eyedropper.

Procedure

- 5) Count the number of drops that the penny holds before the water spills over.
- 6) Repeat steps 2-4 but heat the water for 30 seconds. The temperature should be around 30.3°C .
- 7) Repeat steps 2-4 but place the water in the refrigerator for 2 minutes. The temperature should be around 19.7°C .
- 8) Repeat steps 2-4 but place ice into the water. The temperature should now be around 4.1°C .

Pictures

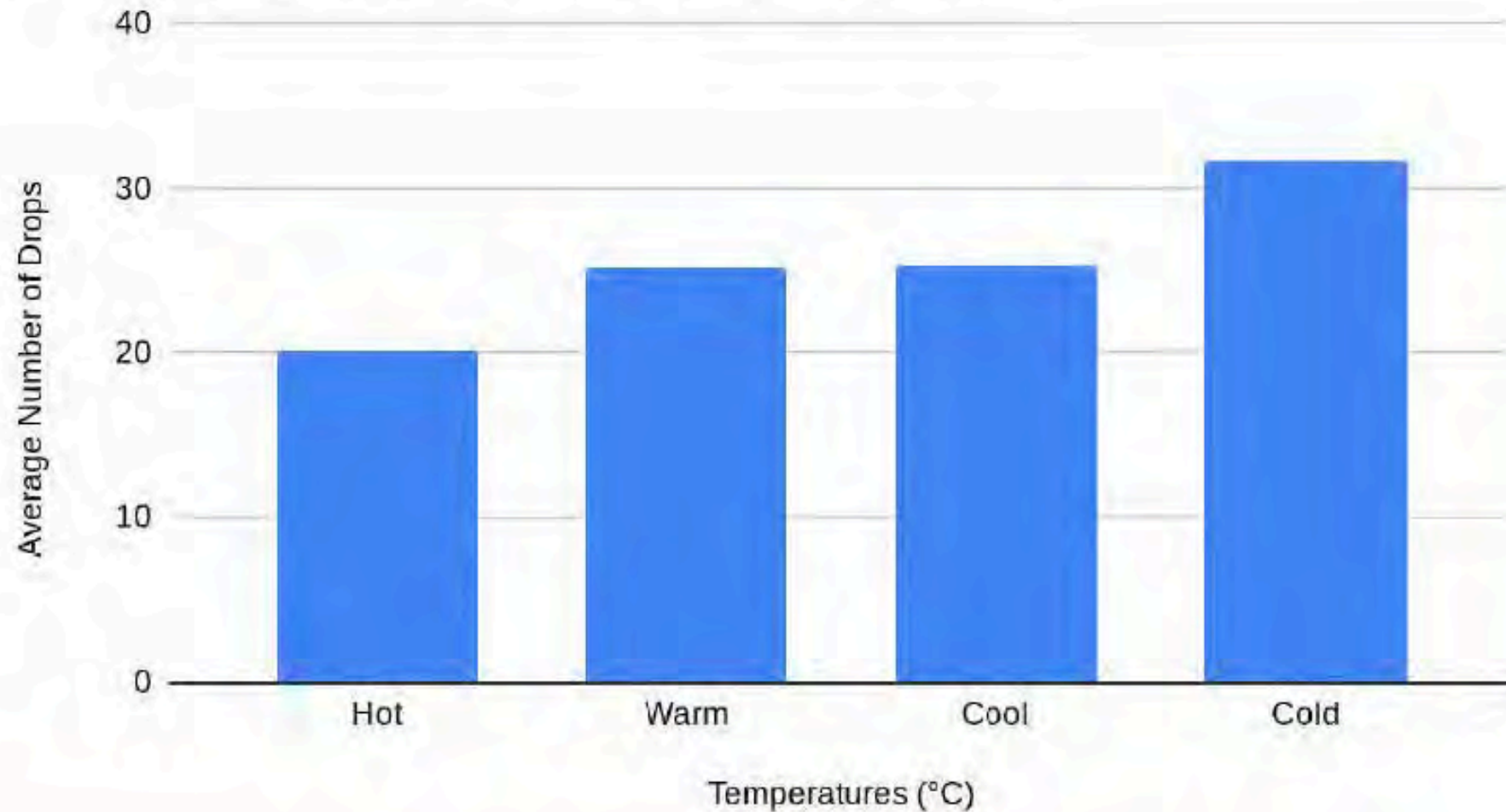


Data Table

Temps (°C)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Average
Hot (97.2 °C)	21	24	18	17	18	23	18	22	20.125
Warm (30.3°C)	27	24	23	24	30	20	24	29	25.125
Cool (19.7°C)	27	29	24	27	26	22	22	25	25.25
Cold (4.1°C)	32	46	31	25	30	32	35	23	31.75

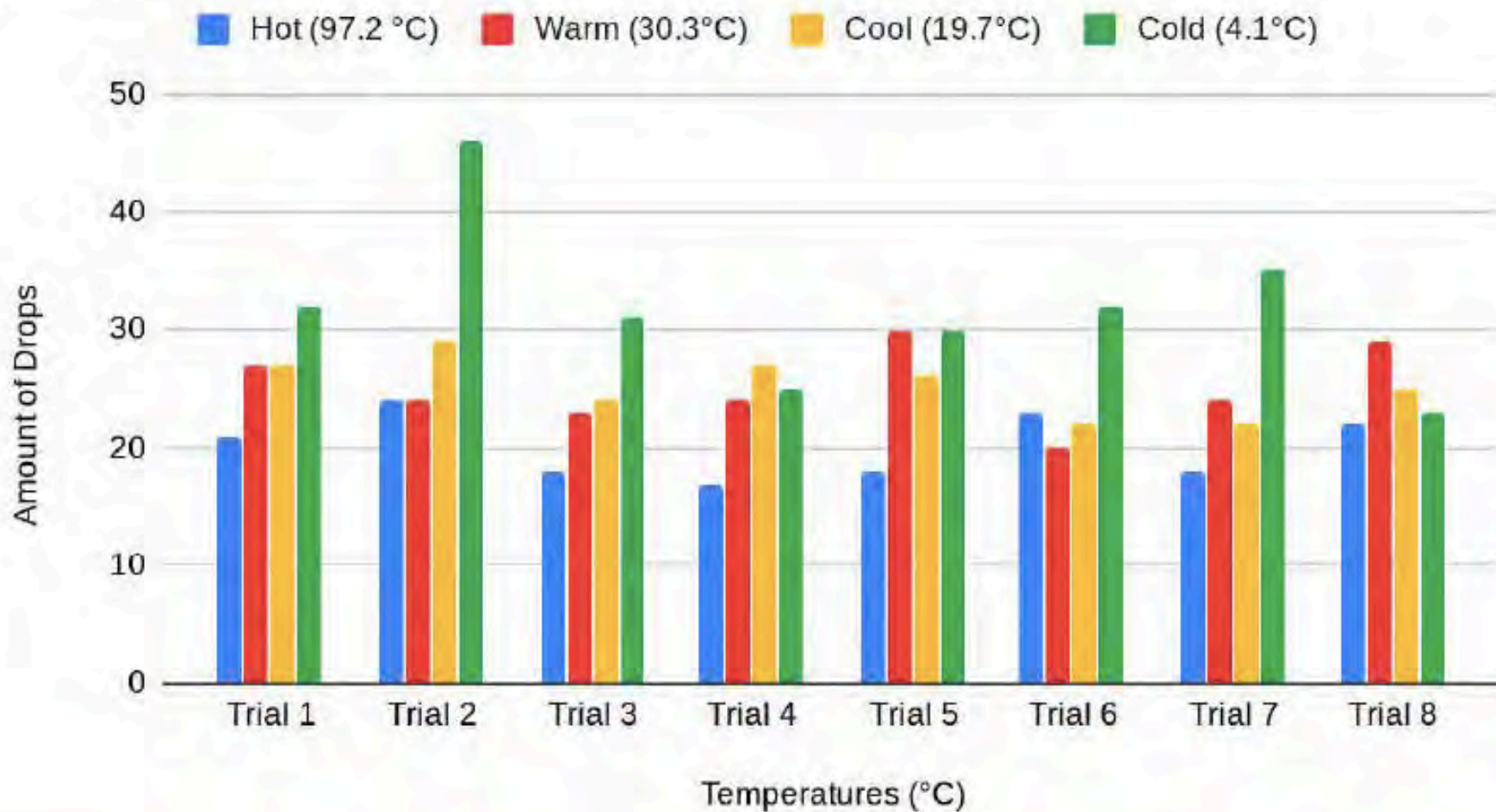
Graphs

Average Number of Drops vs. Temperatures



Graphs

All Trials



Conclusions

- The research question was “How does the temperature of water affect its surface tension?” The hypothesis stated that the warmer the water, the less surface tension it will have. The hypothesis was supported by the data and experiment.
- Surface tension decreases when temperature increases because cohesive forces decrease with an increase of molecular thermal activity. When the water temperature increases, the water molecules are set in motion, so the molecules cannot cling to each other as easily as cold water molecules can.

Conclusions

- When water heats up, the movement of its molecules disrupts the imbalanced forces on the surface of the water and weakens its sheet-like barrier of tightly bound molecules, thereby lowering the surface tension. This is why hot water had a lower surface tension in this experiment.

Conclusions

- While experimenting, some mistakes occurred that should be fixed in future experiments. For example, the distance between the dropper and the penny varied. You can correct this error by measuring an exact distance that the dropper will be from the penny.
- This will be beneficial to society by showing which temperature water is best for washing or cleaning. Because hot water has lower surface tension, it can soak through clothes easier, making it easier to clean with hot water.

Conclusions

- Another experiment that could be done is to test how temperature affects viscosity of water.

Thank You For Listening, Are There Any
Questions?

