A. Topic: ***Cooling the crystals***

B.Hypothesis: If I use different cooling rates for the crystals in borax, then the crystals will grow at different sizes.

C. Title and author(s) of the source:(research articles/videos you are taking help from) :
https://youtu.be/BHRFBKjqEvg?si=d1D5f3vBQ4SPbHUX **and**
https://www.all-science-fair-projects.com/project1617.html

Investigative/ Essential Question:

Your Question: How are the sizes of crystals affected by different cooling rates in crystallization of Borax?

Experimental Design: This is a list of the key parts of the experiment. Identify the independent variable, dependent variable, constants, and control group.

Independent Variable:
Your Answer: the different temperatures/ rates of cooling like 4 degrees celsius, 0 degree celsius and -4 degrees celsius etc.

Dependent Variable: **Your Answer: The size/mass of the Crystals formed.**

Constants:
Your Answer: Food coloring, size of the bowl , size of string, amount of borax used.

STEP 6: REPORTING EXPERIMENTS

A. Materials being used: String, stick, pipe cleaner, hot water, bowl, cups
B. Procedures

1. **I tied a string tightly around a stick**
2. **Then, from the other side of the string, I tied the pipe cleaner on the string,**
3. **When already tied, I made a random shape with the pipe cleaner.**
4. **I grab a liter of hot water and pour it into a cup.**
5. **I pour a cup of borax into the hot water and mix for a minute.**
6. **Lastly, I set the stick on top of the cup and wait for crystals to form.**

C. Possible problems that might be faced while experimenting or while building

your model: Some crystals did not really grow or change size for hours.

D. Proposed solution to the above problem: I made sure to let it sit and leave it alone, then, the crystals grew to an appropriate size

E. Diagrams/drawings/photos of experimental setup / engineered model(including metric labels)

NB: You can draw, then take pictures of the set up/ model and paste it on the document.

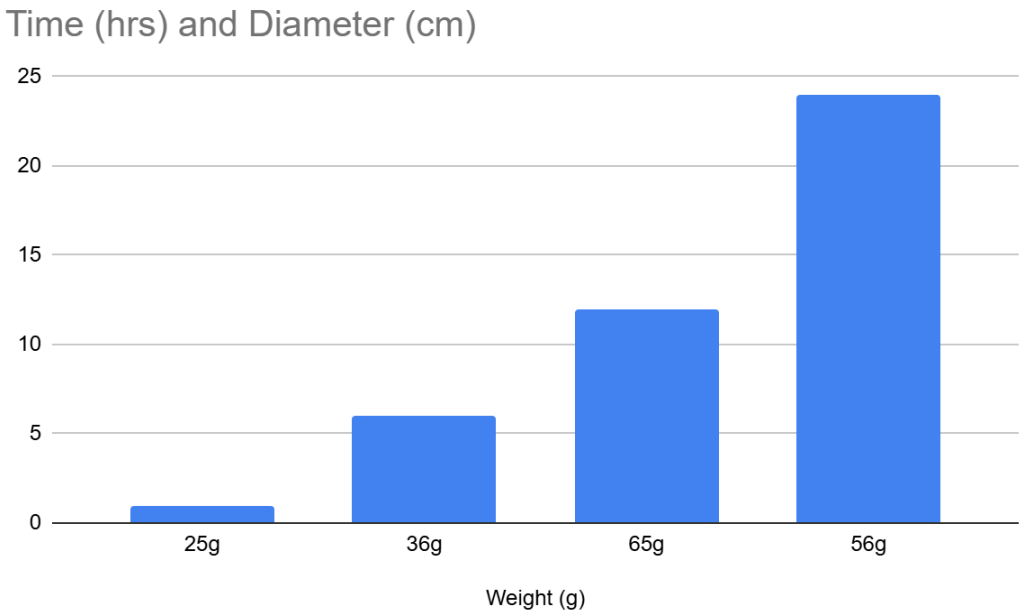
STEP 7: GATHERING AND PRESENTING DATA.

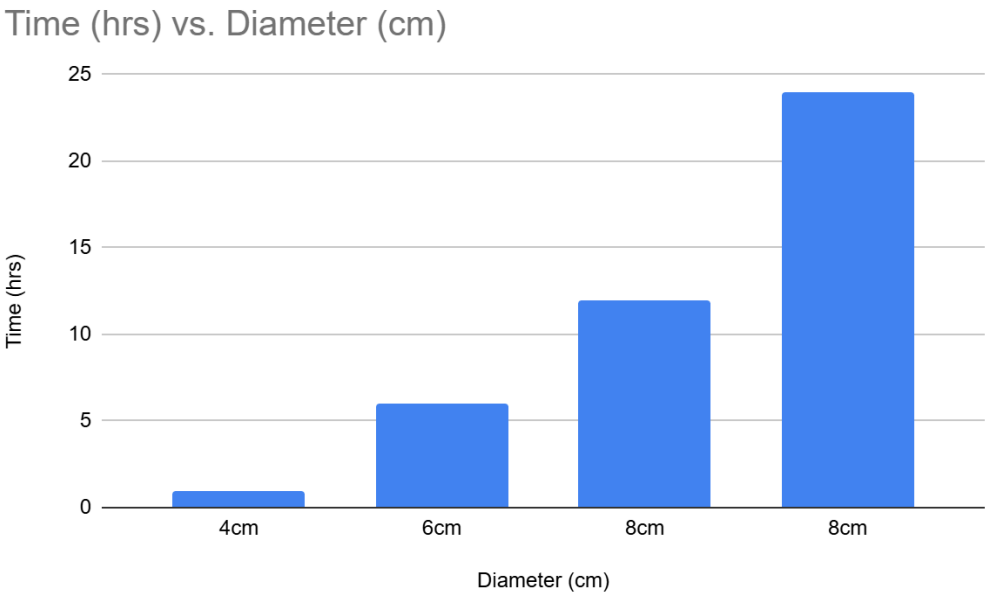
Record all measurements and observations in a table. Draw this table in a scratch sheet first, after conducting your experiments, and get it checked by your teacher. Then draw the final version in this document.

G. **Data table(s):** Draw a table using the above icon INSERT then select rows and Columns and fill in.(The heading to the row/column should be the changes made in the independent variables and the result should be the dependent variable.)

Time (hrs)	Diameter (cm)	Weight (g)
1	4cm	25g
6	6cm	36g
12	8cm	65g
24	8cm	56g

H. Graph(s): The table above should be converted into a graph. (You can either use the graph in built in docs/ sheets or work on a graph paper. This paper needs to be attached on the final poster board) ON PAPER





I. Data analysis:

The time shows the time they were sitting out. They were all mostly the same Diameter, but they all weighted differently.

STEP-8 RESULTS AND ITS IMPLICATIONS

J. Conclusion:

The hypothesis did not work. The crystals only grew a few hours in, and stayed that size until taken out. The only way the crystals could change size is by changing the arrangement of the pipe cleaner .

K. Limitations: The experiment was not at all what I was expecting. I thought that the crystals would change by the time that they sat out, but they only changed by the size of the pipe cleaners. And I forgot to do measurements throughout the experiment, and had to remake the crystals all over again.

L. Application/Future research: I could have maybe tried to make the pipe cleaners all the same size, and then the results would have come back just a bit better. It would be a nice idea to make more trials of the experimental set-up in future, by changing the concentration of the borax used.

Teacher's initials-

STEP 9: ABSTRACT

Cooling the crystals. How are the sizes of crystals affected by different cooling rates in crystallization of Borax? If I use different cooling rates for the crystals in borax, then the crystals will grow at different sizesI tied a string tightly around a stick. Then, from the other side of the string, I tied the pipe cleaner on the string. When already tied, I made a random shape with the pipe cleaner. I grab a liter of hot water and pour it into a cup. I pour a cup of borax into the hot water and mix for a minute. Lastly, I set the stick on top of the cup and wait for crystals to form.

The data from the table states that crystal growth increased rapidly between 1 and 12 hours, with diameter increasing from 4cm to 8cm and weight increasing from 25g to 65g. However, after 12 hours the diameter stopped increasing and decreased slightly. This made the solution less saturated and evaporated faster. So the crystals from hours 24, did not go to its biggest and decreased instead because of the size of the pipe cleaner.

As a conclusion, I would state that the hypothesis did not work. The time that the crystals sat out did not really work nor affect the crystals. The crystals all stopped goring after 12 hours. The only thing that made them grow is the size of shape of the Pipe cleaners. The time that they sat out, did not work and had no effect

D.Research Summary

This project was about Borax crystals. Through a process called crystallization, which happens when a substance dissolved in water comes out of solution and forms solid crystals. When borax is mixed with hot water, it dissolves easily, creating a supersaturated solution. As the solution cools, it can no longer hold and absorb all the dissolved borax, so the particles begin to arrange themselves into an organized, repeating pattern against the pipe cleaners which then will turn into the crystals.

Experiments similar to growing borax crystals include salt crystals, sugar crystals, alum crystals, and copper sulfate crystals. All of them have the similar procedure of hot water to create a supersaturated solution. Scientists use these to help them see how much they grow in size, shape, and rate. Experts know that crystal growth depends on factors such as temperature, concentration, cooling speed, and prity of the solution. Scientists also understand that each substance forms crystals with a unique shape based on its molecule structure.

Crystallization plays an important role in everyday life, including the production of medicines, food items, like sugar and salt materials used in technology and electronics. Understanding how crystals form helps scientists control the purity and structure of these materials. This project helps people learn key science concepts such as suitability, temperature effects, and changes in states of matter. This science experiment helps us know chemistry concepts easier to understand.