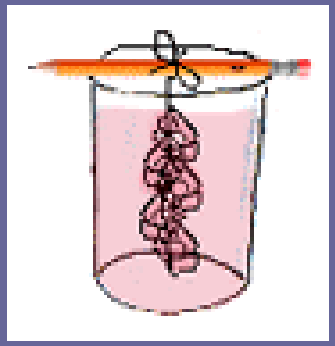
Rock Candy Science



Growing Sugar Crystals

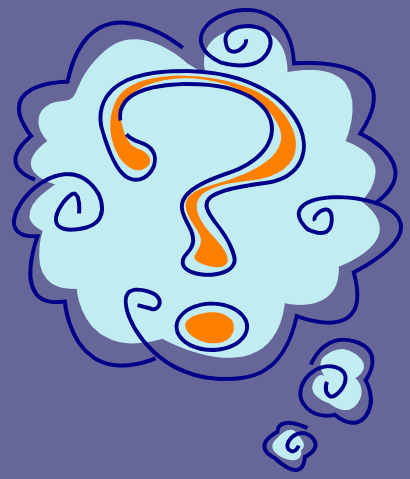
SCE 5020, Fri. AM

Question

Will the addition of an impurity, food coloring, affect the growth of sugar crystals?

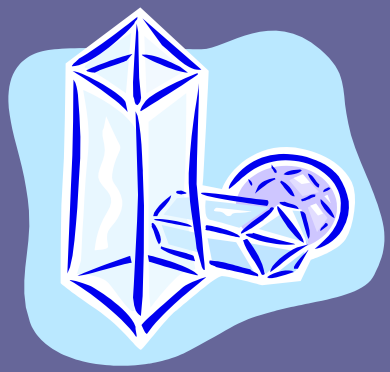
Background Information

What are crystals and how do they grow?



What is a crystal?

- Consistent pattern of connected molecules
- Unit cell: set of atoms that make up the molecules of the crystal; give crystal distinct shape
- Lattices connect the unit cells
- 4 different groups of crystals



How do crystals form?

- Nucleation is the scientific term for crystal growth.
- Assisted growth: a solid matter needs to be present in the solution for the crystals to grow. Ex. Placing a string in the sugary rock candy solution.
- Unassisted growth: a solid matter does not need to be present in the solution for the crystals to grow.
- Crystal growth can be altered by the addition of impurities.

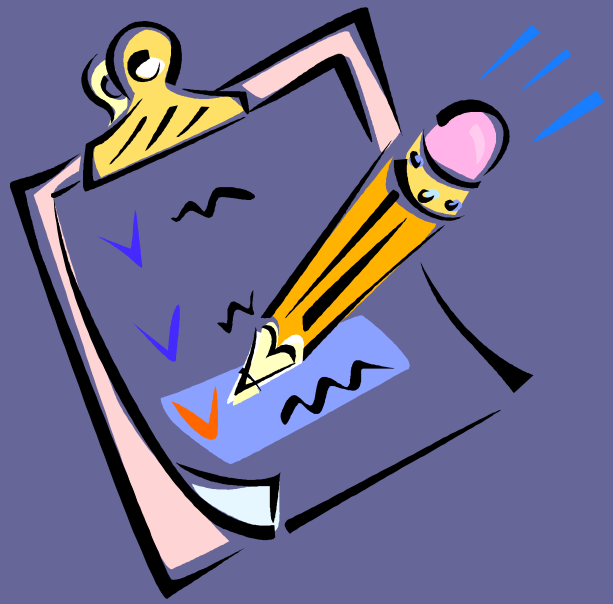
Hypothesis

If an impurity, food coloring, is added to the crystal solution, then the sugar crystals' growth will be affected.

VARIABLES

- Independent Variable
  - The addition of food coloring
    - Red
    - Blue
    - Yellow
- Dependent Variable
  - Growth of crystals
- Control Used
  - No food coloring used

Materials Needed



Materials List

- Food coloring: red, blue, and yellow
- 8 cups of refined, white sugar
- Four, tall, clear glasses
- Ruler
- Scissors
- 60 cm of string
- 4 pencils
- 1 cup measuring cup
- 1 liter of water
- 1 sauce pan
- Heat source
- Plastic spoon to stir solution with
- Ladle to pour solution into cups

Procedures

Steps 1-3

1. Measure 4 cups of water into the sauce pan.
2. Place sauce pan on the heat source and turn heat source on.
3. Place a lid on the sauce pan and wait for water to boil.

Steps 4-5

4. While the water is heating up, cut four 10 cm pieces of string and tie a piece of string onto each pencil. Be sure the string does not touch the bottom of the glass.
5. When water starts to boil, slowly stir in one cup of sugar at a time until all 8 cups have been added.

Steps 6-9

6. Once all the sugar has been dissolved in the water, measure out the solution into the four glasses. Each glass should contain about a 1 ½ cups of solution.
7. Add and mix 4-5 drops of yellow, red, and blue food coloring in three separate glasses.
8. Set the string into the solution.
9. Place the glasses in a place where they will not be touched or disturbed for several days.

Photo Journal

Qualitative Observations

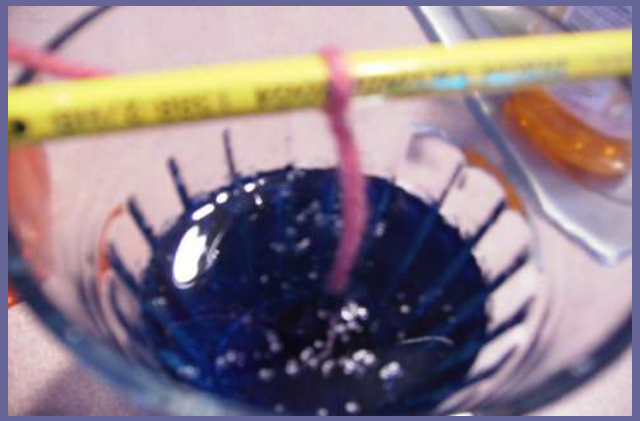
Day 1

The lab was set up and changes in glasses were monitored throughout the day. No changes occurred in the glasses. The small glass in the center is the control.

Day 2

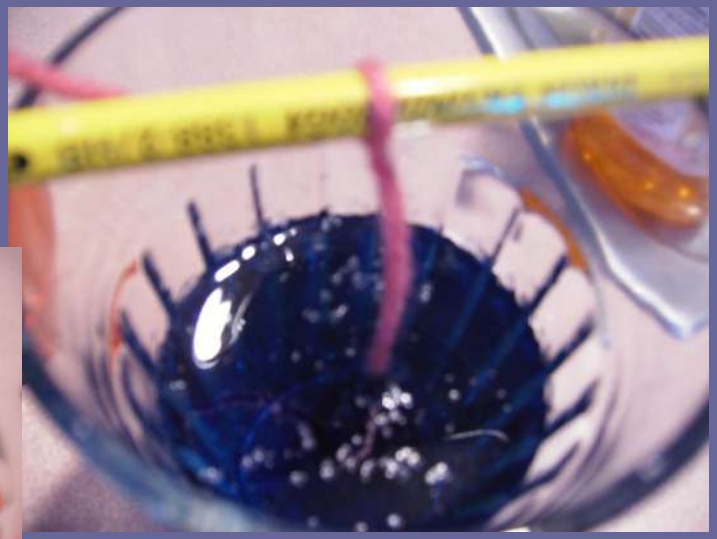
It was hard to capture the changes in the glasses because of the size of the crystals that were forming. The crystals were growing on the surface of the solution and up the side of the glass. The yellow solution appeared to saturate it's wick and develop a shiny crust that could be the beginning of sugar crystals.

Day 3



Greater crystal formation was evident by Day 3. The blue solution was crystallizing at the bottom of the wick and on top of the solution and glass. Tiny, translucent crystals appeared to be forming on the yellow and red wick, while the crystals were growing only on the glass that contained the controlled solution.

Day 4

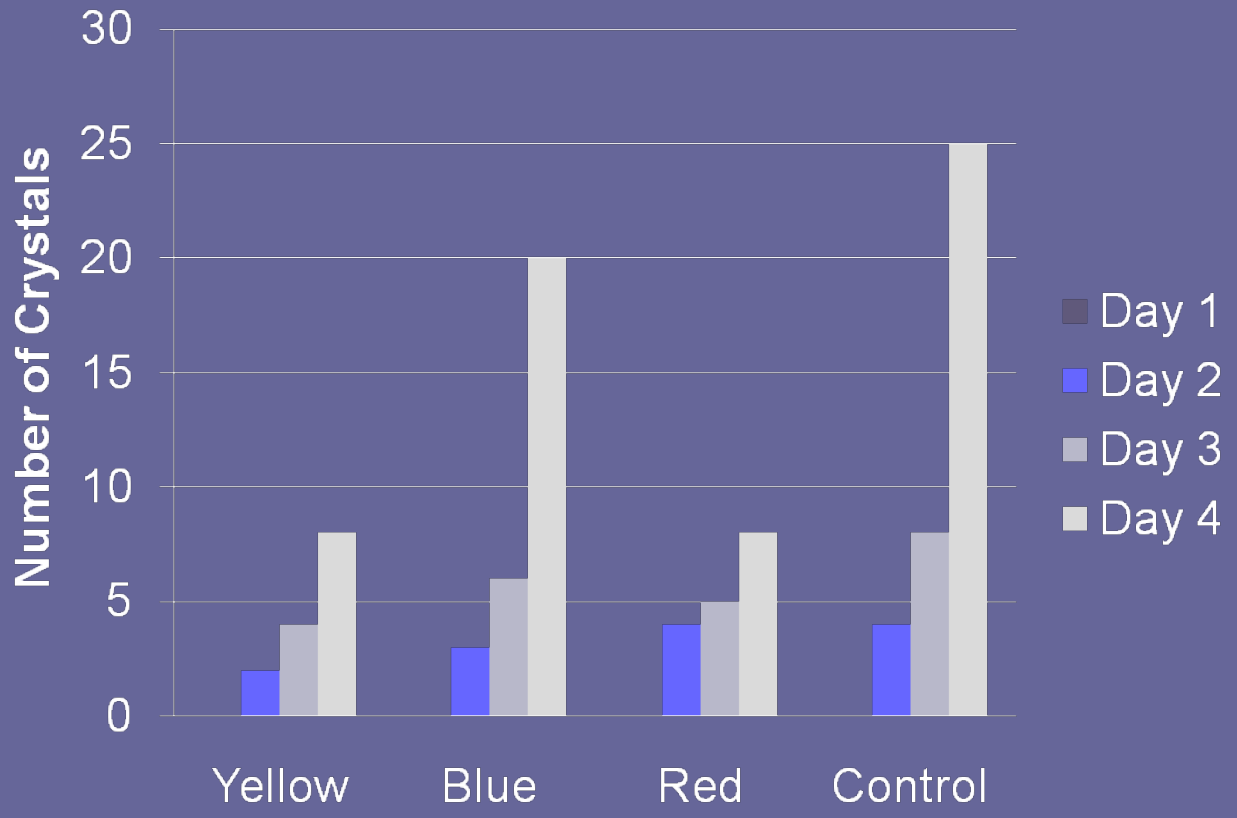


The blue solution seemed to be developing crystals rapidly, as well as the clear, control solution. The yellow and red solution did not appear to change from Day 3's observations. The yellow and red solution had a small amount of crystals forming at the base of the wick.

Quantitative Observations: Visible Sugar Crystals

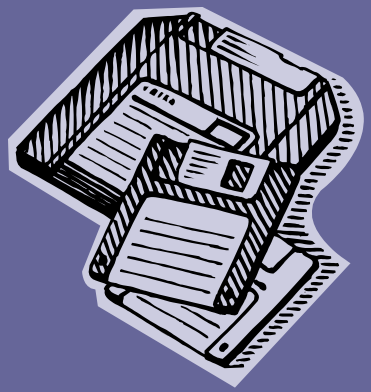
Solution	Day 1	Day 2	Day 3	Day 4
Red	0	2 floating on surface with some forming on wick	4 wick thickening at base with crystals; formations on the side of the glass	8 base of wick continues to thicken; group of crystals on the surface
Blue	0	3 floating on surface with some forming on wick	6 floating on surface; crystals on wick seem to be growing	15 Large cluster of crystals around the base of the wick; crystals forming on the edges of the glass
Yellow	0	4 some crystal formations on the wick	5 main growth on wick; entire wick seems to be saturated	8 crystal growth seems to take place only on wick
Control	0	4 crystal formations around the edge of the solution; floating on the surface	8 wick does not appear to contain any crystals; small crystals formed on the surface	25 small crystals form the surface of the solution, but wick does not seem to contain any

Crystal Growth



Results

The test was run for four days. Each day each solution had more crystals. However the greatest increase was from day three to day four in the blue solution and the control. The solution with blue food coloring and the control grew the largest crystals in the greatest amounts up to 25 crystals each. In contrast the yellow and red grew smaller crystals that numbered only 8 crystals each.



Conclusion

- Was my hypothesis supported?
- Did Lab errors affect my results?

Results were Inconclusive to show if my hypothesis was supported.

If an impurity, food coloring, is added to the crystal solution, then the sugar crystals' growth will be affected.

Final Conclusion

This experiment did not provide enough accurate data to make a solid conclusion as to whether the addition of food coloring affects the growth rate of sugar crystals. The control solution and the blue colored solution developed the largest, most visible crystals. In contrast, the yellow and red solution did not appear to develop sugar crystals as readily and as large as the controlled solution and the blue solution. Therefore, the experiment did not show that my hypothesis was supported or not.

Possible Sources of Lab Errors

- Other family members may have bumped or moved the glasses containing the solutions.
- Weather changes could cause temperature and humidity variations that were originally anticipated to stay stable.
- Sugar and water might not have been precisely measured. Extra drops of food coloring could have been added.
- String could have contained a dye or product on it that inhibited or encouraged crystal growth.

References

The following is a list of sites that I referred to while designing my experiment:

- about.com: homecooking (recipe) http://homecooking.about.com/library/archive/blcandy11.htm
- Kiwi Web: Chemistry and New Zealand (background information) http://www.chemistry.co.nz/crystals_defined.htm
- Lappeenranta University of Technology, Department of Chemical Technology (background information) http://www2.lut.fi/~hhatakka/docit/impure.html