# Title Information

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Ice and Glaciers Lab

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# Data and Observations / Calculations

## Exercise 1: Ice and Glaciers

### Initial Hypothesis

If both dark-colored ice cubes and clear ice cubes are put under the same conditions to melt, then the dark-colored ice cubes will melt first because darker colors have lower albedo and retain heat more than lighter colors which refract.

### Data Table 1. Data for Ice Melting Experiment with Stopwatch

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Plain water ice cubes** | **Trial 1** | **Trial 2** | **Trial 3** | **Trial 4** | **Trial 5** | **Avg** |
| Start time (hr:min) | 0:00 | 0:00 | 0:00 | 0:00 | 0:00 | 0:00 |
| End time (hr:min) | 1:47 | 2:10 | 1:55 | 1:39 | 2:15 | 1:58 |
| Total minutes to melt | 107 | 130 | 115 | 99 | 135 | 117.2 |
|  | | | | | | |
| **Dark colored ice cubes** | **Trial 1** | **Trial 2** | **Trial 3** | **Trial 4** | **Trial 5** | **Avg** |
| Start time (hr:min) | 0:00 | 0:00 | 0:00 | 0:00 | 0:00 | 0:00 |
| End time (hr:min) | 1:32 | 1:57 | 1:26 | 1:13 | 1:45 | 1:35 |
| Total minutes to melt | 92 | 117 | 68 | 73 | 105 | 94.6 |

### Sample Calculations of Average

Average Clear Ice:

(107+130+115+99+135)/5 = 117.2

Average Colored Ice:

(92+117+68+73+105)/5 =94.6

### Data Table 2. Temperature vs Time Data

|  |  |
| --- | --- |
| **Time (minutes)** | **Temperature (oC)** |
| **0 (start)** | **0** |
| **1** | **2** |
| **2** | **3** |
| **3** | **7** |
| **4** | **8** |
| **5** | **13** |
| **6** | **20 (FULLY MELTED)** |
| **7** | **27** |
| **8** | **33** |
| **9** | **48** |
| **10** | **60** |
| **11** | **66** |
| **12** | **68** |
| **13** | **73** |
| **14** | **76** |
| **15** | **79** |
| **16** | **81** |

### Graph 1. Time vs Temperature from Data Table 2

\*\* The red marker at time 6 minutes, temperature 20 degrees Celsius is where all of the crushed ice was melted \*\*

### Photo Requirements

#### Part 1 Step 6 Initial

A picture containing sign, food

Description automatically generated

#### Part 1 Step 6 Halfway

#### A picture containing indoor, table, sitting, coffee Description automatically generated

# Lab Question Answers

## Initial Hypothesis

If both dark-colored ice cubes and clear ice cubes are put under the same conditions to melt, then the dark-colored ice cubes will melt first because darker colors have lower albedo and retain heat more than lighter colors which refract.

## Questions

1. **Which ice cube melted faster on average, the clear or the dark colored one? Why do you think this was? What can you say about each ice cube’s albedo? How do the results relate to your initial hypothesis?**

The darker ice cubes melted fester on average. On average the darker ice cubes melted under a hot lamp in 94.6 minutes and the lighter in 117.2 minutes. As in the HOL Lab, “things with low albedo rend to absorb heat well. High Albedo reflects the sunlight” (HOL Lab, 2020). My results confirm my hypothesis where I used the reasoning of this same concept to inform.

1. **Which type of glacier would likely melt back first: a clean ice glacier or a rock glacier filled with debris? Could you answer this question in the same way regarding piles of snow melting after a snowstorm? Explain your answers.**

By the concept of albedo, the rock filled glacier with debris would have a lower albedo because the debris would be darker. Typical debris could be trees and logs, and forests are notorious for absorbing hear (HOL Lab, 2020). By this logic the rock glacier filled with debris would likely melt first. In terms of applying this knowledge to snowmelt, the snow that is not only run over and put more pressure on and tainted with mud (on the road) melts much faster than snow that sits untouched in a lawn. There is more retained heat in darker items.

1. **Does the growth of glaciers depend on temperature alone, or other factors? How do glaciers get started if albedo is low? How do they ever melt if they have such a high albedo?**

The growth of glaciers depends are so many different factors. One factor is pressure, “adding pressure raises the melting point of most substances” (HOL Lab, 2020). This means that if atmospheric pressure increases glaciers might melt despite having very cold initially sustainable temperatures.

1. **Using what you have learned about pressure and melting points, is sledding better done when the air temperature is 25° F or 0° F?**

I think the fun part about sledding is going fast! With part snow and part water the snow is able to form into a more compact sheet personally making sledding more fun at 25 degrees. Not to mention there’s a slight buffer for your toes to keep a little warmer at 25 degrees (ha-ha). With more sledding putting pressure on the snow, the flip side argument is that I could go sledding longer if it was 0 degrees because my pressure increases the melting point of the snow. Therefore, a colder air temp can keep the snow intact longer.

1. **What happened to the temperature during the ice melt process in Part 2? Did it rise as melting was taking place?**

The temperature rose exponentially as the ice melted. At the beginning the temperature only grew slowly but right as it hit the 4-minute mark the temperatures grew exponentially to slight linearly with the remaining time. As the water began to bubble towards the end, the temperature increased quickly. Thus, once the ice melted, we see an exponential growth of temperature increase.

1. **If the temperature did not rise while melting was occurring, what happened to all of the heat you supplied from the stove burner?**

The heat was going into breaking the strong covalent bonds between the individual water (H2O) molecules. The specific heat of water is approximately 4.18 kJ which is a lot of energy needed to melt ice and boil water.

1. **Predict what the Temperature versus Time chart would look like if you continued heating the water to the boiling point, then let it boil away, while measuring temperature the same as you did for the ice melting. You can actually try this if you like, just be careful once the water starts boiling and avoid placing your thermometer bulb on the bottom of the pan.**

I believe the general trend of the Temperature versus Time chart would look like an exponential graph as I continued heating the water to the boiling point, then let it boil away, while measuring temperature the same as i did for the ice melting.

1. **If glaciers worldwide were to melt, would temperatures around the glacier rise, fall, or remain the same as the glacier was melting?**

If glaciers worldwide were to melt, temperatures around the glacier would rise as the glacier was melting. Something I observed in both of the activities was as the ice cubes melted into water, the other solid ice potion began to melt quicker. The ice takes in the heat energy, and by the laws of thermodynamics energy cannot be destroyed therefore it must transform into a different sort of energy. By this, I think the temperatures would rise with the ongoing process.

# Conclusions

In these two labs, I grew more familiar with a term I learned about in my Weather and Atmosphere Course at CU – Albedo. My professor then stressed knowing this term, and here I was able to see the direct impacts of a high albedo.

Beginning with part 1, I can say for sure that looking at ice cubes was some long past time. The fact that it took upwards of an hour to melt my tiny ice cubes makes me worried for the rate that sheets of global ice are melting. I witnessed first-hand how low albedo correlates to a faster melting point. The HOL Lab put it best when describing the feeling of albedo with wearing a black shirt in the heat of summer.

In part 2, I noticed how with melting ice, the temperature rises exponentially after the melting point is reached. This puts into perspective how now that our ice caps are melting, they will melt even faster due to the already made damage. In terms of climate change an immeasurable disaster is up ahead.

This lab was really informational to putting data to the topic I already knew about. While watching ice took a lot of time out of the day, the results were worthwhile.

# References

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