

# Understanding Water Level in a Changing Arctic

## Student Worksheet

Name: \_\_\_\_\_ Date: \_\_\_\_\_

### Melting Ice Activity

#### Materials:

- Ice cube trays
- Water
- Food Coloring
- Water color paper
- Tray
- rock or waterproof object for setting paper at an angle

#### Process:

1. Prepare the colored ice: Fill each 3 sections of the ice cube tray with water and add 2-3 drops of yellow to one section, blue to another, and red to the last.
2. Create the art: Place the water color paper inside a tray and put a rock or another object under it so your paper slopes at an angle. Place the ice on the water color paper to melt naturally.
3. Observe change: Check your ice every 15 minutes and record observations. What do you see?

#### Melting Ice Observations

After 15 minutes:

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After 30 minutes:

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After 45 minutes:

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After 60 minutes:

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## What happened to your ice?

How did your ice change? Imagine that the blue ice represents carbon stored in glaciers, the yellow is carbon in permafrost, and the red is carbon stored in the ice sheet. As the ice melted what happened to the carbon? Did the carbon mix? Can you trace the carbon back to the source? What are the implications for carbon released from melting ice?

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## StoryMap- Understanding Water Level in a Changing Arctic

### Directions

1. Get your computer and get ready to join Dr. Eric Klein and his team of researchers in Greenland.
2. Go to [www.arcg.is/1DmLuS2](http://www.arcg.is/1DmLuS2)



3. Scroll through the storymap. Be sure to click on links, underlined words, and pictures to learn more about Greenland and Dr. Klein's research.

### Questions

1. What is Dr. Klein's research project called and what are they studying?

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2. What is Greenland called in Greenlandic?

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3. Where are the two sites in Greenland where the Follow the Water team is conducting their research?

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4. What is the cryosphere?

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5. What is the water cycle?

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## Questions Continued

6. What does a pressure transducer measure?

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7. What is the equation for solving for water level?

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## Join the Team!

Now it's time to get on your waders, load up your backpack, and join the team as they hike out to Qaanaaq river to collect data from the pressure transducer.

Date-Time (Greenland Daylight Time)	Absolute Pressure (kPa)	Temperature (°C)	Barometric Pressure (kPa)	Density (kg/m <sup>3</sup> )	Water Level (m)
7/11/2025 0:00	99.333	2.85	98.6	999.98	0.075
7/11/2025 1:00	99.297	2.74	98.527	999.991	
7/11/2025 2:00	99.201	2.74	98.371	999.991	
7/11/2025 3:00	99.105	2.74	98.199	999.991	
7/11/2025 4:00	98.999	2.74	98.082	999.991	
7/11/2025 5:00	98.989	2.74	98.007	999.991	
7/11/2025 6:00	99.044	2.85	97.958	999.98	0.11
7/11/2025 7:00	99.056	2.95	97.951	999.97	
7/11/2025 8:00	99.097	2.85	97.968	999.98	
7/11/2025 9:00	99.07	2.95	97.916	999.97	
7/11/2025 10:00	98.983	3.16	97.839	999.949	
7/11/2025 11:00	98.942	3.27	97.796	999.938	
7/11/2025 12:00	98.905	3.38	97.75	999.927	0.117
7/11/2025 13:00	98.761	3.9	97.645	999.875	
7/11/2025 14:00	98.655	3.9	97.515	999.875	
7/11/2025 15:00	98.52	4.11	97.392	999.854	
7/11/2025 16:00	98.483	4.43	97.365	999.822	
7/11/2025 17:00	98.437	4.32	97.291	999.833	
7/11/2025 18:00	98.342	4.11	97.189	999.854	0.117
7/11/2025 19:00	98.309	3.9	97.125	999.875	
7/11/2025 20:00	98.305	3.69	97.088	999.896	
7/11/2025 21:00	98.431	3.48	97.064	999.917	
7/11/2025 22:00	98.835	3.48	97.036	999.917	
7/11/2025 23:00	99.076	3.27	97.077	999.938	
7/11/2025 23:59	99.286	3.16	97.105	999.949	0.222

We'll solve the first one together.

You know the equation for solving for water depth is:

$$Z = \frac{P_1 - P_0}{g * \rho_1}$$

$Z$  = water depth in meters

$P_1$  = absolute pressure (kPa)

$P_0$  = barometric pressure(kPa)

$g$  = Earth's gravitational acceleration constant  
at the poles m/s<sup>2</sup> is 9.83208

$\rho_1$  = density kg/m<sup>3</sup>

- $Z = ?$
- $P_1 = 99.333$  kPa
- $P_0 = 98.6$  kPa
- $g = 9.83208$  m/s<sup>2</sup>
- $\rho_1 = 999.98$  kg/m<sup>3</sup>

$$\frac{99.333 - 98.6}{9.83208 * 999.98} = \frac{0.733}{9,831.88336} = 0.0000745533661$$

Your answer needs to be in Pa not kPa so multiply your answer by 1,000

$$0.0000745533661 * 1,000 = .075 \text{ (rounded to nearest thousandth)}$$

Continue solving for water level and filling in the chart. Once you have found all the answers move on to the next section, graphing your data.



# Graphing Activity

## Materials:

- graph paper
- 25 water level measurements
- 25 water temperature measurements
- pencil
- ruler
- colored pencils

## Directions:

1. The x-axis will be labeled *Time of Measurements GST (Greenland Standard Time)*
2. The y-axis will be labeled *Water Level (m)* on the right and *Temperature °C* on the left
3. Use the water level and temperature measurements to create a bar graph of your data.

## Questions:

1. Look at your graph. When was water level the highest? Is this surprising to you? How does this relate to water temperature?

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2. What observations can you make about water temperature? What about water depth? Why do you think they had different peaks? How might water temperature influence water depth?

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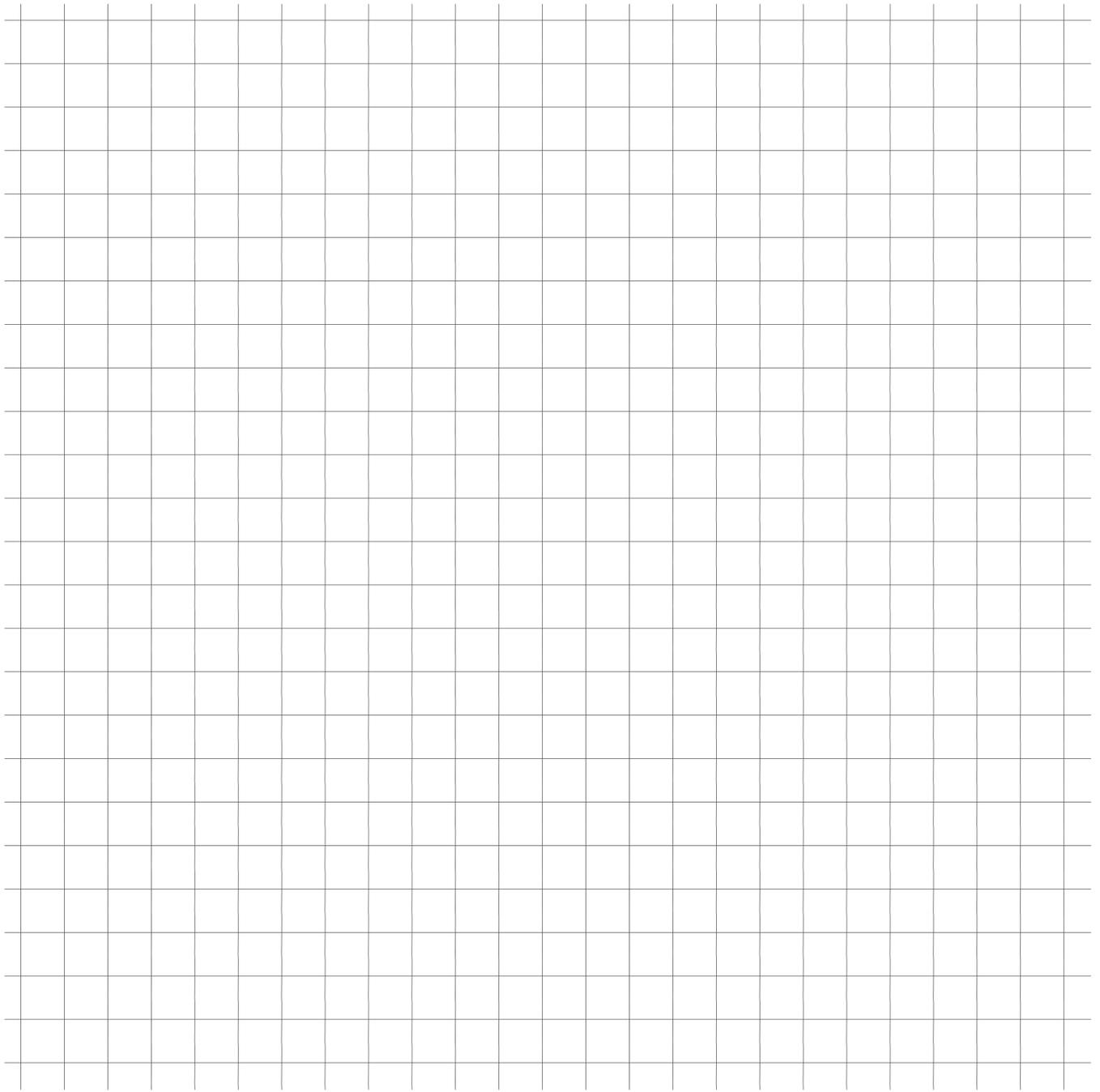
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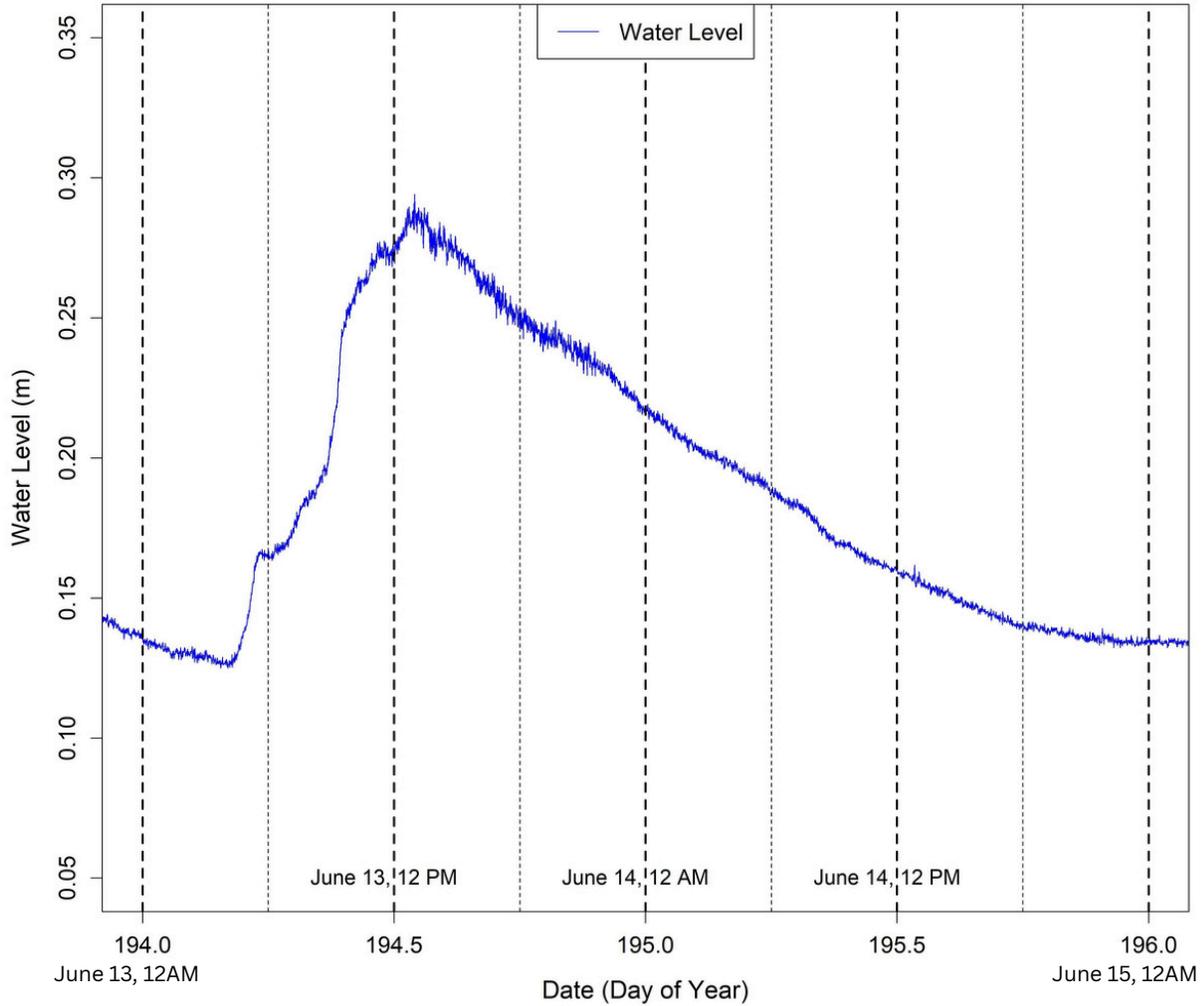




# Comparing Data

## Directions

Below you will find another graph that shows water level increase and decrease over a 48 hour period. You will use this graph and the graph you created to answer the following questions.



The - - - - indicate 12 hours and the ..... indicate 6 hours

## Questions

1. What information do these graphs give you about Qaanaaq River?

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2. How are the graphs similar? How are they different?

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3. Look at the graph you created. What was the water level at 6:00? What was it at 12:00? Look at the provided Water Level graph above. What was water level at 6AM on June 13<sup>th</sup>? What was it at 12PM on June 13<sup>th</sup>?

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14. In the Water Level graph provided what happened between 12PM on June 13<sup>th</sup> and 12AM on June 14<sup>th</sup>?

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15. What is going on here? Why are water levels so different in these two graphs? Write your ideas below.

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### Class Discussion

What is happening in the Arctic? Your teacher will lead a class discussion about your water level observations and how a warmer and wetter Arctic can have rippling effects for the rest of the globe. For more information check out the following websites:

- <https://www.earthobservatory.nasa.gov/images/152575/the-arctic-is-getting-rainier>
- <https://polarsteam.info/project/follow-the-water-understanding-river-discharge-and-hydroclimate-dynamics-in-rapidly-changing-high-northern-latitudes/>
- <https://polarsteam.info/discovering-river-discharge-dynamics-in-the-high-arctic/>

