CYSF 2026 - Digital Logbook
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Mount Royal School

On our way to and from the mountains, for as long as I can remember, my family has always stopped at a natural spring just outside of Canmore to fill up our water bottles. My Dad and I drink the water, but my mom has always refused to drink it for fear of getting Beaver Fever. I want to test the spring water to see if it is safe and to see if the water quality changes at different times of year.

How does Canmore mountain spring water compare to Calgary tap water and does water quality change seasonally?

Control Variable: Calgary Tap Water
Manipulated Variable: Spring Water

Project Title Ideas

- How Safe is the Dihydrogen Monoxide in Your Drinking Water?
- How safe is mountain spring water?

Link to data on sheets

November 22 - First Collection Date

Testing time - 17:45
Outdoor Temperature - 2C

Spring Water

Flow Rate	4.76s/4L	4.46s/4L
Temperature	15.7 C	15.7 C
Potability	159 ppm	
Conductivity	258 µS/cm	

avg 4L in 4.61s	0.87 L/s

Tap Water

Temperature	15.7 C

Potability	173 ppm
Conductivity	346 µS/cm

Test	**Spring Water Nov. 22**	**Calgary Tap Water Nov. 22**
Total Alkalinity mg/L	80	40
Carbonite mg/L	0	20
pH	6.2	6.3
Hardness (mg/L)	100	75
Hydrogen Sulfide (mg/L)	0	0.25
Iron (mg/L)	0	0
Copper (ppb)	0	0
Manganese (mg/L)	0	0
Total Chlorine (mg/L)	0	0
Free Chlorine (mg/L)	0	0
Mercury (mg/L)	0	0
Quaternary Aluminum Salt (Mg/L	0	0
Zinc (mg/L)	0	0
Sodium Chloride (mg/L)	0	0
Fluoride (mg/L)	0	0
Nitrate	0	0
Nitrite	0	0
Sulfate	0	0


17:41
LTE
00:04.76
Reset
Start
Lap 1
00:04.76
World Clock
Alarms
Stopwatch
Timers


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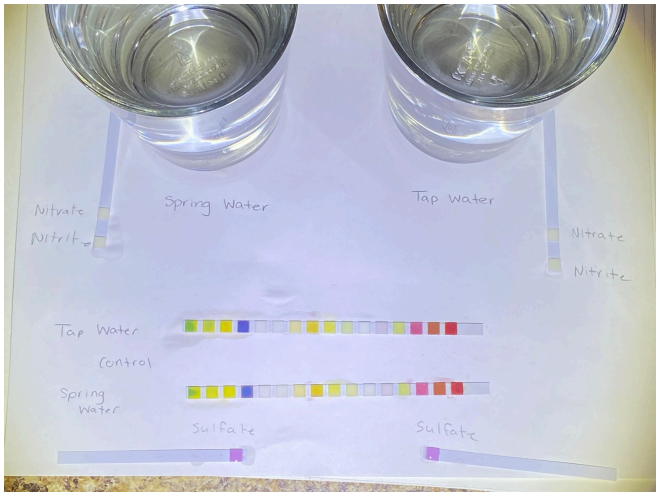
Start
Lap 1
00:04.46
World Clock
Alarms
Stopwatch
Timers



December 19 - Second Collection Date

Testing time - 16:45
Outdoor Temperature - 6C

Spring Water

Flow Rate	5:53 s/4L	4.59 s/4L

Temperature	12.0 C	
Potability	189 ppm	
Conductivity	378 µS/cm	

avg 4L in 5.06s	0.72L/s

Tap Water

Temperature	15.7 C
Potability	173 ppm
Conductivity	346 µS/cm

Test	**Spring Water December 19**
Total Alkalinity mg/L	180
Carbonite mg/L	120
pH	7.2
Hardness (mg/L)	250
Hydrogen Sulfide (mg/L)	0
Iron (mg/L)	0
Copper (ppb)	0
Manganese (mg/L)	2
Total Chlorine (mg/L)	0
Free Chlorine (mg/L)	0
Mercury (mg/L)	0
Quaternary Aluminum Salt (Mg/L	0
Zinc (mg/L)	5
Sodium Chloride (mg/L)	0

Fluoride (mg/L)	0
Nitrate	0
Nitrite	0
Sulfate	

Jan 11 worked on Hypothesis and started on variables
Plan to have the online part done in the next 2 weeks

<u>January 17</u> - Third Collection Date

Testing time - 16:47
Outdoor Temperature - 6C

Spring Water

Flow Rate	5.48 s/4L	4.81 s/4L	5.31 s/4L
Temperature	11.4 C		
Potability	194 ppm		
Conductivity	388 µS/cm		

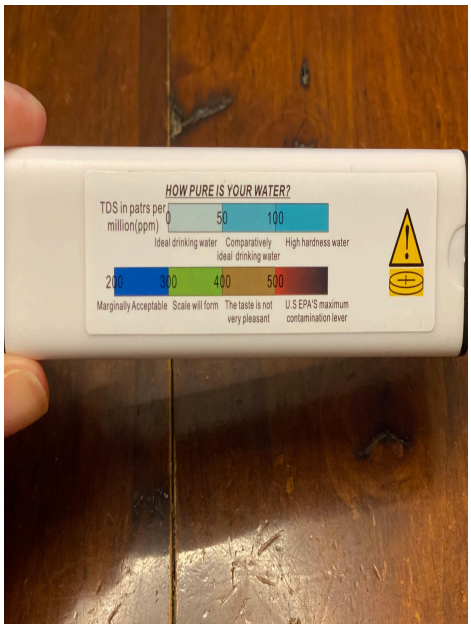
avg 4L in 5.2s	0.77 L/s

Tap Water

Temperature	15.7 C
Potability	ppm
Conductivity	µS/cm

Test	**Spring Water January 17**
Total Alkalinity mg/L	180
Carbonite mg/L	180
pH	7.7
Hardness (mg/L)	250
Hydrogen Sulfide (mg/L)	0
Iron (mg/L)	0
Copper (ppb)	0
Manganese (mg/L)	0
Total Chlorine (mg/L)	0
Free Chlorine (mg/L)	0
Mercury (mg/L)	0
Quaternary Aluminum Salt (Mg/L	0

Zinc (mg/L)	2
Sodium Chloride (mg/L)	0
Fluoride (mg/L)	0
Nitrate	0
Nitrite	0
Sulfate	200


HOW PURE IS YOUR WATER?
TDS in patrs per million(ppm)
0
50
100
Ideal drinking water
Comparatively ideal drinking water
High hardness water
200
300
400
500
Marginally Acceptable
Scale will form
The taste is not very pleasant
U.S EPA'S maximum contamination lever


114


4:51
5G
00:05.31
Reset
Start
Lap 1
00:05.31
World Clock
Alarms
Stopwatch
Timers


4:49
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Start
Lap 1
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World Clock
Alarms
Stopwatch
Timers


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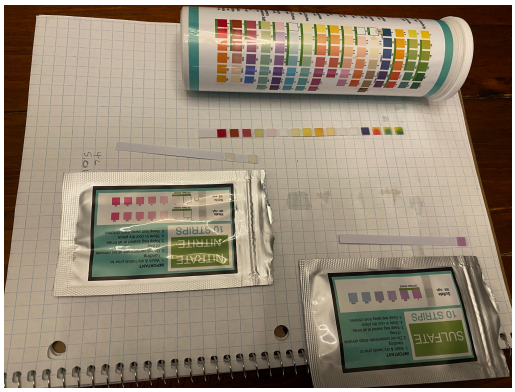
World Clock
Alarms
Stopwatch
Timers




SULFATE
10 STRIPS
IMPORTANT:
1. Wash & dry hands prior to handling.
3. Keep bag sealed at all times.
4. Store in cool dry place.
5. Keep test away from children.
Sulfate

February 15 - Fourth Collection Date

Testing time - 17:03
Outdoor Temperature - (-4C)

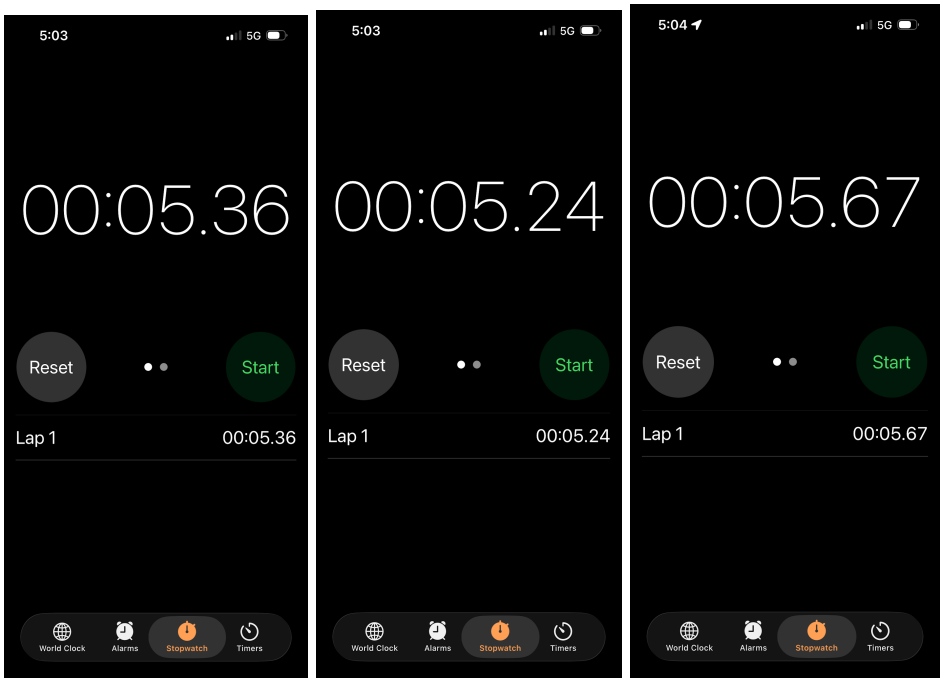
Spring Water

Flow Rate	5.67s/4L	5.36s/4:	5.24 s/4L
Temperature	Not Recorded		
Potability	173 ppm		
Conductivity	346 µS/cm		

avg 4L in 5.42s	0.74 L/s

Test	**Spring Water February 15, 2026**
Total Alkalinity mg/L	120
Carbonite mg/L	80
pH	7.6
Hardness (mg/L)	250
Hydrogen Sulfide (mg/L)	0
Iron (mg/L)	0
Copper (ppb)	0
Manganese (mg/L)	0
Total Chlorine (mg/L)	0
Free Chlorine (mg/L)	0
Mercury (mg/L)	0
Quaternary Aluminum Salt (Mg/L	0

Zinc (mg/L)	0
Sodium Chloride (mg/L)	2
Fluoride (mg/L)	0
Nitrate	0
Nitrite	0
Sulfate	180



March 1 - Fifth Collection Date

Testing time - 16:43
Outdoor Temperature - (-8C)

Spring Water

Flow Rate	4.56	4.98	4.63
Temperature	11C		
Potability			
Conductivity			

avg 4L in 4.72s	0.85 L/s

Test	**Spring Water February 15, 2026**
Total Alkalinity mg/L	90
Carbonite mg/L	40
pH	6.8

Hardness (mg/L)	425
Hydrogen Sulfide (mg/L)	0
Iron (mg/L)	0
Copper (ppb)	2
Manganese (mg/L)	0
Total Chlorine (mg/L)	0
Free Chlorine (mg/L)	0
Mercury (mg/L)	0
Quaternary Aluminum Salt (Mg/L	0
Zinc (mg/L)	2
Sodium Chloride (mg/L)	5
Fluoride (mg/L)	0
Nitrate	0
Nitrite	0
Sulfate	0

Gemini said:

In Canada, water quality is primarily determined by the **Guidelines for Canadian Drinking Water Quality**, established by Health Canada. They categorize indicators into three types:

1. **Maximum Acceptable Concentration (MAC):** Levels that could affect health.
2. **Aesthetic Objective (AO):** Levels that affect taste, smell, or color (but not necessarily health).
3. **Operational Guidance (OG):** Levels that help treatment plants run smoothly.

Below is a guide for the indicators you tested, specifically tailored to what you might find in a natural spring in the Rockies.

Water Quality Indicator Guidelines

Indicator	Guideline / "Healthy" Range	Category	Notes for your Project
Potability	**0 CFU/100 mL**	MAC	For a spring, "potable" means zero *E. coli* or Total Coliforms. Natural springs often fail this without treatment!
pH	**7.0 – 10.5**	AO	Canmore water is often slightly alkaline (7.5–8.5) due to limestone.
Hardness	**80 – 100 mg/L**	AO	No health limit, but >200 mg/L is "hard." Canmore springs are notoriously hard.
Nitrate	**10 mg/L**	MAC	High levels usually suggest runoff from fertilizer or waste.
Nitrite	**1 mg/L**	MAC	Usually tested alongside Nitrate.
Sulfate	**≤ 500 mg/L**	AO	High levels can have a laxative effect.
Iron	**≤ 0.3 mg/L**	AO	Prevents orange staining and "metallic" taste.

Manganese	**0.12 mg/L (MAC)**	MAC/AO	0.02 mg/L is the limit for taste/staining.
Copper	**≤ 2000 ppb (2 mg/L)**	MAC	Usually comes from pipes, not the spring itself.
Zinc	**≤ 5.0 mg/L**	AO	Prevents a "greasy" film and astringent taste.
Fluoride	**1.5 mg/L**	MAC	Naturally occurring in Bow Valley rocks; check if your spring has "trace" amounts.
Total Dissolved Solids (TDS)	**≤ 500 mg/L**	AO	Linked to **Conductivity**. High TDS = high conductivity.
Hydrogen Sulfide	**≤ 0.05 mg/L**	AO	This is what causes that "rotten egg" smell.

Indicators without "Static" Guidelines

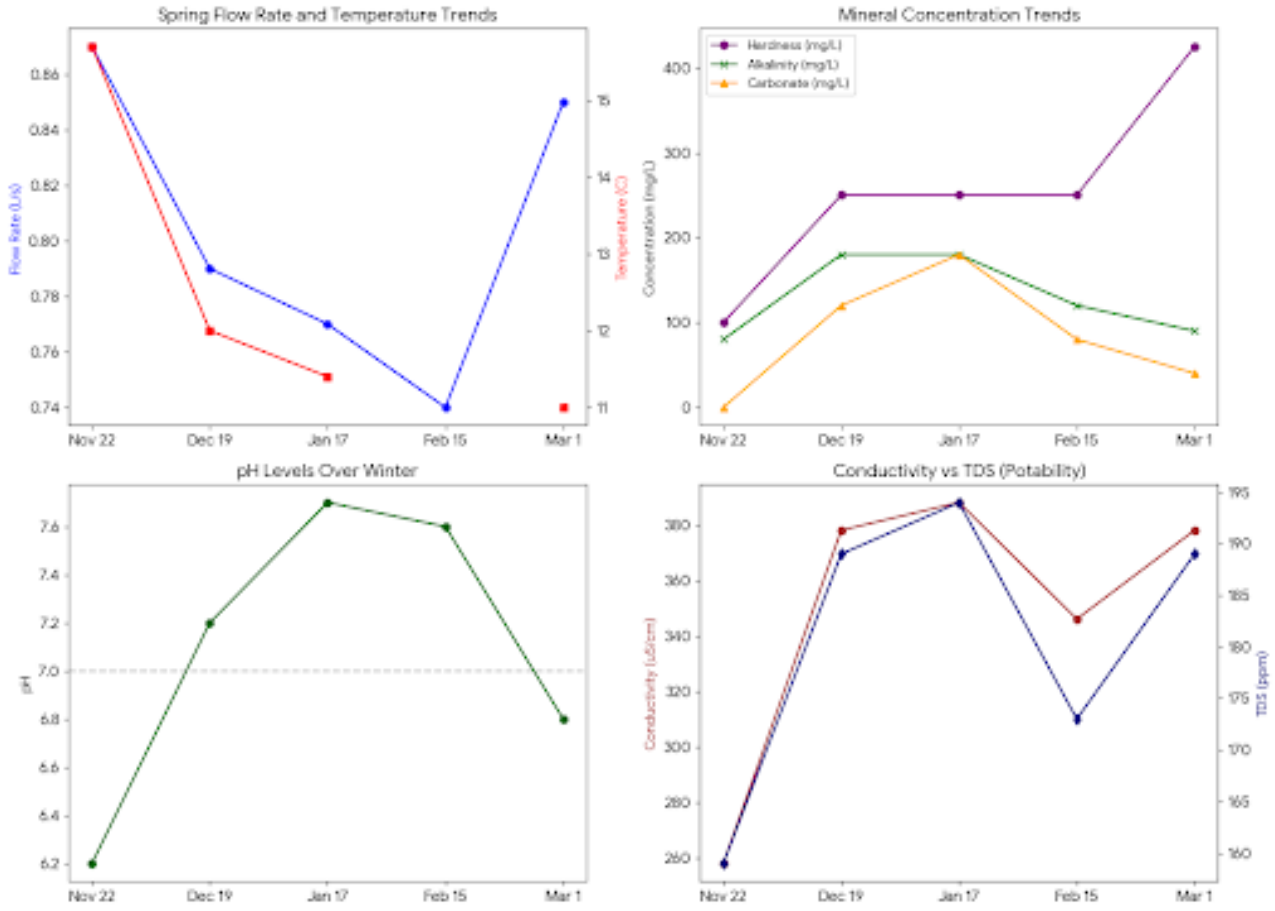
- **Flow Rate:** No "healthy" number; it's a measure of the spring's productivity. It changes with the seasons (highest during spring melt).
- **Temperature:** Natural springs in Canmore are often "cold springs" (under 10°C). If it's warm, it might be influenced by deeper geothermal activity.
- **Chlorine (Free/Total):** These should be **0 mg/L** in a natural spring. If you find chlorine, it means the water has been treated or contaminated by city water.
- **Alkalinity / Carbonate:** These measure the water's ability to resist pH changes. In the Rockies, 100–200 mg/L is very common and "healthy" for the ecosystem.

Research Tip for your Science Fair:

Because you are looking at a **natural spring** rather than tap water, you should also mention the **CCME Guidelines for the Protection of Aquatic Life**. Sometimes water that is "unhealthy" for humans to drink (like very hard water or water with high iron) is perfectly healthy for the bugs and fish living in the creek!

03 29 at 437 pm

Worked on copying info into google slides



1. Hardness and Mineral Content

This is your most dramatic result.

- **The Trend:** Your hardness started at 100 mg/L in November and skyrocketed to 425 mg/L by March.
- **Scientific Analysis:** In the Rocky Mountains, groundwater flows through limestone and dolostone. As winter progresses, there is less "fresh" surface water (rain or melting snow) to dilute the spring. By March, the water coming out of the spring has likely been underground for a long time, picking up high amounts of Calcium and Magnesium.
- **Note:** 425 mg/L is considered "Very Hard" water. For comparison, Calgary's city tap water usually ranges from 160 to 210 mg/L.

2. Flow Rate and Temperature

- **Flow Rate:** You caught a "V-shape" trend. It decreased from November (0.87 L/s) to February (0.74 L/s), which makes sense as the ground freezes. The jump back up in March (0.85 L/s) likely indicates the very beginning of the spring melt or a late February warm spell (a Chinook!) starting to recharge the spring.
- **Temperature:** The spring water stayed relatively warm (11.0°C to 15.7°C). This suggests the spring is "deep-seated," meaning the water is coming from deep enough underground that it isn't freezing, even when the air in Banff is -20°C.

3. pH and Alkalinity

- **pH Shift:** The water moved from slightly acidic (6.2) in November to more basic/alkaline (7.7) in mid-winter.
- **Alkalinity:** Your Total Alkalinity and Carbonate levels peaked in December and January. Alkalinity acts as a "buffer" for the water. The high alkalinity in mid-winter explains why the pH rose—the minerals in the water were neutralizing any acidity.

4. Potability and Conductivity

- **The Connection:** You'll notice that your "Potability" (measured in ppm) and "Conductivity" ($\mu\text{S/cm}$) follow almost the exact same pattern. This is because your potability meter is actually measuring **Total Dissolved Solids (TDS)**.
- **Analysis:** Pure water doesn't conduct electricity well; dissolved minerals (ions) do. As your mineral content (Hardness) went up, your conductivity and TDS followed.

Conclusion

My results support my hypothesis. As the winter progressed hardness increased from 100 mg/L to 425 mg/L. This confirms that colder weather and slower water flow, increased contact time with the rocky mountain concentrating existing minerals.
The flow rate also dropped with the weather, It reached it's lowest point (0.74 L/s) in February coinciding with the coldest air temperatures (-4 to -8). This suggests that the recharge of the spring was restricted by frozen surface ground, leaving only the deep-seated aquifer to supply the flow.
While the overall winter trend showed a decrease in flow, the March 1st increase was slightly unexpected. This likely indicates an early melt, where rising temperatures in February begin to introduce surface water back into the system, slightly ahead of what I would have expected.

Sources of Error

As much as I tried to make my project perfect, there were lots of things I couldn't get perfectly.
Sensor Calibration: Most pH and TDS meters can drift over time. I didn't calibrate the meter with a buffer solution between testing, I also bought it cheaply on Amazon and that could have impacted my results.
Colour Strip reading: The chemical test strips required me to interpret the colours, and there could have been errors in my interpretations month to month
Missed Data Point: In February I did not have my thermometer and could not test the water temperature as it was collected.
Human Error in Flow Rate: I used a bucket and stopwatch method and this human error could have changed my flow rate measurements. We did measure flow rate 3 separate times each month, and then averaged those 3 measurements to somewhat account for human error.
Recent Weather Events: It snowed 20cm the night before my January test and that could have impacted the water quality testing.

Improvements

I would have liked to have collected more samples to add to my data set but once a month was the most I could convince my parents to drive me out. I would like to continue collecting samples and testing over the summer, it would be interesting to have a monthly test completed for a year, and then to retest the following year to compare month to month.

I would have liked to have tested specifically for Beaver Fever directly, but the cheapest kits I could find were 300-750 dollars a sample.

I would have also liked to have spent more time researching how Calgary Water is treated (what is added to the water for example) and how temperature impacts the water quality indicators. I only found out near the end of my testing that cold water holds more dissolved carbon dioxide which enhances the dissolution of calcium and magnesium from rocks. So this would have impacted my mineral trends and then my pH data as a result.

Future Testing

Initially I just wanted to test the water to see if it was safe to drink. Then I wanted to compare it to Calgary's water. Then I wondered how it changed throughout the year. I feel like I have a better understanding of all those things. But next steps would be to look at Ecological Implications. How do the abiotic changes that I measured in the spring water impact the flora and fauna in Canmore.

Application

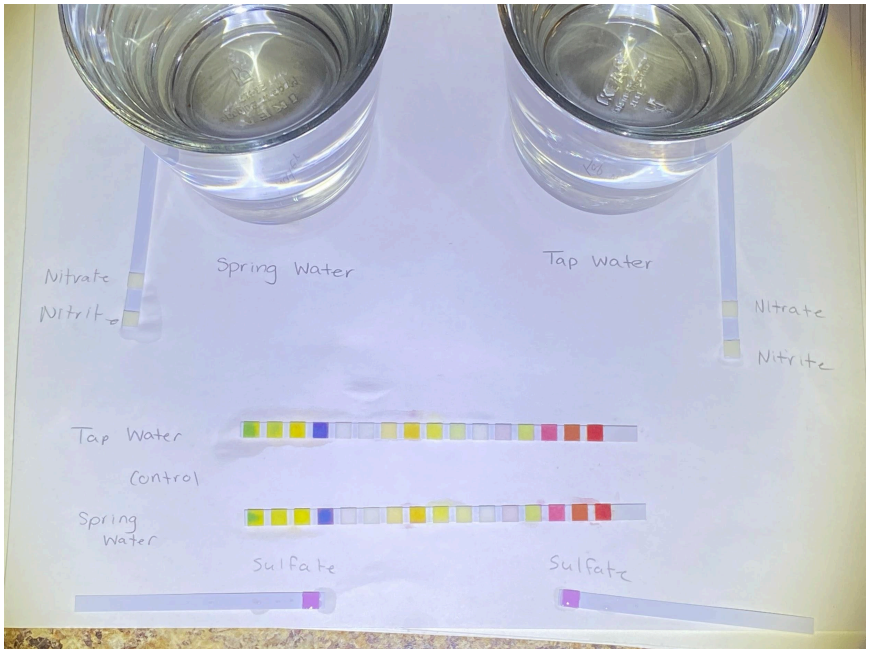
While many water quality projects are a single snapshot in time, my project is a longitudinal analysis. Collecting data consistently from November to March allowed me to observe how the winter freeze-in effect alters mineral concentration.

My findings have implications for local hydrogeology. The 325% increase in hardness I measured by March shows that any winter wildlife relying on this spring are interacting with a completely different chemical environment than they do in the fall.

Understanding these natural fluctuations can be important for setting accurate environmental benchmarks for our mountain ecosystems.

Finally, I'm hopeful that my findings will also have personal applications and my whole family can continue to enjoy fresh mountain spring water. Including my mom.


SULFATE
10 STRIPS
NITRATE
NITRITE
10 STRIPS


Spring Water
Tap Water
Nitrate
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Tap Water
control
Spring
Water
Sulfate
Sulfate


Spring Water
Tap Water


1
Trans-Canada Hwy
Bow River
Bow River
Bow River
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