SCIENCE FAIR LOGBOOK 2023 - 2024

https://www.cysf.org/wp-content/uploads/logbooks.pdf

APR - NOV

Project idea: disparity between children's perceptions of parents vs parent's perceptions of themselves?

-Misinformation? Incorporate AI (generated images, bots, etc.)
Hugging Face AI detector
Misinformation + parenting → today's generation, etc.
Survey? Add ai (csv files)
https://surveyswap.io/sign-up
Type up something that [sounds] legit but is fake
Language formality influencing belief in said info
https://www.altalang.com/beyond-words/how-did-that-register-five-levels-of-formality-in-language/
https://www.forbes.com/sites/alisonescalante/2022/01/17/facebook-parenting-groups-are-the-new-target-for-extremist-misinformation/?sh=48e552b65c77
https://onlinelibrary.wiley.com/doi/full/10.1002/bsl.2605

https://huggingface.co/spaces/openai/openai-detector
Run through real texts vs ai generated ones?
-cover letters
-essays
-'scholarly' articles (could be in the parenting thing)

https://grover.allenai.org/
Fake news generator

Indigenous water concerns? DIY water purifier
Cheapest best water cleaner???
https://storymaps.arcgis.com/stories/52a5610cca604175b8fb35bccf165f96

Homelessness???
Portrayal of homelessness in media (stigmatization)?
Technology and homelessness?

Freedom of speech and AI?
Inflation?

SCHEDULE:

Major Dates:
-Mar. 14: School Science Fair
-Mar. 15: CYSF Platform closes
-Apr. 8: City-wide Science Fair

DEADLINES:
Dec. 1: Finish project outline, start research
Jan. 1: Finish research for ALL aspects (filter, neural network, etc.)
Jan. 20: Finish system design
Feb. 1: Finish collecting experiment data
Feb. 29: HARD DEADLINE → Finish ALL experiment + neural network related stuff
Mar. 5: Finish trifold design + CYSF stuff
Mar. 13: Finish making trifold, video

GOALS/ APPLICATIONS

https://water.org/our-impact/water-crisis/
https://www.theindigenousfoundation.org/articles/indigenous-safe-drinking-water-crisis-in-canada-overview#:~:text=The%20lack%20of%20clean%2C%20safe,rights%20to%20water%20and%20sanitation.&text=Drinking%20water%20advisories%20are%20issued,water%20by%20testing%20water%20quality.

Designing & making an effective water filtration system from common waste items that is inexpensive and easy to make, thus making it widely accessible.

NOV
OUTLINE:

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https://www.google.com/search?q=diy+water+fliter&rlz=1CAKDUD_enCA965&oq=diy+water+fliter&aqs=chrome..69i57j0i10i512l9.5233j0j7&sourceid=chrome&ie=UTF-8
Making / designing a diy water filter
Trying out different types of diy water filters (analyzing cost, effectiveness, availability of materials, etc.)
USING NATURAL/MATERIALS READILY AVAILABLE in AREAAAA
CATEGORIZE POLLUTANTS (CARCINOGENS, LEAD, ETC.)
Focus on carcinogens, and common pollutants
Also include sub-section on school water quality
Researching filtration methods
-Indigenous water concerns
Testing Method: pH strips? Water tester?

Real world Applications
World water crisis: https://water.org/our-impact/water-crisis/
Indigenous water crisis:
https://www.theindigenousfoundation.org/articles/indigenous-safe-drinking-water-crisis-in-canada-overview#:~:text=The%20lack%20of%20clean%2C%20safe,rights%20to%20water%20and%20sanitation.&text=Drinking%20water%20advisories%20are%20issued,water%20by%20testing%20water%20quality.

Make filters
Use python to assess water quality before and after

NOV-DEC

BACKGROUND RESEARCH:

Indigenous Water Crisis

https://www.theindigenousfoundation.org/articles/indigenous-safe-drinking-water-crisis-in-canada-overview#:~:text=Description%20of%20Issue&text=Despite%20that%2C%20618%20First%20Nations,the%20inadequate%20water%20they%20have.
https://www.theindigenousfoundation.org/articles/causes-of-unsafe-drinking-water-on-indigenous-reserves
https://storymaps.arcgis.com/stories/52a5610cca604175b8fb35bccf165f96

-Indigenous communities are disproportionately affected by water treatment issues
    -Probability of having safe water is 90 times lower
    -Waterborne disease rate is 26 times higher
-Reason A: Canada doesn't actually have any concrete water safety standards across provinces
-Reason B: The water sources they have are polluted
-Reason C: Lack of government support and Indigenous leaders
-Many advisories have lasted for over a year (some for over 15!)
-A significant burden in the context of financial resources, as people have to buy clean water from commercial sources
-People living on these reservations have an increased chance of skin diseases and cancer

World Water Crisis

https://water.org/our-impact/water-crisis/
https://www.who.int/news-room/fact-sheets/detail/drinking-water#:~:text=In%202022%2C%20globally%2C%20at%20least,risk%20to%20drinking%2Dwater%20safety.
https://www.unesco.org/reports/wwdr/2022/en/tags/water-pollution

-1 in 10 people lack access to safe drinking water
    -27% of the population do not have access to a safely managed water service
    -229 million people are taking their water from unprotected springs & wells
    -115 million people are collecting *untreated* water from lakes, ponds, rivers and streams
-1 million people die each year due to lack of clean water (disease!)
Factors: Time (to collect clean water), strength (to carry loads of clean water)
    -Decreases time for other ventures (education, work, etc.)
    -Decreases rate of physical disorders (reduce need to make long + potentially risky journeys to collect water)
-People with less access to clean water are less prepared to face climate issues

Water Pollutants

https://www.britannica.com/science/water-pollution
https://www.sciencedirect.com/topics/earth-and-planetary-sciences/water-pollutant#:~:text=Water%20pollutants%20can%20be%20classified,sewage%20into%20the%20water%20bodies.

Possible Pollutants:

-Pathogens (bacteria, viruses)
-Parasites
-Algae
-Organic waste (fecal matter, etc.) (simulate with dirt)
-Toxic chemicals (chlorine, nitrates, fluoride) (fertilizer, toothpaste???)
-Lead, iron (how to simulate??? Stick to 'normal pollutants' and carcinogens?)
-Oil (HOW TO SIMULATE???)
-Mercury

Types of Filters

https://atlas-scientific.com/blog/water-purification-methods/
https://www.homedepot.com/c/ab/types-of-water-filters/9ba683603be9fa5395fab906724e001#:~:text=UV%20filters%20work%20without%20additional,filters%2C%20including%20faucet%20water%20filters.
https://www.open.edu/openlearncreate/mod/oucontent/view.php?id=80015&printable=1
https://www.aquasana.com/info/boiled-water-vs-filtered-water-pd.html#:~:text=Boiling%20water%20can%20only%20remove,dangerous%20than%20if%20left%20alone.
https://www.freshwatersystems.com/blogs/blog/what-is-reverse-osmosis

Major Tactic: Boiling

-Heat removes bacteria and other pollutants from water
-Has to be boiled hot enough and long enough to take effect!
-Will need to be filtered first (if cloudy, particularly dirty)
-Will NOT remove chemicals and some bacteria
-Deceased organisms may remain at the bottom
-Pretty good method overall, if paired with another tactic (filtration!)

Distillation

-Very thorough, will eliminate heavy metals and disease-causing organisms
-Very time-consuming and expensive (also needs a heat source!)
-Eliminates beneficial minerals
-Best for smaller amounts of water
-Works like science class taught you: water is boiled, and the vapourized steam is transferred to a chamber to condense

Disinfection

-Chlorine

-Effective way to purify water

-Used in emergencies where there are no other options

-Mild bleach solution is used (5% chlorine)

-Use tablets (must be used on HEATED WATER so it can dissolve)

-Not fully accessible (people with thyroid problems, cost (usually around 14-24 dollars)

-Iodine

-Very effective and fast

-Kills bacteria and viruses (doesn't remove solids, though)

-Adds undesirable taste to water

-If too much is added, it can be fatal

-ONLY USE AS LAST RESORT

-UV (deionization)

-Best with water with low turbidity (cuz it's light! It needs to actually hit the water)

-Extremely effective; can inactivate bacteria & viruses

Pros:

-Effective! Used in many developing countries

Cons:

-Water needs low turbidity (must be paired with another cleanser)

-Will also remove residual disinfectants, so more will have to be added

-Potentially less accessible (expensive! Cost is generally in the hundreds!)

Filtration

-One of the cheapest methods to purify water

-Does not deplete minerals in water

-Also a con: no method can remove dissolved properties from water (nitrates, heavy metals, etc.), and thus must be paired with another method

-Simple and fast

-Reverse Osmosis

-Basically just a bunch of filters one after another (so membrane, but gigachad)

-Pressure is applied to force water through the membrane

-Membrane must be very fine

Pros:

-Very effective

Cons:

-May also remove vitamins and beneficial metals

-Materials may not be widely available

-Rapid Sand Filters

-Rapid sand filters are the most commonly used filters
-Water goes through sand, which has a layer of activated carbon on it
-MUST be used with carbon! Otherwise ineffective

Pros:
-Easily cleaned and reused
-Fairly effective

Cons:
-Can only filter out any solids larger than the pore sizes between the sand (so no bacteria!)
-Can throw off chemical balance of water

-<u>Slow Sand Filter</u>
-Space effective
-Relies on biological processes rather than physical filtration
-Water flows through layers of sand (finest on top, coarsest on bottom)

Pros:
-Easy to build, doesn't take much space

Cons:
-Harder to maintain
-Requires skilled worker to handle

-<u>Membrane</u>
-Basically, water goes through a semipermeable membrane

Pros:
-Can operate under pressure or even in a vacuum

Cons:
-Depending on how permeable the membrane is, only some pollutants will be filtered

Testing Water Quality

-Water Testing Strips
-Turbidity sensor

<u>Influencing Factors:</u>
-Temperature
-PH
-Turbidity
-Metals
-Hydrocarbons
-Chemicals

Water Quality Standards - Canada & Global

https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/guidelines-canadian-drinking-water-quality-summary-table.html
https://www.who.int/teams/environment-climate-change-and-health/water-sanitation-and-health/water-safety-and-quality/drinking-water-quality-guidelines
-Water drinkable pH (world) is between 6.5 and 8.5

Pollutants to Use

-Chlorine → bleach?
-Fertilizers?
-Fluoride → toothpaste?
-Dirt
-Some type of pill? Human drug (but which one?)
-Salt

Common Waste Items

https://www.usatoday.com/story/news/nation-now/2018/06/27/ocean-beach-pollution-plastic-trash/738173002/
-Plastic (food wrappers, bottles (bottle caps), bags, straws…)
-Cigarette butts
-Foam take-out containers
-Search for melting point?
-Wet wipes → wash???

DECONTAMINATION:
https://www.areyour.org/en/2020/10/09/cleaning-and-decontamination-of-plastic-waste/

Another science fair idea that involves Python, the world water crisis, water filters, and carcinogens could be to develop a water filtration optimization system using machine learning and Python. The project could involve collecting water samples from different sources and testing them for the presence of carcinogens. Using Python, you could develop a machine learning model that analyzes the water quality data and identifies the most effective combination of water filters to remove carcinogens. The model could consider factors such as filter type, flow rate, and contact time to optimize the filtration process. This project would aim to address the world water crisis by providing an automated and data-driven approach to improving water filtration systems and ensuring the removal of carcinogens from contaminated water sources.

You can create a simple program using Python to simulate the effectiveness of different water filters in removing carcinogens from contaminated water. Start by researching common types of water filters and their filtration mechanisms. Then, using basic Python skills, you can create a

program that allows users to input the initial concentration of a specific carcinogen in water and select a type of water filter to simulate its filtration process.

The program can apply a basic mathematical model to simulate the filtration process based on the selected filter type. It can calculate the reduction in carcinogen concentration after passing through the filter and display the resulting filtered water quality.

To enhance the project, you can incorporate additional features such as comparing multiple filter types, displaying graphical representations of the filtration process, or even implementing a basic recommendation system based on the initial carcinogen concentration.

This project will allow you to demonstrate your understanding of basic Python programming while exploring the importance of water filtration in addressing the world water crisis and mitigating the risks associated with carcinogens in drinking water.

-boiling
-filtration
-distillation (diy!)

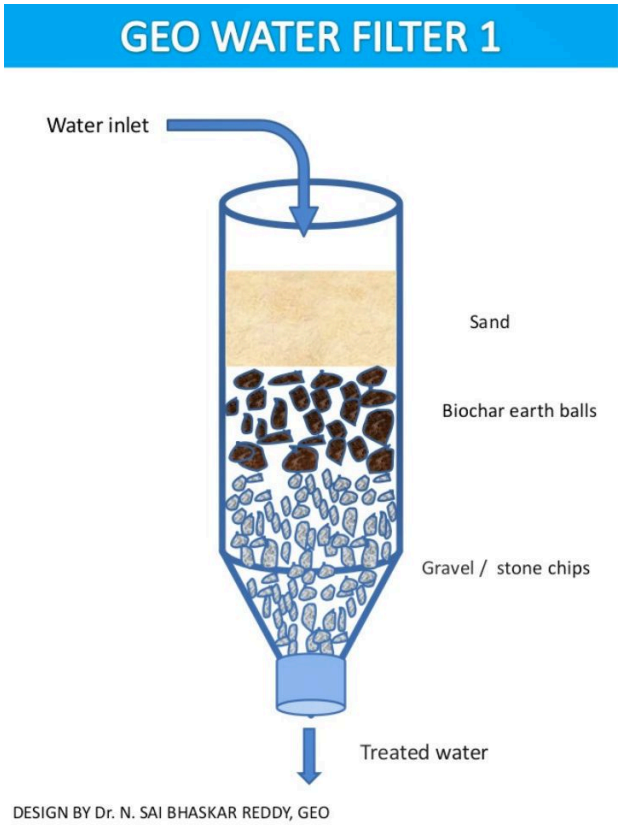
Python resources:
How to Work with CSV Files in Python: An Advanced Guide.
https://www.w3schools.com/python/matplotlib_plotting.asp
https://www.datacamp.com/tutorial/how-to-analyze-data-in-google-sheets-with-python-a-step-by-step-guide

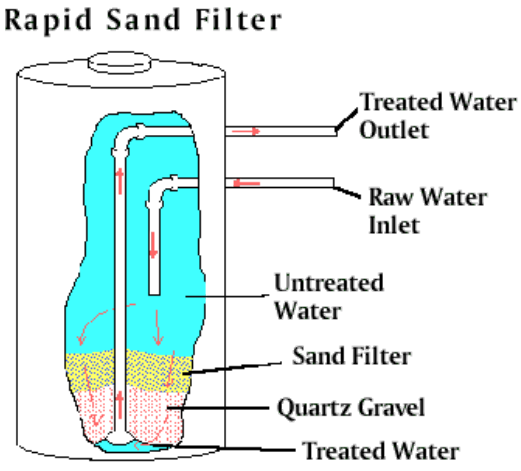
Filter Planning:
Carbon → can be replaced with biochar in actual thingy (food waste gone too!)

https://pinnguaq.com/learn/create-a-water-filter-from-recycled-and-natural-materials/
https://ourworldindata.org/grapher/most-common-waste-rivers-oceans
https://www.h2odistributors.com/info/how-to-make-a-water-filter/

For COARSE MATERIALS: wrap larger pieces of plastic with fabric or film?

Examples:


GEO WATER FILTER 1
Water inlet
Sand
Biochar earth balls
Gravel / stone chips
Treated water
DESIGN BY Dr. N. SAI BHASKAR REDDY, GEO


Rapid Sand Filter
Treated Water Outlet
Raw Water Inlet
Untreated Water
Sand Filter
Quartz Gravel
Treated Water

NOV

-Thought of project ideas

- Did background research in a variety of areas (current events & world issues, etc.): Research is key to understanding the current landscape and identifying areas where my project can make a difference.

- Eventually decided on something to do with water quality: Water quality is a crucial issue that affects communities worldwide.

- Listened to a thing on CBC, and was inspired to create an accessible way to filter water:

Nov 16: Came up with my final project idea after finding an article on the Indigenous water crisis. It was interesting to me that even though Canada has a lot of freshwater compared to other countries, there are still people who can't get clean water to drink. I was also inspired by the water shortage last summer in Calgary. My goal was to create something that had a wide range of applications.

- Start planning a project outline and started this logbook

Nov 23: Went through the logbook guidelines and made a to-do list of everything that I had to do so I wouldn't overlook anything. I also wrote an outline and consulted people for some ideas so I had a straightforward path to follow.

- First school science fair meeting occurred

DEC

-Started researching (research above!)

- -Water filtration methods
- -Common water pollutants
- -Water standards

Dec 7: Found out that Canada didn't really have clear-cut drinking water standards, which contributes to why the Indigenous population is still suffering from water issues. Instead, I looked at the WHO water standards. The main issue at this point was figuring out what to use to test the water.

- -AI (coding and applications)

Dec 18: I already had a vague idea of what I wanted the AI to do in my project outline. I continued researching AI models and started experimenting with some pre-made ones. This

was when I learned the difference between machine learning and AI, as well as deciding to code the neural network.

-Fleshed out schedule and started planning out logistics (samples, etc.)

Dec 21: Since it was winter, I decided to use snow as one of my main samples, as it was readily available. After researching common water pollutants and deciding on which ones I could obtain and which ones I would have to predict, I settled on fertilizer, disinfectants, and fluoride (the ban!) as my final choices, so they could correspond with the predicted stuff.

-Ordered necessary supplies

Dec 30: I tried to keep the budget fairly low on stuff I needed to order. I ordered the testing strips, as they came with pre-defined quality standards, as well as a mid-priced commercial water filter. For the activated charcoal, I bought the cheapest but legit-seeming option I could find, which was about $5.00. The total budget at the end amounted to about $50 CAD,

JAN

-Finished blueprint

Jan 5: I started drawing the draft, referencing common techniques that were used in many DIY water filters. I also realized that I would have to do more planning in terms of materials and coarseness.

Jan 8: I finally finished the good copy. After looking over the pollutants again, I decided to incorporate a distillation system into the filtration process. To figure out how to do this with household items, I did some googling and found a particularly helpful Youtube video. I labeled the layers and started the material acquisition. Also, the orders arrived! I can start actually experimenting now!

-More science fair meetings! The platform's up!
-Finished basic project info & Ethics 2A form

Jan 9: I went onto the platform and filled all the basic stuff out. I also started typing out the problem.

Jan 12: My ethics 2A form can only be approved if my project has a title, so I had to come up with one on the spot. After some suggestions from family and friends, as well as a little help from ChatGPT, I decided on one that I liked.

-Started (& finished) the actual filter

Jan 17: I got all the materials together and started building some stuff. I cut up the plastic bottle lids, which were surprisingly durable, and started wrapping them in fabric. I washed two Lysol Wipes for the finer quality fabric.

-Started sample collecting (I spent about 2 weeks on this)

Jan 20: I basically just walked around outside with a glass bottle. ONE glass bottle. I filled it with snow and put it in the sink. My sample collecting phase will have to be integrated with the experimental phase, as I only have one bottle. I also assessed the quality of the control. It's in a spreadsheet.

-Started the data spreadsheet & did more research on data analysation

Jan 28: I did the first experiment! I forgot to take a picture of the actual sample, though, so that's a pain. The distillation was more violent than expected. I found out that the results of the water testing strips start becoming unclear after about a minute after the testing, so I have to keep the computer close to the workstation.

Jan 30: I looked at some ways to analyze data using Python. I'm not sure if I have the time to code everything, with the neural network completely unstarted, so I might scrap the idea.

-Started coding the first dregs of the neural network

FEB

-Finished the experimental phase!

Feb 2: I did the experiment for the dirty snow and started getting stuff ready for the other samples. I soaked some Lysol Wipes in tap water. Hopefully that works.

Feb 3: It worked! I prepared the fertilizer sample. Washing the filter components after every round is pretty annoying. I have to remember to take pictures.

Feb 9: I finished all of the experimental stuff. I forgot to take a picture of the dirty snow sample, so I'll have to do that. I did take some photos of the filter in its stages of development, though. I made a graphic explaining the dist. setup.

-Put all the data into the spreadsheet, created a few graphs

Feb 14: It's valentine's day. I looked at the data and put it into mini-sheets to graph it. I'm not done with all the graphing, though.

Feb 15: The graphing is done now. ONTO the network!

-Most of this month was just coding the AI

Feb 18: I started coding the AI on Google Colab. I don't really use notebooks in my other projects, so I had to figure some stuff out.

Feb 23: A BIG coding day. I got the matplotlib worked out, but the sigmoid function isn't working because the sizes of the arrays are different. I tried to fix it, but it didn't work. I did more research.

Feb 25: I got it going. I still have to code the other half, though.

-Researched accuracy v precision

Feb. 28: I spent like 3 hours working on the network, because March is coming and the school science fair is on the 14th. I wanted to find the accuracy, so I did research on that and learned about confusion matrices. I then spent an hour figuring out how to express it on matplotlib.

-Researched AI and visualization
-Learned Pytorch techniques
-Did some data cleaning
-Researched other common water pollutants and decided what samples could be used to train the model
-Did extensive research on the makeup of lead, chlorine, and indus. Oil
-Finished coding AI, debugged a LOT

MAR

-2 weeks until the school fair!

Mar 1: There are less than 2 weeks until the school fair. I started working on my platform a lot more and started the trifold planning.

-More meetings
-Basically just did all the display elements
-Also finished training and testing the AI

Mar 5: This is late, but I finally finished training the AI. I got it to output stuff, which I put into the sheets.

Mar 6: I made graphs from the predicted data. I also remembered that project reports exist, so I started that.

-Put predicted data into a separate spreadsheet and made graphs

-Put everything (EVERYTHING) into the CYSF platform
-Started and finished the design for the trifold

Mar 10: I put everything into a printing doc for the trifold creation. I'll take advantage of the school's colour printer. In the meantime, I still have to finish the video for the platform.

-Started putting stuff together into a trifold doc for easy printing
-Took photos, had to get some samples again because I forgot to take photos of them originally
-Printed tri fold stuff at school
-Made a video

Mar 12: I was sick, so I had time to put the trifold together. It took like 8 hours. I like the outcome though. It's better than last year's.

-Put together trifold
-Refined and checked platform

Mar 13: I speedran the video using Capcut. My computer crashed in the middle, so I had to switch to another one, and the voice quality is really trash on that one. It is currently 3AM and the fair is tomorrow. Good luck, me.

-Tomorrow: school fair!

Mar 14: I made cities! Since the platform closes tomorrow, I looked over it and made final edits.