

CYSF Logbook

Contributor: Yatharth Trivedi

September 19, 2025

- Initially I came up with the idea of building upon my previous year's ionic wind thruster optimization experiment. The idea was to develop and apply a fully automated system for the device, yet after careful consideration, I dropped the idea due to the project's simplicity for a grade 10 level. I continued then to brainstorm and think of new projects, which is when I did some research and specified my testable question to: By what loading increments does the iron-oxide nanocoat quantity on biochar need to be adjusted with increasing salinity to maintain a constant phosphate adsorption percentage? The project aims to primarily address rapidly occurring eutrophication due to insufficiently treated wastewater releasing phosphate back into the environment. I researched what has traditionally been used in these systems and how biochar is being considered as a more cost-effective alternative. However, biochar cannot adsorb large amounts of pollutants on its own. Thus, magnetite nanocoats are oftentimes loaded onto the biochar surface to boost adsorption. I formatted these basic details and the issue this project addresses into a couple paragraphs. According to my research, varying salinity in the wastewater actually impacts the amount of phosphate removed. This means that the magnetite nanocoat loaded onto the biochar would need to be incremented to compensate for the reduced phosphate adsorption caused by increases in the salt concentration of the wastewater. Hence, relating back to my testable question which attempts to quantify the increment in magnetite required for each increase in salinity to maintain constant phosphate adsorption.

September 20, 2025

- I spent time researching the actual science behind the mechanisms as to how nanocoated biochar adsorbs phosphate and how fluctuating salinity within the wastewater impacts the process. Then, I formatted the research in a way that covers three key points required to understand the overall testable question. The three key points include the basics of biochar and magnetite, mechanisms explaining how nanocoated biochar scientifically adsorbs phosphate, and impact caused by increases in the salt concentration. Once the research was completed, I formatted all of the sources in APA 7ed.

September 29, 2025

- I made a quick 2 minute edit to ensure the testable question flowed smoothly and then formatted it alongside the background research on a separate Google Docs used to write the lab report for this entire experimental science fair project. Once this lab report is complete, I will start to transfer that information onto the CYSF platform.

November 7, 2025

- Reviewed the science fair proposal guidelines from the previous science fair, and answered some basic information about my new science fair project. I came up with a hypothesis in a if...then...because format, outlined my experimental design, and described the variables, all based on the information gathered from the background research. Next, I will be discussing these plans with the science fair coordinator at my school so that I can proceed to filling out basic project information and receiving ethics approval from CYSF.

November 14, 2025

- Had a quick chat with the science fair coordinator to go over the project details. Mr. Buhler, the science fair coordinator, then registered me on the CYSF Platform in order to request ethics approval while providing basic information on the project.

November 16, 2025

- Prior to submitting on the CYSF platform, it came to my attention that I also should identify the issue my project addresses and attempts to solve (which I had already written about as part of the background research conducted before). In my case, the primary issue was to address rapidly occurring eutrophication by further streamlining municipal wastewater treatment in order to ensure constant phosphate removal despite varying salt concentration levels present in the effluent. Additionally, there were other issues that my project addresses, but I will include this in the application section of the project. Afterwards, I submitted the request for ethics approval and now I'm waiting to hear back.

November 19, 2025

- I continued work on the project by elaborating on the variables section. For example, I did have my control variables listed, but I elaborated by justifying why these variables should be controlled opposed to simply listing. Next, I started specifying my materials list and researching types of biochar, iron-oxides, etc. I also specified the magnetite loading increments I will be manipulating during testing and specified that the responding variable of the phosphate adsorption will be measured using a digital phosphate test meter (MW12).

November 20, 2025

- I continued research on the available materials and started a list. Primarily, I focused on exploring the different types of biochar as it was important that the texture and particle size of the biochar is controlled. This means that fine-grained biochar powder best meets these control requirements opposed to other types of irregularly-textured biochar containing unprocessed materials such as wood chips. Once I found the biochar I was looking for on Amazon, I proceeded to search for the other required materials for the experiment and add them to the list.

November 26, 2025

- I ordered the materials and am expecting everything to arrive by December 15, 2025

December 3, 2025

- I got started on planning out the general experimental design for the project. I focused on dividing the design into distinct parts such as preparing the biochar samples, preparing the testing phosphate solutions with varying salt concentrations, and planning the phosphate adsorption testing. Once I had the general experimental design created, I contacted Dr. Tejas Oza, an expert in the field to discuss the overview and receive suggestions for improvement. Dr. Oza's primary recommendation was a more scientifically appropriate method to nanocoat the biochar samples with iron-oxide. The recommended method involved combining both biochar and iron-oxide in a slurry and then setting to dry in the same shapes.

December 7 and 8, 2025

- Based on Dr. Oza's recommendations, I adjusted the experimental design. Next, I formulated these ideas into a detailed and sequenced procedure that someone could follow to replicate the experiment. The procedure was also divided into three distinct parts similar to the experimental design for enhanced organization. I ensured that the steps in the procedure were written using descriptive and accurate wording to avoid confusion for the reader.

December 21, 2025

- I started to carry out the testing procedures. The first step in the experimentation was to prepare the biochar samples which required time to dry. Thus, according to the procedure I prepared the control biochar samples and set them to dry. Next, I proceeded to prepare the nanocoated biochar samples for which the nanocoat quantity was adjusted per group as per the procedure. These samples were also set to dry.

December 22, 2025

- Today I finalized all of the prepared samples so that each group was dried properly and ready for testing. Before proceeding, I double-checked the labeled beakers and confirmed that all of the mass measurements matched the procedure. I also prepared the salinity solutions by measuring out the salt increases (of 100mg/L) and dissolving them into the phosphate stock solutions. I recorded all the volumes and made sure each solution was mixed thoroughly to avoid concentration inconsistencies. By the end, all the solutions and materials for the adsorption tests were fully ready.

December 23, 2025

- I carried out the initial adsorption trials for each sample group. This involved adding the dried biochar samples to their respective phosphate-salt solutions and maintaining the constant mixing time outlined in the procedure. I monitored the samples periodically to lightly agitate a few of the beakers to keep the solids suspended where possible. After the adsorption period finished, I carefully filtered each sample. The filtrates were stored in labeled containers so I could measure the remaining phosphate concentration later.

December 24, 2025

- I completed the spectrophotometric measurements for the first round of samples. I followed the same calibration procedure I practiced earlier, including preparing a fresh standard curve. Each filtrate was tested three times in order to reduce random error and average out any inconsistencies. Once I had the absorbance values, I converted them to concentration using the new calibration curve and entered all results into my data table. From initial observation, it already seemed clear that increasing salinity lowered the adsorption percentage for the control samples, but the nanocoated samples performed differently depending on the amount of magnetite loading. It is important to note that I made sure to fill in the data table for trial 1 of the experiment as the testing was conducted. I collected and formatted all the measured data on the table and left the column for the phosphate adsorption percentage blank as it requires calculations to be performed. These calculations can be performed after the testing using the collected data recorded on the table.

December 26, 2025

- Since the first trial went smoothly, I repeated the full testing process for a second and third round to ensure reliability. This included preparing fresh phosphate-salt solutions, re-confirming the sample masses, and repeating the entire adsorption and filtration process. I kept all time intervals identical to the first trial. Once the filtrates were ready, I stored them the same way as yesterday, making sure no cross-contamination could occur. In the meantime, I performed the phosphate adsorption percentage calculations for trial 1.

December 27, 28, and 29, 2025

- I ran all spectrophotometer measurements for the second trial and third trial and averaged the values between trial 1, trial 2, and trial 3. I then calculated the phosphate adsorption percentages for each group. The trends became more noticeable after averaging: higher salt concentrations caused clear drops in adsorption for the uncoated biochar, but the nanocoated groups responded differently depending on how much magnetite they had. The samples with the mid-range magnetite loading seemed to maintain adsorption more consistently than both the low-loading and high-loading groups. I wrote brief notes describing these trends so I could refer back to them during the analysis phase. It is

important to note that I made sure to fill in the data table for trials 2 and 3 of the experiment as the testing was conducted. For these trials, after the testing was done and the area was cleaned, I performed the phosphate adsorption percentage calculations shortly after and recorded the results in the appropriate column on both the tables (labelled “phosphate adsorption percentage”).

January 1, 2026

- I created a new data table and averaged all the collected data from each trial. The table was of identical format compared to the other tables, but the inputted data was the average of all three trials.

January 2, 2026

- I spent some time exploring different graph types and ended up finalizing a scatter plot. Using Google Sheets, I transferred all of the collected from each trial onto a distinct graph and created a fourth graph for the average data. For the analysis and conclusions I primarily plan on referring to the average graph when making statements that require evidence from observations. Once all four of the scatter plots were created, I decided to add a trend line which ended up being a curve. The added trend line helped visualize patterns and trends within the data, as well as spotting any evident outliers.

January 3, 2026

- I started writing the analysis section. I summarized how the data lined up and explained possible scientific reasons for any unexpected results. I included comparisons between groups and linked each observation back to the background research I collected earlier. I also described sources of error such as minor inconsistencies in filtration speed, small temperature fluctuations in the room, and the possibility of uneven coating thickness between samples.

January 5, 2026

- I continued analyzing the data and spotted two major outliers for which I decided to highlight in my write up. I used specific evidence from the trials to explain why those values are considered to be outliers. Lastly, using the potential sources of error, I suggested possible reasons for these outliers.

January 11, 2026

- I completed the conclusion. I restated the testable question alongside my hypothesis predicting that a magnetite loading increment of 2.00g will yield a constant phosphate adsorption percentage. My hypothesis was proven incorrect by the data. All in all, to

most accurately answer the testable question, a moderate loading increment of 1.50g, starting from 0.50g, maintained adsorption most consistently across salinity levels. This was evident in the data because with a magnetite loading increment of 1.50g, the phosphate adsorption percentage remained relatively similar to the control value of around 95.9%.

January 12, 2026

- I described potential applications for the data collected from this experiment in fields such as wastewater treatment, agriculture, and aquaculture facilities. Next, I indicated how this experiment could be expanded, such as testing finer increments of magnetite or including real wastewater samples instead of controlled lab solutions. Lastly, I highlighted future improvements such as more trials that could be applied to the project to further refine the data collection.

January 27, 2026

- Today, I formatted all of the science fair write-ups pages to ensure they were ready for printing and putting onto the trifold. I started by transferring the information into Word in which I expanded the page margins for maximum readability. Then, some pages such as the analysis had more information, therefore I applied A3 (large paper) sizing to those specific pages and left the remaining in A4 (regular paper) size. Lastly, I had certain pages in landscape while the remaining were in portrait depending on the information present best utilizing the paper space.

January 28, 2026

- I printed the online pages in the appropriate size and started to lay out on the trifold. Once the trifold plan was finalized, I started to officially attach colored posters for the background and the information pages on top. I was able to finish putting together the entire trifold today.

January 29, 2026

- I started transferring all of the information from the write-up onto the CYSF platform. All of the information I had successfully matched into its respective experimental project component on the CYSF platform. Once all the information was transferred into the correct sections, I realized that the data tables could not be formatted properly and glitched out on the platform when I tried saving. Therefore, I transferred the data tables to a separate Word document and then downloaded the document so that I could upload it onto the CYSF platform. The uploading of the table allowed me to visually display the

quantitative observations without the formatting glitching out upon saving. This is why you might see all of my data tables as images on the CYSF platform project display.

February 2, 2026

- I prepared and recorded a video presentation of the entire project. I then uploaded this onto the CYSF platform. To finish off, I also made sure to write the acknowledgements of all the individuals who helped me along this project. Lastly, I completed the declarations on the CYSF platform.