Hello everyone,

Thank you for your interest in my email series! I am very excited to share what I have been learning over the past couple of months.

In these emails, I will try my best to explain topics that I have enjoyed learning and I will attach hyperlinks to youtube videos that I find interesting about the topic.

Please feel free to reply to these emails! (However, please just reply back to me, so as not to bombard everyone's inboxes.)

Here it goes…

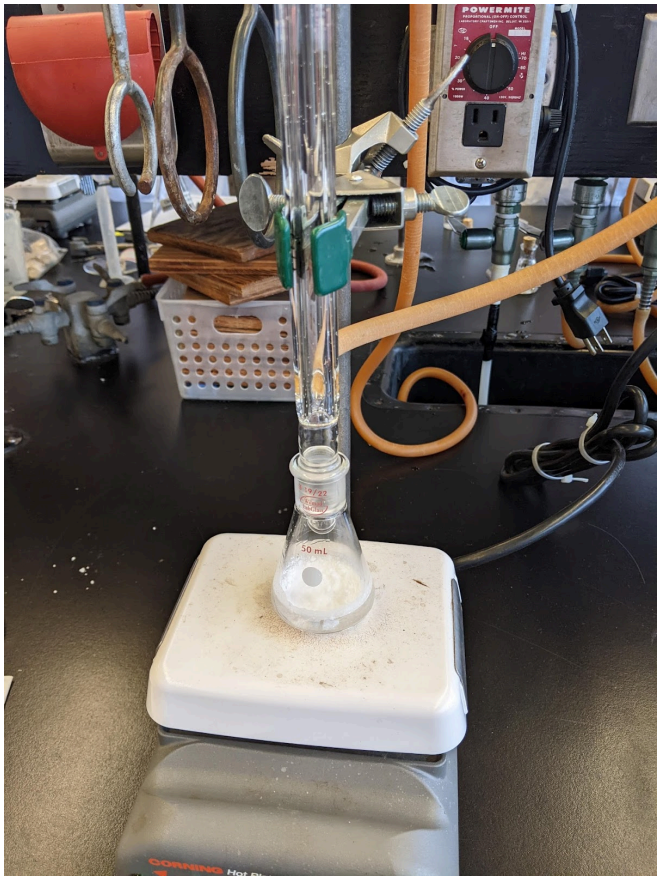
1. CHEM 233: Organic Chemistry Laboratory

The first class I'd like to introduce is my organic chem laboratory course! So far, it is my most enjoyable course as it is mostly hands-on work. I've learned to use a lot of cool techniques to study and isolate compounds.

In one of my previous experiments, I was given a homogenous mixture of two unknown compounds. By the end of three subsequent lab sessions, I had to separate and identify the two unknown compounds. A major hint that was given to me was that one of the compounds was acidic, while the other was neutral.

In order to separate the two compounds, I used a process called liquid-liquid extraction that essentially dissolved the unknown compounds with two immiscible liquids (two liquids that are heterogenous/do not mix with each other: ie. water and oil). Since I knew that one of the compounds was acidic and one neutral, I chose liquids that dissolved each compound individually (one liquid dissolved the acidic compound, while the other liquid dissolved the neutral compound). From there, I separated the two unknown compounds with a rotary evaporator to evaporate the liquids they were dissolved in so that just the unknown compounds remained.

After separating the compounds, I used recrystallization to purify the compounds. I needed to recrystallize the compounds to remove any impurities in them so that I could get the most accurate results when analyzing the properties of the compounds so I could identify what they were.



Above is a picture of my recrystallization set-up. During recrystallization, all of the compounds (both the pure substance and its impurities) are dissolved in a solution. The solution is slowly cooled, allowing the desired compound to crystallize out of the solution, while the soluble impurities remain in the solution. You can see in my image above that my solution is being heated up with a giant glass tube above it. The giant glass tube is hollow and has cool water running through its perimeter so it acts as a condenser that prevents the solution from evaporating into the air.

Here are some pictures of the crystals I generated:

Finally, after removing the crystals from the solution and taking their respective melting points, I concluded that my two unknown compounds were Salicylic Acid and 2,4,6-Tribromoaniline by comparing the values with literature.

Anyway, all of these lab techniques described above are just some of the things I've been learning in my organic chemistry lab course. I hope to take some more chemistry lab courses in the future as I find them quite fascinating. Now, onto other things I've been learning…

2. ELEC 221: Signals and Systems

This class is by far, my most difficult course this semester. However, it also teaches me the most applicable knowledge for the engineering industry. The objective of this course is to teach me to analyze and modify signals. As a simple example, how does a landline phone know how to convert someone's voice into a signal, transmit it through a wire, and output it as an audible signal to the receiver?

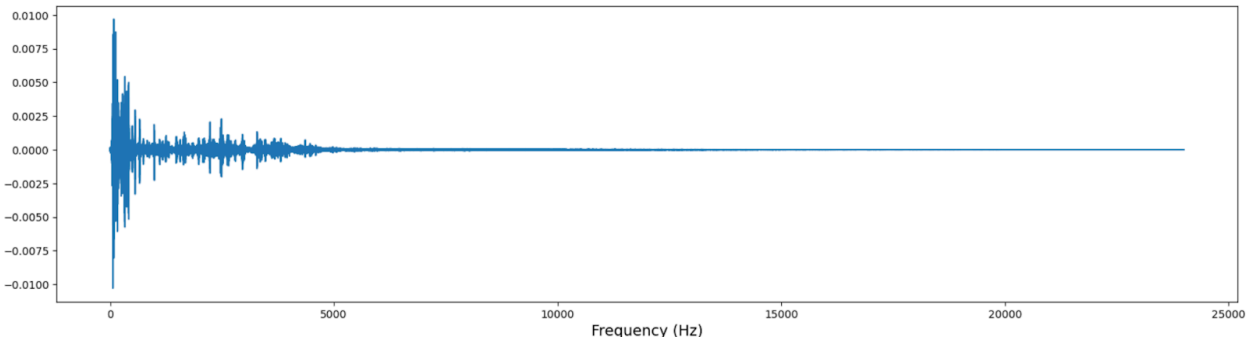
The applications of signals are endless and super cool. In this course, I've been able to experiment a lot with audio. For example, I've been able to create varying filters for audio signals, ie. cutting off all of the low frequencies in a song so that there is no more bass; or modulating the frequencies of a song so that it sounds like the whole song is being played/sung with vibrato.

Essentially, an audio signal can be expressed in two different ways. Firstly, it can be expressed as a signal in the time domain (how audio signals are typically thought about in normal life).

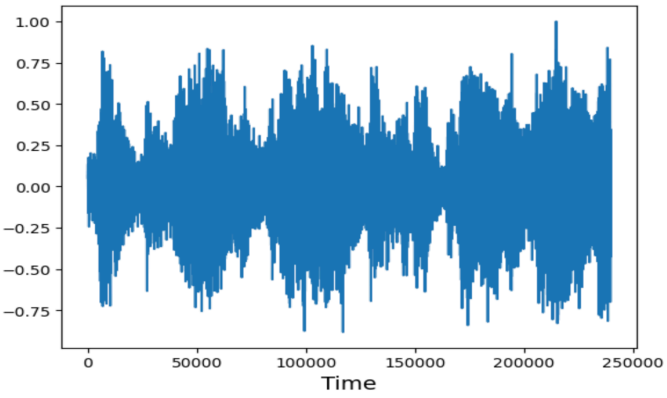
For example let's look at the song Octopus's Garden by the Beatles. At time = 0, there is no audio, but soon enough you hear the electric guitar go *badadadadadada ba ba bmmmm.* Maybe at time = 2 minutes, you hear the lyrics, *I'd like to be, under the sea, in an Octopus's garden, in the shade.* This is what I mean by a signal being expressed in the time domain.

Secondly, an audio signal can be expressed in the frequency domain. As we know, a certain sound has a specific frequency to it. For example, the middle C has a frequency of 256 Hz. These varying frequencies allow us to hear varying pitches. So in Octopus's Garden, there are various different frequencies in the song. Some of the frequencies correlate to the vocalist singing the lyrics, others the strums of the electric guitar, etc.

So in my assignment, I used python to perform to convert the opening of Octopus's Garden (using the Fourier Transform) to look at all of the frequencies present in the song! The graph below shows what frequencies are present: (x axis = frequencies present; y axis = how much of each frequency is present… bigger spike = more frequency present in song)



Compare this with plotting Octopus's garden in the time domain where the x axis shows the time and y axis shows the amplitude (loudness) of the song at that point!



I have attached a file below that shows how I created a low pass filter (a filter that only allows low frequencies through and removed high frequencies) to remove the vocals from a song. Please have a look at it below and email me back if you need any help opening it :) (I used Jupyter Notebook but can be opened with VS Code, Spyder, etc.).

If you are particularly interested, I can also send you all some functions that remove other select frequencies, or code that can create 'vibrato' in a song with modulation so you can have some fun experimenting with audio.

To ensure that this email is not too long, I will finish off here! In my next email, I will share some of the fascinating things I've been learning in my other classes.

Anyway thank you all for reading and I hope you all have a great day.

See you all soon,

Lillian