**Why I’m writing this chapter**

Early on in my PhD career, my advisor inspired me to train my brain to learn at the highest level with a simple credo: know what you don’t know.

To think about what you know so deliberately that you’re able to figure out what there is left to learn. And it’s worked: I’ve finished my research and am working to publish my research to put down my infinitesimally small stamp in history. The PhD finish line is full of triumphs: a published paper, a final defense to showcase and explain your research, and recognition as an academic expert.

But my PhD wasn’t straight forward. I picture it as a personal journey: traversing the valleys and mountains of knowledge about cell membranes and biophysical forces. Sometimes, trekking and running energetically through a field of fluorescent green flowers. But more often, barely learning anything and feeling completely stuck, as if trudging through multiple feet of snow in the dark. And through all the pushing and pulling, dragging myself through the knowledge, I’ve ended up learning more than just the science.

So when I saw the opportunity to write a chapter about “the parts of the story of science that don’t get told in scientific publication”, I felt moved to write.

**Sonder**: the realization that everyone has a life as real and full as your own. It’s one of my favorite words, expressing how connected we are as humans, going through our own emotions and personal turmoil, figuring out our lives as we go. Research is typically presented without mentioning the rigorous mental fortitude, the exhaustive emotional toll, the strains on life that it takes to succeed. But with this opportunity, I wanted to flip that narrative and share some of the mental and emotional swings of my PhD journey.

10 years from now, I’m not sure how I’ll feel about graduate school. 7 whole years. A project that brought me deeper into the niches of science than I ever thought I could go. What is van der Waals packing anyways? This miniscule attractive force that relies on the periphery of atoms in space. Investigating subatomic interactions within both theoretical and physical experimentation and making sense of the results. And here, finally at the end, realizing that my thesis is a translation of my findings that this superficially nanoscopic (it’s actually smaller!) force has on membrane protein folding and association. Discovery and novelty are extremely difficult to quantify.

So what does it mean to become an arbiter of this seemingly immeasurable and imponderable academic knowledge?

Thank you to SciFun, Wisconsin Initiative for Science Literacy (WISL), and WISL staff for allowing me this opportunity to write and share these transparent reflections on my PhD. Thank you to Professor Bassam Shakhashiri, Cayce Osborne, and Elizabeth Reynolds, for helping me to develop and analogize the bits of science included in here! helping me to fine tune my drafts for the inclusion in this thesis, critiquing! And thank you to my friends for sharing their thoughts and insights and helping me to put something coherent and hopefully interesting together: Diego Lanao, I truly cannot thank you enough for the help!

Thanks again for reading, and best of luck on whatever journey you are currently facing. Sending love and good vibes your way :D.

**Glossary**

Sonder – realization that everyone has a life as real and full as one’s own

Protein – molecules necessary for many important biological functions: supporting cells, building immunity, sensing changes in environment

Membrane protein – proteins found in the cell membrane (the biological membrane that separates the inside of the cell from the outside environment); important for helping cells adapt and react to change

Associate/Association – when two proteins stick together, like partners coming together in a choreographed dance

Computational model – way to visualize what a protein looks like

Van der Waals packing – “static” like attraction between proteins in close contact

Algorithm – sequence of instructions that I made to build models of proteins with different amounts of “static”

Petrichor – the smell of rain

Gjetost – Scandinavian cheese that tastes like caramel

Tsundoku – the art of buying books and never reading them

Frisson – aesthetic chills, psychogenic shivers; commonly tingling of the skin when listening to music

Imposter Syndrome – internalized feeling of doubt in one’s skill, talent, or intelligence; feeling like you don’t deserve success and that much of it is attributed to things out of your control

Burnout – state of emotional, mental, and physical exhaustion brought on by prolonged or repeated stress

Etterath – the feeling of emptiness after a long and arduous process is complete

Smiling depression – someone living with depression on the inside while appearing perfectly happy or content on the outside

**And some words that don’t make it in but are fun anyways because I have the space:**

Zarf – coffee sleeve

Leitmotif – short, recurring musical theme accompanying a person, place, or idea

Lessons from my PhD

[I do](#_Toc166003668)

[It’s so hard to swim against the tide](#_Toc166003669)

[The world sayin’ what you are because you’re young and black, don’t believe ‘em](#_Toc166003670)

[There will be mountains you won’t move](#_Toc166003671)

[I don’t belong here, let me start over, I wanna sleep so wake me up when I’m older](#_Toc166003672)

[You build it to a high to say goodbye because you’re not the same as them](#_Toc166003673)

[Where’s my soul going?](#_Toc166003674)

[Time has come, take it all in](#_Toc166003675)

[Into the Woods](#_Toc166003676)

[Why don’t you leave if you wanna leave, if you wanna?](#_Toc166003677)

['Cause is it really love if it don't tear you apart?](#_Toc166003678)

[And we keep doing these things, not because they're guaranteed to make us feel good But because failing to do them? Guaranteed to make us feel bad](#_Toc166003679)

[You don't cross my mind, you live in it](#_Toc166003680)

[I’m trying to start my life again](#_Toc166003681)

[Spotify Playlist Link](https://open.spotify.com/playlist/7uCMwIdmgFSFA8ZWYnkQas?si=9c3295a8377b4c9d)

A qr code on a white background

Description automatically generated

**A letter always seemed to me like immortality because it is the mind alone without corporeal friend.**

― Emily Dickinson

I do

Flipside-postlude by Kid Quill

Dear Reader, April 2017

What do you want to be when you grow up?

I’ve answered multiple variations of this question over the years: What subject are you majoring in? What’s next after college? Do you want to go to medical school?

I’m a first-generation Haitian-Filipino American, and no one in my immediate family is a scientist. Yet the security of becoming a medical doctor to make money and have a reliable job was preached as the ideal route in the immigrant community I grew up in.

I chose to major in biology to assuage my curiosity to better understand how life works. But I took most of the same classes and learned many of the concepts necessary for medical school. Deep down, I knew that the route I was taking could result in me becoming a doctor. It felt like I was too afraid to run away from the expectations that the adults I grew up around had for me.

So when my undergrad mentor told me that a PhD might be a good fit for me, I was befuddled yet elated. I’d been rejected from several research labs during college, and I didn’t even know that PhD programs existed until my junior year. But I think he saw my passionate curiosity to learn: this deep-seeded interest in diving into subjects and a willingness to bang my head against a wall full of knowledge. I applied, and I’ve recently been accepted to a program at the University of Wisconsin-Madison!

I’m not particularly gifted, I end up being average at everything I do, and although I wanted to help people from a young age, I couldn’t see myself going to medical school at this stage in my life. But my fascination with how to learn and to apply knowledge between different areas of learning might fit well in a PhD. This potential route to become a doctor, despite not being a “real” doctor, feels semi-validating, and for now soothes those immigrant expectations inside of me. College didn’t prepare me for the real world, but I’ve acquired a passion for learning, and it seems that this PhD doctor is going to be an exciting journey for me!

Gilbert

P.S. …

P.P.S. **Frisson**: The aesthetic chills from the layering of instruments, the tingling up your spine from hypnotic harmony, engulfing you in tantalizing bliss. When I close my eyes and listen to music, I feel the sounds pouring into my being, as if my body is literally resonating. Some of these letters might be convoluted, but I hope you’ll understand my feelings by listening to the music!

P.P.P.S.This song is about wanting to be heard. About having bold ideas and passions, wanting to share. I’m hoping that a PhD will allow me to cultivate ideas, determine my strengths in learning, and allow me to confidently share something that I’m passionate about with the world.

It’s so hard to swim against the tide

Swim Against the Tide by The Japanese House

Dear Reader, October 2017

Graduate school classes have a conversation-like feel. Instead of lectures where professors talk about a subject for an hour, classes are focused on maximizing time to discuss what we as students are most curious about.

Recently, one professor posed a personal question: What are your goals with your graduate education?

“Gilbert, what about you?”

“I’m not sure.” I’ve never been good with public speaking, I never raise my hand in class, and being called on is *extremely* uncomfortable.

“That’s okay, just say anything that feels right.”

With that little bit of encouragement, I used my avoidant gaze, stared at the ceiling, and thought. *What could I do?*

“I want to find a way to replace PowerPoint.”

“Okay! Why is that?”

“I feel like there are some weaknesses in how it communicates concepts, and I think there would be some benefits to having something better.”

In biochemistry, there’s a technique called polymerase chain reaction, or PCR. Using our knowledge of how DNA replicates in cells, we’re able to effectively replicate DNA with PCR! But how did we come up with something that is now so fundamental in scientific research and important in forensics to identify people by any trace left behind? Kary Mullis, the inventor of PCR said it best: “I was looking for something else…PCR was the possible outcome of a solution to a hypothetical problem that didn’t really exist.”

The best science comes from harnessing creativity, trying to see things that haven’t been imagined, and discovering questions that haven’t yet been answered.

How does van der Waals packing impact membrane protein association?

Research doesn’t look for a specific answer. Rather, it focuses on understanding why things are as they are. My mind is racing, questioning what I know about my project, striving to delve deeper into membrane protein research. What sticks with me is that my professor gave me the opportunity to share an idea of an idea. I was encouraged, allowing my mind to drift towards something creative and fantastical. Asking “why” helped me feel comfortable in a situation that I otherwise wouldn’t enjoy. It helped me grow. And although it currently feels impossible, this journey into the unknown reaches of science is beginning to feel a little more comfortable.

Gilbert

P.S. How often do you go outside of your comfort zone?

P.P.S. Grad school is showing me that personal growth is enhanced when outside of your comfort zone. Whether it’s getting called out in a class and answering with something that sounds outlandish, or moving to a state where sometimes the temperatures reach an unimaginable -40 degrees (which is the same in both Fahrenheit and Celsius!), there are a variety of ways to get outside of your comfort zone to grow! Why does Gjetost exist, why does it taste like caramel, and why the heck does it taste so delicious? By harnessing creativity and learning when to ask why, I’m hoping to find my stride on this journey for discovering knowledge.

The world sayin’ what you are because you’re young and black, don’t believe ‘em

Outside by Childish Gambino

Dear Reader, September 2018

I was chatting with someone recently about TV shows. They were surprised that I had never watched *How I Met Your Mother* and *Arrested Development*.

“Why not?”

“Honestly, there are too many white people in them.”

A couple of days later, they recounted the conversation: “I looked up the demographics in those shows, and they don’t skew too far from the US population.” They didn’t understand that those shows aren’t likely to portray experiences I can relate to. Why didn’t they just ask me to clarify?

As a person of mixed descent, I’ve found it difficult to figure out how I belong. How do I fit in this world while being myself? What’s the correct answer for surveys asking for my ethnicity? I love sharing culture, ideas, listening to a wide variety of perspectives with little judgment. But why don’t I know who I am? Why do I feel like an outsider?

In science I’ve often felt the same. Entering a biochemistry program after majoring in biology, my transition has been a bit more arduous than expected. I’m finding it difficult to communicate how I understand science with the wording and depth that people need to understand it. As if the words I’m saying don’t mean what I think they mean.

*What knowledge am I missing? Do I have the ability to navigate the field of biochemistry? Do I even belong here?*

**A comic strip of a person

Description automatically generatedImposter syndrome**: a persistent, unjustified feeling that one’s success is fraudulent. Because I know how the world perceives me by the color of my skin, I can quickly spiral into a mix of other negatives: *I’m a token minority for my program to look good, people don’t understand me because I’m just not smart enough to be understood, if I wasn’t a minority I wouldn’t have been accepted, I don’t deserve to be here.*

In both my personal and professional life, I feel like an outsider. Isolated away from people who are like me.

*Does that feeling ever go away?*

Gilbert

P.S. When was the last time you felt you didn’t belong?

P.P.S. I thought coming here would allow me to feel more comfortable because I’d find more people who question things. People who want to learn by challenging the norm and developing insights into other people's unique experiences. So why does it often feel like I have to conform to what other people expect of me rather than being given the chance to share my own identity?

There will be mountains you won’t move

Godspeed by Frank Ocean

Dear Reader,

In the previous letter, I mentioned reflected on how a conversation about TV shows made me feel like an outsider. It amplified my feelings of imposter syndrome in science.

I can’t change how people see me or treat me, but I’m still trying to treat others the way that I want to be treated. We all deserve to have opportunities to share our thoughts and feelings, likes and dislikes. So before getting too deep into some of the mental anguishes of grad school, I wanted to share some of the things that helped break up my grad school journey, keeping me going as distractions or helping me to reflect on my grad school journey.

|  |  |  |  |
| --- | --- | --- | --- |
| **TV** | **Animation** | **Movies** | **Games** |
| [Devs](https://en.wikipedia.org/wiki/Devs_(TV_series))  [The 100](https://en.wikipedia.org/wiki/The_100_(TV_series))  [Euphoria](https://en.wikipedia.org/wiki/Euphoria_(American_TV_series))  [Mr. Robot](https://en.wikipedia.org/wiki/Mr._Robot)  [House MD](https://en.wikipedia.org/wiki/House_(TV_series))  [Sex Education](https://en.wikipedia.org/wiki/Sex_Education_(TV_series))  [Hearstopper](https://en.wikipedia.org/wiki/Heartstopper_(TV_series))  [Ted Lasso](https://en.wikipedia.org/wiki/Ted_Lasso)  [Atlanta](https://en.wikipedia.org/wiki/Atlanta_(TV_series))  [Pen15](https://en.wikipedia.org/wiki/Pen15)  [Dave](https://en.wikipedia.org/wiki/Dave_(TV_series)) | [Inside Job](https://en.wikipedia.org/wiki/Inside_Job_(2021_TV_series))  [Plastic Memories](https://en.wikipedia.org/wiki/Plastic_Memories)  [Bojack Horseman](https://en.wikipedia.org/wiki/BoJack_Horseman)  [Cyberpunk Edgerunners](https://en.wikipedia.org/wiki/Cyberpunk:_Edgerunners)  [Frieren: Beyond Journey’s End](https://en.wikipedia.org/wiki/Frieren)  [The Dragon Prince](https://en.wikipedia.org/wiki/The_Dragon_Prince)  [Scavengers Reign](https://en.wikipedia.org/wiki/Scavengers_Reign)  [Girls’ Last Tour](https://en.wikipedia.org/wiki/Girls%27_Last_Tour) | [Waves](https://en.wikipedia.org/wiki/Waves_(film))  [The Farewell](https://en.wikipedia.org/wiki/The_Farewell_(2019_film))  [Lady Vengeance](https://en.wikipedia.org/wiki/Lady_Vengeance)  [Sorry to Bother You](https://en.wikipedia.org/wiki/Sorry_to_Bother_You)  [Portrait of a Lady on Fire](https://en.wikipedia.org/wiki/Portrait_of_a_Lady_on_Fire)  [BlacKkKlansman](https://en.wikipedia.org/wiki/BlacKkKlansman)  [The Fallout](https://en.wikipedia.org/wiki/The_Fallout_(film))  [Nimona](https://en.wikipedia.org/wiki/Nimona_(film))  [Soul](https://en.wikipedia.org/wiki/Soul_(2020_film)) | [NBA 2K](https://en.wikipedia.org/wiki/NBA_2K)  [Nier: Automata](https://en.wikipedia.org/wiki/Nier:_Automata)  [Animal Crossing](https://en.wikipedia.org/wiki/Animal_Crossing)  [Fire Emblem: Three Houses](https://en.wikipedia.org/wiki/Fire_Emblem:_Three_Houses)  [Zelda: Tears of the Kingdom](https://en.wikipedia.org/wiki/The_Legend_of_Zelda:_Tears_of_the_Kingdom)  [Persona 5 Royal](https://en.wikipedia.org/wiki/Persona_5)  [Journey](https://en.wikipedia.org/wiki/Journey_(2012_video_game)) |

**Tsundoku**: the art of buying books and never reading them. I didn’t get to read much other than scientific journal articles…but I’ll get to books eventually!

Hope you’re well and taking time to take care of yourself!

Gilbert

P.S. If a friend asked you to give them something so they could know you better, what would you give and why?

P.P.S. A few highlights from the above lists without spoiling too much

**Devs** – computers are God & the [soundtrack](https://open.spotify.com/album/5zxOIozK7nGNtXoDdVchg6?si=gUhIcDIJSVSXlM9h2DXIng) is DEEP

**Plastic Memories** – falling in love with a limited amount of time

**Waves** – tragedy befalls a minority family; dope [music](https://open.spotify.com/playlist/4RCcwSpuTaOntENcvYQuET?si=f13596f94575453a)

**Girls’ Last Tour** – children on a post-apocalyptic journey

**Sorry to Bother You** – examples of black politeness/model minority

**Nimona** – highlighting identity & self-discovery

**Animal Crossing** – cottage core that helped get me through COVID

**Zelda** – the water temple mechanics & intensity of the ending sequence

I don’t belong here, let me start over, I wanna sleep so wake me up when I’m older

atlas by Keshi

Reader, May 2019

Today I had my preliminary exam, or prelim for short. It’s the most unique exam I’ve ever taken: After a year of conducting independent research and reading a copious number of academic papers, I prepared a presentation detailing how I’m going to successfully complete my research.

I was put into a room with my advisors – 5 professors who I’ve asked to supervise my progress during my PhD. I explained a carefully thought-out research proposal to these professors who have *many* scientific publications to each of their names. I stood in front of them talking about the beginnings of my project, sharing my ideas to bring this research to completion. They asked me detailed questions, expecting me to think on my feet and to come up with reasonable answers.

“What’s the definition of van der Waals? What will you do if your experiments don’t work as you expect? If a tree falls in a forest and no one is around to hear it, does it make a sound?” After an hour and a half, I left the room to allow my advisors to discuss.

Deflated, exasperated, mind afloat, I remembered to breathe

“Did you just finish your prelim?” I nodded to the student passing by in the hall. “Congrats, the worst part is over.”

27 minutes of sitting on the floor later, I’m called back into the room

“Gilbert, we’d like to thank you for the presentation, but we can’t give you a pass. There are some weaknesses…”

But I tuned the rest out. They didn’t say the word, but I knew what it meant.

i failed

“…however, you’re making progress and we look forward to seeing you have another opportunity next year.”

I cried for an hour in that windowless, dimly lit room. I didn’t want to exist.

**1. For many prelim failures, there is no second chance. You’re given a master’s degree and asked to leave.**

**2. I have a year to move on from this heartbreaking moment to do it over again, hoping for a different result.**

**3. I’m one of the few black people in my research program.**

I’m insecure about my identity and my ability to communicate. But I want to leave Wisconsin on my own terms. To do that, I have to figure out what I’m missing in my learning. What can I do to pass next year?

But for now, I’m just going to lay in bed. Is it still considered crying if your eyes no longer have tears left to shed?

Gilbert

P.S. Have you discovered any limitations about yourself recently? If so, how have you pushed through them?

P.P.S. I think this song fits how I’m feeling: strained by feeling constantly overwhelmed with a hint of wanting to be better. These lyrics have been constantly pulsing through my head. *i don’t want to fail, i don’t want to feel like i just have a second chance because i’m a minority, i don’t want to feel like a token student in this very white state. i just want to do science and learn, i want to discover knowledge and support other minorities, do i have to live with these feelings of failure forever, am i okay with that when will i be okay with that should i be okay with that? will they go away after i pass, i hate myself, will i always feel like a failure no matter what i do in my life, am i worth anything other than my work? if i place all my value in work then what could i even do, what’s the point, why am i here?*

***Trigger Warning: mental health, suicidal ideation.*** *I sincerely hope that this letter finds you in a good space, and that no burden in your life is too heavy to bear. Please take care of yourself.*

You build it to a high to say goodbye because you’re not the same as them

I Always Wanna Die (Sometimes) by The 1975

My Dear Reader, October 2019

A screenshot of a video game

Description automatically generatedA few months ago, I had a dark notion. As I was waiting for the bus, my head felt heavy and everything went black. My eyes were open, yet things looked motionless, greyscale. Intrusive thoughts flitted in and out of my head.

*You’re tired. What if you just stopped trying?*

But wouldn’t my family and friends be disappointed in me?

*Nah, no one would care. Stop now, give up, what’s the point.*

I want to end this on my own terms.

*You still can. Just walk forward. Don’t think. Move.*

Into the middle of the street?

*It won’t take longer than a second.*

Thankfully the bus arrived. I’ve had bouts with depression in the past, but never to the extent that my inner suicidal ideations were so evidently clear.

Then one day as I was preparing to start my day with a walk through the farmers market, I found myself unable to move. My mind was awake, eyes were open, and my inner voice told me to move. But my body wouldn’t listen. Literally petrifying: to think “Move!”, “Get up!”, “Go over there” while my body lay unresponsive.

I couldn’t spend time with friends, stopped eating, and my mental health continued to fade. My therapist couldn’t fix my movement issues, but she helped me state my feelings, rationalize, and reflect on my thoughts. I realized that my worst days were an **8** on this suicidal ideations chart. She gave me actionable ways to improve, helping me recover from a shell of myself. My journey back to myself began with her advice: “Take risks”.

I find it ironically comical that risking my mental health is the motivation to keep me here to pass my prelim because that feels riskier than just leaving. But I’m alive. And it’s time to put in the work to learn some science.

Gilbert

P.S. What’s the riskiest thing you did in the past year?

P.P.S. My body stopped listening to my inner voice. Although my mind contemplated feelings of wanting to disappear, something within me felt that it wasn’t right and resulted in outright rejections of simple thoughts of movement.

P.P.P.S. My limits are being tested here, mentally, physically, emotionally. But I’m still here. I’ve never acted on my intrusive thoughts, but the risk is there. Outside of the song title and lyrics alluding to suicide, the sounds of this song really resonate with me. The strings fill me with hopeful melancholy, accentuated by the strain in the singer’s voice. As if things will get better with time, even though it doesn’t feel that way right now.

Where’s my soul going?

WELCOME TO SOUL, PRESENT by Q

Dear Reader, February 2020

I have a few more months before my second chance to pass my prelim and I’m anxious. I think not understanding how to effectively communicate my project was a glaring weakness during my first prelim. I need to learn how to speak confidently about my science if I’m going to be successful in this pursuit of knowledge.

How does van der Waals packing impact membrane protein association?

A screenshot of a video game

Description automatically generatedThe focus of my research is to further humanity’s understanding of how proteins found within cell membranes, or membrane proteins, interact.

Membrane proteins are complex structures that help our cells adapt to stimuli. From helping us recover from cuts and bruises to signaling to our brain that something feels hot or cold, membrane proteins are responsible for a multitude of our body’s natural responses to the environment.

The membrane proteins I work with are tiny, helix-like structures. These proteins naturally like to stick together, or associate. I’m trying to discover if different amounts of van der Waals packing changes how well proteins associate.

Van der Waals packing is like the “static” that comes from rubbing a balloon against hair: it’s a weak attraction between things in close contact, sticking them together. This “static” does make proteins associate, and we have the tools to predict the static strength in between proteins. But no one knows how strong it causes membrane proteins to be stuck together. Is it more like the lid of a jar before or after asking someone to open it: impossible to twist or so loose that it’s open in 3 seconds?

My current goal is to develop a computational algorithm to build, or design, proteins with different amounts of packing. By using software developed by my lab, I can create models of proteins. We know that protein shape affects the amount of “static”, so I’m currently working on creating a way to design proteins with different shapes.

My second goal is to test these designed proteins with experiments to see if my predictions agree with the data. But that comes after my prelim. If my computation and experiments are similar, then I’ll be able to design membrane protein targeting drugs to prevent numerous viral infections and diseases.

Wouldn’t that be a story? Researcher at UW-Madison develops the cure for Alzheimer’s, cystic fibrosis, or cancer.

But that’s MUCH farther away, tens of graduate students of research after me. For now, my research will have the potential to be a “possible outcome of a solution” that impacts humanity.

I’m feeling a smidge more confident in communicating my research. But this burden to pass to prove myself as a scientist still feels heavy. *if i don’t pass, then did i ever even have potential in science? why does it vaguely feel like my failure would reflect poorly on not just myself…but other minorities in science?*

Gilbert

P.S. When was the last time that you were proud of yourself?

P.P.S. An electronic/disco like vibe felt fitting for this “static” attraction between proteins. Have you ever felt indebted to those who gave you an opportunity? So much so that you feel like what you do reflects on them? I’ve been given this chance, but I feel like if I fail, I’ll just be an example of why there aren’t many minorities in these upper-level degree programs. I want to set a good example, but will I lose myself on the way?

Time has come, take it all in

5 Year Plan by Chance the Rapper

My Dear Reader, June 2020

Have you ever thought of how you could impact humanity?

With the world currently entrenched in a global pandemic, with minorities being abused and killed in a time of global strife, why is understanding how proteins interact important?

*If we better understand how membrane proteins interact, could we engineer proteins that disrupt these interactions?*

It’s bizarre to know that I’m living through this piece of history. For anyone studying virology during this time, they get to see the applicability of their research in real time. But for a biochemist trying to understand the forces that impact membrane protein folding, could my research ever help anyone?

*But how do you engineer proteins? We’d need to understand how van der Waals packing sticks proteins together.*

I’ve learned to question whatever I don’t know about a subject. I’ve developed critical reading skills, marking any paragraph, sentence, word that I can’t fully comprehend in my brain. I take that information and go deeper, peeling away layer after layer until I reach the core bit of knowledge that I need to understand.

*If we can simulate and predict how viral proteins interact with human cell membrane proteins and then support that predicted data with an experiment, we could engineer drugs to combat viral infections!*

Know what you don’t know. I joined my advisors on a zoom call and pitched my research to them.

After 40 minutes of defending and answering questions, my prelim exam was over.

**I passed**

*But did I really do that much better? Was I that much more prepared?*

Yes and yes*.*

But all of this deep learning has left me searching for more questions: *What don’t I know?*

With the police brutality and empowerment of the Black Lives Matter movement happening right now, *did I pass because it would look bad if one of the few black people in the program got kicked out for failure?*

Gilbert

P.S. What are 5 things you’re excited to do in the next 5 years?

P.P.S. A PhD is usually 5-6 years, but who can plan for failing a prelim OR for a global pandemic. The chords in this song remind me of a sunshower: a sprinkle of refracted sunlight, dancing on your skin amidst the soothing petrichor. It’s like a prescription of hope for the future. And when Randy Newman sings these lyrics, it resonates with nostalgia. Even if a plan doesn’t work out completely, even if you can’t exactly predict how things will go, you can still appreciate what happened because you’re alive. It makes me feel optimistic for a future in which I’ll feel nostalgic about the present.

P.P.P.S. My feelings of my identity driving my success still weigh heavily on me. There are a lot of things that I still don’t understand about my project, but I’m now trusted to take it to completion, and that’s what I’m going to focus on despite my internal doubts. My research likely isn’t going to be used for anything impactful. But just the fact that it’ll be a small bubble on the expansion of human knowledge is enough for me.

A video game screen capture

Description automatically generated

Rest here traveler,

I appreciate you taking the time to share these bits of my journey with me and thought this would be a nice place for a break. Graduate school has been quite a pensive and emotional journey: I’ve been broken down, survived mental anguish, and learned to think critically while finding comfort in the unknown.

Into the Woods

by Mree

Through it all, I’ve found myself closing my eyes and finding respite in music. This song channels both the fear of traversing the unknown, as well as the excitement of the discovery waiting ahead. Whether you’ve read through and identified with me in some way, are curious about someone’s graduate school experience, or you’re just a random person reading this for entertainment. Thank you for being here right now. I hope that, wherever you are on your own journey, you’re able to find solace and happiness.

You’ve made it to the middle stages of my journey. The pandemic slowed everything down for me while I was in grad school. Those few years blurred together, and then as if no time passed, stores began to open, mask mandates ended, and people started to gather again.

All the while those years were full of anxiety and all-consuming focus on my research.

Have you ever felt so much pressure that you felt like you couldn’t carry on? Like there’s a huge weight on your shoulders and you need to finish something for it to go away? I’ve learned how to learn, but science isn’t kind. It’s purely honest. And if you interpret something wrong, or your hypothesis wasn’t good enough, it’s difficult to find enough data to make conclusions that can be shared with the scientific community. It’s like … analogy

I’m still insecure. It still takes me longer than I would like to feel confident about a subject to discuss it. At times, I feel like I’ll forever be an imposter. But I’ve continued this journey, and I’m nearing what it means to find knowledge, to ascertain truth, to discover. And with it, ever so close to graduation. The triumph is coming! But there are still a few more lessons to learn along the way.

Thanks for reading, sending much love and support your way! I hope you enjoy the rest of these letters.

Gilbert

P.S. If you’re still not convinced that my research could be helpful to humanity, another group doing similar research was able to use protein design to combat Coronavirus during the pandemic. Their research is involved in the [SKYCovione](https://www.ipd.uw.edu/2022/06/covid-19-vaccine-skycovione-wins-full-approval-abroad/) vaccine (cite)!

Why don’t you leave if you wanna leave, if you wanna?

Leave If You Wanna by Overcoats

Dear Friend, July 2023

Sometimes I feel robotic.

I’ve fine-tuned my algorithm over the last few years, tested my designed proteins in small experiments, and witnessed several failures. My protein design algorithm can do three things: 1) build 1000s of proteins with unique shapes, 2) predict how well the proteins stick together (associate), and 3) estimate the amount of packing (“static”).

A close-up of a screen

Description automatically generatedA few years ago, my lab developed an experiment that I can use to test my proteins. We created a way for bacterial cells to produce our proteins alongside green fluorescent protein, or GFP. When the proteins associate stronger in the cell, more GFP is produced. We can’t count exactly how much GFP is made, BUT the GFP makes cells light up green!

A screenshot of a computer

Description automatically generatedWe can measure the cells’ green light using a machine called a cell sorter. The machine passes bacterial cells through a detector that records the green light for each cell. This allows us to estimate how much GFP is produced per cell, effectively telling me how well our proteins stick together! I sorted billions of cells producing different proteins, and calculated how well each protein sticks together from the data. And for once, it looks promising! My designed proteins associate as my algorithm predicts!

In my first 3 years of graduate school, no experiments worked, and I grew accustomed to failure. But I’ve finally reached the point in my graduate career where instead of taking an hour to work up the mental bandwidth to conduct an experiment, I can plan 2 or 3 experiments around one another. My experiments work on the first or second try. I’m a well-trained, diligent grad student.

But the laboriousness of research is draining me. I know this is the best data I’ve discovered, so why do I feel so detached from my science? Where’s my excitement? Why do I miss my family and friends so much?

Why is the only thing on my mind this desire to leave?

Gilbert

P.S. What was the last family/friend gathering that you regret missing?

P.P.S. After years of failure, I’ve finally found my stride in grad school. My project is taking shape, and the data I’ve discovered will ever so slightly push the boundary of membrane protein knowledge forward. I’ve learned to think on my feet and to dissect experimental data. I’ve become a good scientist. But after experiencing some success, I now feel this sudden urge to leave. I’m realizing how much I’ve neglected my life outside of science. Missing events with family, not seeing close friends for years. Am I losing my passion for research? Is science moving on from me?

P.P.P.S. *Why am I still here?*

'Cause is it really love if it don't tear you apart?

When You’re Breaking My Heart by Gatlin

Dear Friend, September 2023

It’s been six years now, and my time here is finally coming to an end.

I was given the acknowledgement of my advisors that I’m close to finishing up: “We can see the story forming, and we think you’ll be able to graduate next summer.”

Do you remember the last time you had a mental spiral? One of those times where your thoughts begin in one place and start looping into another. And then another. And another. Another. An infinite abyss of issues, problems, and conundrums that to work out in your head.

*I really need to rest but I have to organize the data for my thesis, I guess I’ll just do that this weekend, but if I do that then when do I get to reset and relax and do something fun? I need to go grocery shopping, but is eating even worth it this week, do I even have enough money to spend on food? is it worth living alone if I have to spend more money to do so, what am I going to do after I graduate, how will I make money to live, I have no marketable skills, I still don’t know what I really want to do, is academia worth it? should I sell out and join industry, potentially doing something insufferable like optimizing protocols only slightly more human relevant than grad school research but not really moving my desire or ambition to pursue something I love? am I even good enough for industry?*

***What is even the point of this PhD*?**

Pensive, contemplative, unrelenting, my stream of consciousness spirals out: *what is my relationship with my PhD?*

Smiling depression. I’ve built this intense relationship, where my research can do no wrong and I’m always at fault. Experiment after experiment, failure after failure, I attribute to myself. And yet I still try to smile. I do whatever I can to reach the needs of my research, giving it all the time I have at the detriment to myself, not allowing personal needs like hunger or sleep to prevent me from focusing on the research. I’ve had to be selfish. Haven’t given friends the support they need, rarely give intentional time to my family, don’t have time to talk extensively to those that I care about. Smile. It’s been difficult trying to lean on people from a distance. When not doing research, I’m filled with apprehension. For the last 6 years, my project has been my life.

And now that I’m getting close to the end, is it fair that I can’t even smile when I think about finishing up?

Why does it feel like I’m being pushed away?

Gilbert

P.S. When was the last time you had your heart broken?

A comic of a person with her hair pulled back

Description automatically generatedP.P.S. In this song, Gatlin realizes that she loved the chase of a relationship more than the person.

P.P.P.S. For a while now, I’ve stopped thinking about my future. I don’t know if I want to teach, to support and mentor students, or even remain in science. I’ve been focused on chasing this PhD. *What do I love? Is there anything that I would be happy doing for the rest of my life? The pursuit of finding knowledge is what kept me here, but do I even enjoy it?*

P.P.P.P.S. Those questions from years ago ring in my head, and with a smile on my face I wonder: *Do I belong here?*

And we keep doing these things, not because they're guaranteed to make us feel good  
But because failing to do them? Guaranteed to make us feel bad

GOOD MORNING SUNSHINE by The Narcissist Cookbook

Dear Friend, November 2023

I didn’t realize the end of this journey would lead to such paralyzing and everlasting burnout.

A fire in the sky

Description automatically generated**Burnout**: a state of emotional, mental, and physical exhaustion brought on by prolonged/repeated stress. My fierce zeal for science, to understand the auspicious beauty hidden within intricate systems that naturally form life, feels like it’s nearing an end. I’m running out of the once seemingly infinite amount of kindling I had of patience, time, and willpower. That once unwavering fire and indelible passion inside me is gradually fading away.

It feels like I’ve already given a lifetime’s worth of energy to this endeavor called PhD. My body is perpetually tired, my mind incessantly ailing with doubt, anguish, and distress. Another sleepless night. Hours pass and I continue to feel useless, thinking of all the things that I have to accomplish to graduate, yet being unable to do any of it. Everyday feels like I’m searching for something: *What’s the one thing that will pull me out of bed?*

Too many goals, temporary objectives, efforts to maintain content and find solace in the chase.

*Today I’m going to analyze this set of data. I’m going to write this part of my thesis.*

Insurmountable frustration begins to set in. The goals shrink and as the hours pass, so does my willingness to do anything.

*I’ll prepare for my presentation next week, maybe take out the trash, go grocery shopping, do laundry for the first time this month, clean the kitchen, wash dishes from the fried rice I made 2 weeks ago, feed my cat, eat SOMETHING, shower for the first time this week, brush my teeth.*

Overwhelmed and powerless, I’m forced to abandon that teeny glimmer of hope that I would make it to work today. Only one goal is left.

*I just want to get up and leave the comfort of my bed.*

It’s 3 pm and I’m ready to start my day. I’m alive.

But am I well?

Gilbert

P.S. When was the last time you felt burnt out? Were you able to take care of yourself? What types of support do you need/want?

P.P.S. At a time when I just needed ANYTHING to feel good about, I discovered this song that immediately resonated with me. Most days, it’s hard to get out of bed. It’s difficult to motivate myself to do even the most inconsequential things. I find ways to work through it as best as I can. Even with all these anxieties bogging down my mind, I find a way to tell myself that I’ve done enough each day. Telling myself that gets me through, keeps me productive, and gets me closer to the end of grad school.

You don't cross my mind, you live in it

Off Day by Lyn Lapid

Dear Friend, February 2024

What does it mean to live?

As I write this, I should be sleeping, resting, prepping my body and mind for the next day. But this incessant gnawing deep within the recesses of my brain continues to keep me awake. I close my eyes, but countless thoughts continue to ring around in my head, drowning out my tinnitus. I peek at my phone: 12:19 AM. Readjust, pull the sheets a little closer. I don’t enjoy sleeping tight. It feels restrictive and reminds me of being unable to force my body to move. 2:13 AM. I stare at my eyelids, no rest or reprieve. I firmly understand what it means to have a restless night.

During my 2nd prelim year, I found myself dreaming of the science. My subconscious was hard at work while I slept, envisioning how to design proteins to associate, imagining possible experimental results, and coming up with reasonable explanations. I thought it was a superpower.

But now, with fewer experiments and a deeper understanding of my research, the main thing left is to relay my findings. No more anxiety about redoing experiments or thinking of new ways to interpret data. I need to write, to put my thoughts into coherent words on paper. But how? Instead of dreaming, my mind continuously tells me *to work.* I’m constantly thinking about what and how to write. Instead of dreaming of the science, it’s preventing me from reaching any semblance of rest. I can’t sleep because if I do, then I’m not working. But if I can’t sleep, then I can’t work. A delightful feedback loop at the end of my PhD.

**A waking nightmare (image?)**

But during my 3AM trips to the lab, when the traffic lights are blinking red and yellow, I’m able to recognize myself as one of the few living beings filling the halcyon silence. Amid insomnia and the existential crisis that I’ll never be able to leave, I’m finding a deeper appreciation of the stillness. Cherishing the freedom and fluidity of time in graduate school. From deciding to take advantage of my sleeplessness to remembering to breathe. And in the early glow of the sun as the brisk air fills with birdsong, I’m finding ways to appreciate life.

Gilbert

P.S. When was the last time you closed your eyes and just took a moment to pause, breathe, and take in life?

P.P.S. A few letters ago, I mentioned that I would miss the chase, miss the ways that I’ve been forced to push myself past my limits to simply learn. But I’m beginning to realize that the enjoyment has been a bit more than just the chase. This environment has pushed me towards discovery: time to allow my brain to acclimate to the idea of working at the boundary of human knowledge. Allowing me to excise bias in pursuit of truth. It reminds me of being a kid again – just staring at the sky, letting all thoughts freely flow in and out of my mind. I feel like graduate school harnesses this latent ability, allowing for deeper exploration within our understanding of anything you find interesting.

P.P.P.S. This song feels like it bundles you up in a freshly washed blanket on a snowy day. A blend of tranquil and reassuring warmth amidst the frigid winter. I’ve questioned myself and my capabilities for the past 7 years, but I’ve finally made it to a place of what feels like mutual respect. Pushed to grow by finding comfort outside of my comfort zone. Pulled out of the ebbs of 36-hour water diets, to the flows of stress binge eating sweets (Babcock ice cream/donuts/Reese’s cups) as rewards for accomplishing tiny goals I set for myself. Birther of my restless mind, bringer of appreciating the peaceful subtleties of the day. My PhD has been that warm blanket for me, and I never expected it to be so comfortable. Which means it’s probably about time for me to move on.

Once I saw fire, and all I know is something happened

Did I let it go?

Before the Line by dodie

Dearest friend, May 2024

If you could do it all over again, would you still go to graduate school?

I’ve been caught within the greyscale of science for so long. Crafting my contribution to the scientific community, developing my research to ascertain a nuanced glance into membrane protein association.

But writing these reflections has reminded me how much I’ve learned about myself in graduate school.

From failing early on my quest to get to the highest level of learning, to now being ever so close to reaching the mountain top. I’ve been able to reflect on my shortcomings, explore my love for science in depth, while discovering and mending cracks in my mental health.

Cherished those small moments where I get to breathe and taste the air, smell the morning geosmin.

I’ve willingly put myself through this grind because of how big this opportunity feels to me: I’ll be the first person in my family to receive a PhD, in a field as prestigious as science. I recognize how important an opportunity it is to become another minority in a field still growing in diversity. And I’ve been fortunate during graduate school. My family is healthy, my friends are understanding, and my professors and lab mates have been exactly the type of academic support I’ve needed.

But I’m realizing now at the end how little time I’ve taken for myself: Diplomas, Bachelors, PhD. For most of my life, I’ve continuously reached for the next academic accomplishment, rarely investing my time to appreciate.

**…talk more about how isolated you felt during prelim…**

But for once, I feel an odd bit of freedom: *I don’t know what comes next*.

**Trumspringa**: the longing to wander off your career track in pursuit of a simple life. That feeling that an escape from what you’re currently doing will be enough to bring you back to the grind. I can’t shake this feeling right now of wanting to go somewhere new, taking a break from it all, spending intentional time with friends and family. Having time to take care of myself: schedule going to the dentist, ….

I’ve loved my time in school, investing time to learn at the highest level. All the ups and the many downs, and I’ve come far enough now to appreciate the experiences that it’s given me. That passion for knowledge is everpresent. But I need to find better balance, allowing me to have mental energy to spend with family, to foster deeper conversations with friends, to make passion to gain learn more about the people in my life. To feel more like I’m thriving, reveling in the knowledge rather than drowning.

I don’t know what’s next, … but I’m excited to find out.

Gilbert

P.S. If you could do it all again – as a bright eyed, younger version of your current self – would you make that big decision that would lead you to where you are today?

P.P.S.

I’m done with experiments, and the writing feels less daunting by the day. Like **…analogy to describe feeling actually free…**

**What does it feel like to have no experiments left to do? Did you ever imagine that feeling happening?**

I’m trying to start my life again

Wallflower by mxmtoon

My Dear Friend, August 2024

University of Wisconsin-Madison finds itself on an isthmus: a strip of land between the lakes Monona and Mendota. Composed of about 50,000 students and 25,000 staff, 3 out of every 10 people in the city are affiliated with the school. I moved here 7 years ago, knowing just as much about Wisconsin as I did then about what it takes to do a PhD. I quickly learned to love cheese curds and spicy cheese bread, found joy on long walks around the farmer’s market, and appreciated the amount of people biking through the city on even the chilliest, snow filled days.

When I first arrived in Madison to interview for grad school, my hosts took us out for a night walk around the city. It was … quiet, the sides of streets were filled with many tall piles of snow. We made our way to Monona Terrace, tiptoeing around icy, slippery sidewalks. We had gone ice skating on a small lake earlier in the day, so I understood that Madison could get quite cold. But to see Lake Monona, 5 miles (13km) of water across, completely frozen over, I was astounded. We ignored the orange tape and traffic cones, and walked onto the lake. I stared across the darkness, wind gusting chill against my corneas. I closed my eyes for respite from the cold, seeing the same darkness with one difference: the phosphenes on the backs of my eyelids clearer than ever before.

That memory sticks out to me as a fitting introduction to the hellishness of a PhD. Serenity in the quiet, astonishment at the unexpected beauty of nature, as biting cold winds whip against my being, making me question why I’m here.

From failing my prelim and questioning why I’m alive to developing the computational skills to create an algorithm that builds protein structures. Feeling like an imposter and a failure because of my identity, yet discovering my personal deficiencies in work life balance. From knowing basic biochemistry to becoming what many would consider an expert in my field.

***Beware of people that say that they know everything about a subject  
Because, people that think that they know everything  
Are the ones that know nothing***

Even If It’s Lonely by Hazlett

Graduate school has taught me that I don’t know much at all. I’ve learned to live life in this kind of neutral zone, experiencing new discoveries, looking with a non-judgmental eye, and interpreting what I can with the information given. I’ve poured so much mental energy into learning the intricacies of how membrane proteins fold and the biochemistry behind it, that I’ve learned how little I know about it. I don’t see my PhD as making me an expert in biochemistry, but rather that I’ve become an expert in how to learn.

To be an expert is to have the ability to make the unknown feel tangible.

As I’m writing this, I haven’t yet defended, the thesis isn’t submitted, and I’m not even sure if my committee will award me my PhD. But I do know that I’ve learned enough on this journey, and it’s time to move on.

I’ve thoroughly enjoyed learning how to passionately search through the unknown for information, trekking through journal articles, learning jargon needed to synthesize my understanding of a subject. That childlike, innocent curiosity on the search for deeper understanding. Becoming so enthused with that feeling of learning something new that it becomes more than just a subject, but a lifelong passion. And I’ve been able to apply this passion outside of science too: I created a podcast, learned the basics of music production and sound editing, I can code in 4 different languages, discovered the heights of my academic stress result in increasing my awareness of my lack of self love (body issues…). My love for learning won out.

Failed experiment after failed experiment, constantly banging my head against a seemingly unbreakable wall. But with flickering grit and teetering determination, my hardheadedness was enough to put a crack in it.

I’ve gotten a glimpse into what it means, what it feels like to discover something.

Do you remember the first time you held a kaleidoscope? Not knowing what it is, you’re encouraged to put one eye up to the tiny sliver of clear plastic. For those first few seconds of looking inside, you see a glistening, prismatic repeat of color and shapes so overwhelming that it seems unable to fit into the small toy in your hand. It’s infinite. That fleeting moment of first revelation is probably something I’ve been chasing my entire life.

Proteins that I made, sticking together because of the “static” that I designed, discovering the subtle impact that van der Waals has on membrane protein interactions. To do something difficult, to do something novel.

I can see myself doing the same thing forever. Searching for that same joy in discovery, that kaleidoscopic spark.

I’ve truly loved my time in graduate school. But my head is throbbing from banging against the wall of discovery.

For now, I’ve used up all my passion and determination.

***I’d rather be free***

Escapism from Steven Universe

**Etterath**: the feeling of emptiness after a long and arduous process is complete. Maybe this is what the end is supposed to feel like. Every time I’ve wanted to leave prior, I felt exhausted from the grind. But I gritted my teeth and continued the trek into discovery. Like finishing a great TV show or reaching the end of an awesome video game. Bittersweet, not exactly ready…but knowing that it’s time to move on.

I don’t know where I’ll be 10 years from now.

When will I be inspired again by an intense drive and passion to learn? I’m not yet sure what I’ll be doing next, or if I’ll even want to be in science. But I recall something my dad told me when I was a little boy: “If you put your mind to it, you can learn anything.” Thank you, PhD, for teaching me how to learn at the highest level. I’m not the smartest person, and this journey wasn’t anywhere near a perfect PhD. But it helped me grow into the person that I am: a tryhard, a thinker, and someone who now knows I can make a difference somewhere, someway if I just put my mind to it to learn enough.

Gilbert

P.S.

P.P.S. To my mom, dad, and brother, thank you for all of your support. From sending food or just making time to distract me from my personal turmoil, I appreciate all of the love you’ve sent my way.

P.P.P.S. To all my professors, friends, roommates, lab mates, communities (shoutout SciMed, CBI, and IPiB DEI), thank you for every little bit of support you gave me along the way. Whether it was thoughtfully chatting about science to discover my weaknesses, finding ways to develop a more supportive environment for students, or just discussing life and food and the mundane things – I truly appreciate every conversation, every moment of time that you’ve all given me. This PhD wouldn’t be complete without it!

P.P.P.P.S. And to you reader, whether a friend old or new, thank you for sharing this journey with me! Academia isn’t always the most vulnerable, and I wanted to create a transparent view to highlight my grad school experience. I hope that I succeeded! Best of luck on whatever journey you’re currently facing, I’m supporting you from afar, and would happily support you if you reach out :D.

**Other parts to potentially add in!**

Can you imagine knowing that you loved something, and then wondering years later where the love went? Time is a fickle thing. Like any relationship, you need reminders about why you fell in love in the first place. Graduate school for me was a grueling experience. As I’m sure many former graduate students understand, the constant failure, trying an experiment again, failing, and learning to finally find an answer is extremely demoralizing. It takes a special kind of person to continue that journey. And right now, I don’t know if I’m it.

Becoming an expert in anything is daunting. This story is just one person’s journey to it. I now know how much I don’t know.

This comfortable and steady environment full of individuals searching for the unimaginable, using all their will power and energy to do the impossible and discover knowledge …

Convey the fact that for a really long time I didn’t think that I deserved anything. Whether it be getting to play games longer than my brother, or … On feeling like I’ve been treated differently, when all I want is to be treated with respect.

Talk about how I seem to no longer enjoy the wins, but I still hate the losing?

Emphasize that you just can’t feel relief anymore. The feeling that the rug could get pulled from under you at any moment is still with you.

“Academia can be toxic.” When people say that I’ve always thought they were referring to the people, or the lack of minorities, or the slow-moving grind to find your own niche within the academic community. But the toxicity goes deeper than that. The mental anguishes, the beating yourself down, the … well you already know. Feel free to reread the other letters if you need a reminder :P.

Science seems to keep calling me back.

Citations (in progress)

Kary Mullis quote: <https://www.youtube.com/watch?v=xd4De47ldYs&ab_channel=NobelPrize>

Reddit: u/nodubby (suicidal ideation chart)

The dictionary of obscure sorrows by John Koenig

Ways to cite all of the music, and the tv and video games and such if I have to?

Citing definitions for the glossary (probably mostly just merriam-webster.com)