THE CSB FOREFRONT

" The code of life, one luminious twist at a time."

Light painting by Denise Le, Karan Ishii and Ernest Liang.

Volume IV

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-Sanjana Bhatnagar

From Editors

Sanjana Bhatnagar

I am truly delighted to present the 2024-2025 edition of *The CSB Forefront* to the entire department. This project has been an incredible journey, made special by a brand-new team that brought it to life.

I extend my deepest gratitude to everyone who contributed to this project—our ingenious writers and content creators, our perceptive editorial board members, and, of course, our artistic graphic designers. A huge shoutout as well to *Denise Le, Karan Ishii, and Ernest Liang* for gracing our cover page with a stunning DNA light painting, featuring the DNA sculpture crafted by the Moses Lab during their 2024 lab retreat.

A heartfelt thank you to *Haushe Suganthan*, who enthusiastically agreed to take on this journey with me during a chance conversation at a friend's birthday party. Despite being new to the role of editor, you gave it your all, offering valuable insights that shaped this magazine. To our dedicated editorial board members—*Maksym Shcherbina, Tammy Lee and PJ Gamueda* —thank you for committing to this initiative and ensuring every draft reached its full potential. And a special shoutout to *Gerald Lerchbaumer*, whose stunning photographs generously provided for this edition added beauty and depth, making this magazine a true pleasure to explore.

Despite being a team of graduate students, many in the final stretch of their degrees, their dedication and creativity breathed life into this project. Their contributions were nothing short of remarkable. To everyone who joined the team to propel CSB Forefront forward—you are an incredible group of people. I hope the experience of shaping this magazine proves valuable to you and extends into other aspects of your journey. Keep nurturing your creativity and your drive to contribute to the department—sharing insights, perspectives, and ideas that bring us closer, foster connections, and create lasting memories.

If you are inspired by our initiative and would like to come forward and give wings to your creativity, we encourage you to the join the team. Please, feel free to reach out to us and enquire the ins and outs of creating and reimagining The CSB Forefront!

Haushe Suganthan

It has been a whirlwind of a year, and I am glad that The CSB Forefront has been a part of it. Although, it was unconventional how I joined, as I was asked a party and didn't make much of it in the moment, I am glad I did. It has been an extremely fulfilling involvement to be able to see such hidden talent within our department, not only are they scientists but hidden artists.

With the upswing of emerging new technologies, such as AI, it has been an interesting time to be around, especially as an academic. Where we are making strides from the wet lab to machine learning, and cultures to computational models. Nonetheless, this magazine serves as a medium and platform to bring all sorts of perspectives together, building a community fostering openAI, whoops, I mean openness and inclusivity.

I would also like to express my gratitude to all the members of the CSB forefront for their talents, time, and effort in putting together and sharing their ideas for this issue.

Special thanks to *Gerald Lerchbaumer* for the beautiful photographs he has taken, which we have incorporated in this issue giving it its timeless aesthetic.

Thank you to our CSB Communications Officer, *Neil Macpherson* for his support, in helping us share this graduate student-led project with fellow students as well as our faculty members.

Especially thanks to the CSB department for giving us the opportunity to publish this magazine, specifically *Ben Eldridge* for support in funding, allowing us to share this magazine digitally and seamlessly.


Sanjana Bhatnagar

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The building we all walk past.
Photograph by Gerald Lerchbaumer

Dr. Ahmed Elbassiouny's workspace at BC Cancer Research Institute, offering a breathtaking view of the majestic mountains in the background.

From Electric Fishes to Cancer Research: Dr. Ahmed Elbassiouny's Journey into Academia

- by Christine Nguyen

Dr. Ahmed Elbassiouny is a molecular biologist who is extremely passionate about functional genomics.

Like many of us, Dr. Elbassiouny pursued his education at the University of Toronto in the Department of Cell and Systems Biology, initially as a master's student and then transferring to PhD. During his graduate studies, he was interested in investigating the molecular basis of metabolic adaptations in electric fishes. **In September 2023, he successfully defended and graduated from the program** and further pursued his career in academia.

In January 2024, Dr. Elbassiouny moved across the country from Ontario to British Columbia where he landed his **first job as a Research Fellow for the BC Cancer Research Institute.**

Dr. Elbassiouny added, **"***I have always been interested in studying molecular biology. I want to know what happens inside the cell. I want to study the molecular mechanisms of how cells respond and behave to stressful environments.***"** This postdoctoral position was an exciting opportunity for him to make a difference in a cancer research lab focused on identifying targets for treatments that affect children and young adults.

During the interview, Dr. Elbassiouny discusses more in-depth about his transition from graduate school to his career.

Can you describe the research you are doing at BC Cancer Research Institute?

Our lab focuses on cancers that affect mostly children and young adults by identifying targets for treatments in the form of immunotherapy. *My work includes the use of molecular biology techniques, performing CRISPR screens, working with cell cultures, and testing compounds.* I work across from the hospital and therefore, I have access to tumor samples from patients, which can be easily grown in the lab to test the effect of these targets. We identify targets *in vitro* and eventually, we move into *in vivo* experiments to confirm and validate the effect of these targets. If things are promising, we will begin clinical trial experiments. If the clinical trial experiments are successful, the target(s) we identify can progress into a form of immunotherapy. This treatment can be offered to pediatric cancer patients that develop secondary diseases from their chemo treatments.

What factors influenced your decision to pursue a postdoctoral position and continue your career in academia?

Originally, I was interested in pursuing a career in the industry. I applied for more industry jobs than academia. However, I connected with people in British Columbia (BC) and managed to expand my knowledge on the ins and out of the hiring process. When I connected with these people, they informed me that there was a hiring freeze. I had to make a decision about what I wanted to do: did I want to stick it out and wait for an interview or widen my net and see what other opportunities were possible for me by pursuing a postdoctoral position? During my time job hunting, *I learned that academic positions allow for intellectual freedom, including building your own project and following your own questions in a completely different field*. This intellectual freedom was valuable to me and therefore, it attracted me to pursue a postdoctoral position at BC cancer research. Overall, I think the science we conduct at BC cancer is great, and the cause is great, which is what matters to me.

When did you start applying for a job?

I started applying for jobs during my thesis preparation. Specifically, there was approximately *6-8 weeks from my approval meeting to my defence that I had free time to apply for jobs.* During this time, I connected with people on LinkedIn, worked on updating my profile, resume and writing cover letters for specific jobs I was applying for.

During the interview, you mention a lot about "connecting with people." How did you connect/network with people?

During my thesis writing phase, I started *networking with people on LinkedIn* who I knew graduated from the CSB department. For example, I saw a biotech job offer at the MARs building and there was a person I knew from the CSB department working for the same company. I connected with the person on LinkedIn and he agreed to meet up with me for coffee to discuss about the company. He explained to me about what he liked and what he did not like about the job. This coffee meet up was a great experience for me to learn more about the job. *After our conversation, I learned that certain aspects of the job position were not suited for me*, and therefore, I did not apply for it.

I *also attended professional meetups in Toronto and BC*. I met up with people working in biotech companies. These social events were great opportunities for me to socialize with people in a relaxed environment. I was able to make connections and learn more about the ins and outs of the hiring process and work environment.

Navigating the peaks of cancer research by day and conquering BC's mountain trails by weekend—postdoc life with a view! - feat Dr. Ahmed Elbassiouny

How was the interview process like? How did you prepare for an interview?

I applied for jobs in Canada and the U.S. I had several interviews in the U.S. that were for the industry. Depending on the job you are applying for, the interview process may look different. For example, when you are applying for *industry jobs in the U.S., there are three rounds of interviews you need to prepare for.* The first round is with human resources (HR). They will brief you about the logistics of the interview process, provide you an overview of the company, and reiterate information about the job description and your salary. During this interview, you can discuss with HR about things you care about, including the work environment, benefits, compensations, such as compensating your move, growth and potential for moving up in the field.

For the *second round of interviews, you will want to prepare for a meeting with the hiring manager.* This will be a technical interview that is relevant to the job you will be performing. The *third round of interviews include a site visit* discussing more about the job and a presentation that you should prepare slides for regarding your PhD work. During these interviews, you also should go back to the company's website, look at their publications, and prepare questions to ask for.

What resources or support have you found helpful in preparing for both academic and non-academic job markets?

I found networking events, conferences, resume writing workshops, and online resources, such as *HR automated (i.e., tools to help look over your resume)* to be very helpful.

What skills or knowledge have you gained during your time as a graduate student that you find most valuable?

There are many transferable skills that I gained during my graduate experience I found to be helpful, *including how I approach problems, how I troubleshoot, and writing skills.*

Secrets for Trainees GRAD hacks

Notion

At its core, Notion is a versatile note-taking app that you customize to meet your specific needs. You can transform your dashboard into a daily planner with to-do checkboxes, a mental health journal with randomized prompts, or your book reviews for the CSBGU Book Club!

When writing my thesis, I found it incredibly useful to create a Kanban-style (think Trello) page where I could move around experiments and ideas to craft a coherent story, as if I were using sticky notes on a corkboard.

While Notion can empower your notes with features like tags and embedded code formatting, if you're short on time to create these dashboards, fret not! Notion's community uploads hundreds of templates onto the website, so your needs are just a search away.

Notion is free for students and teachers. **www.notion.so/product/notion-for-education**

Alternatives: Microsoft OneNote, Obsidian

PhotoPea & Pixlr

Maybe your lab doesn't purchase Adobe licenses, or you don't like Adobe's new policies that allow them to take any of your saved images and use them as AI training data…. Regardless of the reason, PhotoPea and Pixlr are fantastic free alternatives that live on the web! Those even with a cursory knowledge of Photoshop and Illustrator will be at home with PhotoPea, as it supports all those document formats. So next time you're making a genetic pathway diagram or trying to brighten a figure in PowerPoint, try using PhotoPea!

PhotoPea is free with ads, but lifetime access is available. **www.photopea.com**

Alternatives: Adobe Photoshop (paid), Affinity Designer 2 (paid)

Author

Written by: Maksym Shcherbina

OK

According to Statistics Canada, 60% of food waste is avoidable. While most food waste comes from households, 46% of restaurants also report a surplus of edible food. Too Good To Go is an app that tries to save the food that restaurants would otherwise throw away by grouping items into "surprise bags" and selling them for a third of their normal price. By its very ethos, you can't pick what you're getting in your surprise bag. However, for less than $8, you can treat yourself to groceries from a local market or indulge in baked goods and bubble tea from a shop any day of the week. While there are dietary filters, some places may slip through the filters and you will need to manually search around. Once you have found a few places that you're happy with, though, you can favourite them and be notified when they go on sale.
Membership for Too Good to Go is free. **www.toogoodtogo.com/en-ca**
Alternatives: None in Canada!

Endel

Are you someone who simply must listen to something while working? In that case, you may be interested in giving Endel a try. Endel is an audio app that dynamically creates soundscapes to help you better focus, sleep, or relax. In a peer-reviewed study conducted by the company, participants listened to Endel's soundscapes while working, and their focus was found to be higher than when working in silence (Haruvi et al., 2022). …What may not be advertised on Endel's website is that this study also found that [in under 36-year-olds], any other "Focus"-oriented playlist helped focus just as much. Regardless, if your dynamic novelty brain center wishes for music with no repeating tracks or background vocals, Endel might be worth a try (I am currently listening to the Deep Focus soundscape as I write this!)
The Endel app is free, albeit limited in functionality. The paid experience provides you with richer soundscapes that are less likely to repeat themselves. If you're not looking to download a new app, Endel also releases many pre-recorded soundscapes on Apple Music and Spotify. **www.endel.io**
Alternatives: Apple Music's "Pure Focus" playlist, Spotify's Focus genre.

> Harvard's CS50: Introduction to Computer Science

Whether you're analyzing data in R or manipulating large datasets with Python, having some programming knowledge is increasingly valuable as a CSB student! If you've never written a line of code, Harvard's CS50 is the perfect starting point. The online course takes you from the bare basic concepts of programming to covering languages like C, Python, SQL and even Web Development. David Malan's lecturing style is incredibly engaging, and the problem sets are designed to build your confidence in programming week by week. If you're already familiar with the basics, the EdX platform has many other courses waiting for you to take at your own pace - perfect for fitting around your research schedule.

Harvard's CS50 has a paid certificate, but all course materials and lectures are 100% free and accessible year-round. **cs50.harvard.edu**
Alternatives: freeCodeCamp(free), DataCamp (paid)

From Lab Bench to BenchSci:

An interview with Dr. Luís Eduardo Abatti, Data Extraction Scientist at BenchSci
by Maksym Shcherbina

In the evolving landscape of biological research, the intersection of technology and life sciences has created exciting new career paths for scientists. We recently sat down with Dr. Luís Eduardo Abatti, an alumnus who transitioned from academic research to BenchSci, a tech company revolutionizing how technology companies can work in a research field.


Luís Eduardo Abatti, PhD, working as Senior Data Extraction Scientist at BenchSci

Bridging Biology and Technology

BenchSci, as Luís explains, is "a tech-first company that happens to work in the biology world." The company develops platforms that help pharmaceutical researchers digest and understand complex biological information more efficiently. For scientists developing new drugs or investigating disease targets, BenchSci's tools make information more accessible and actionable.

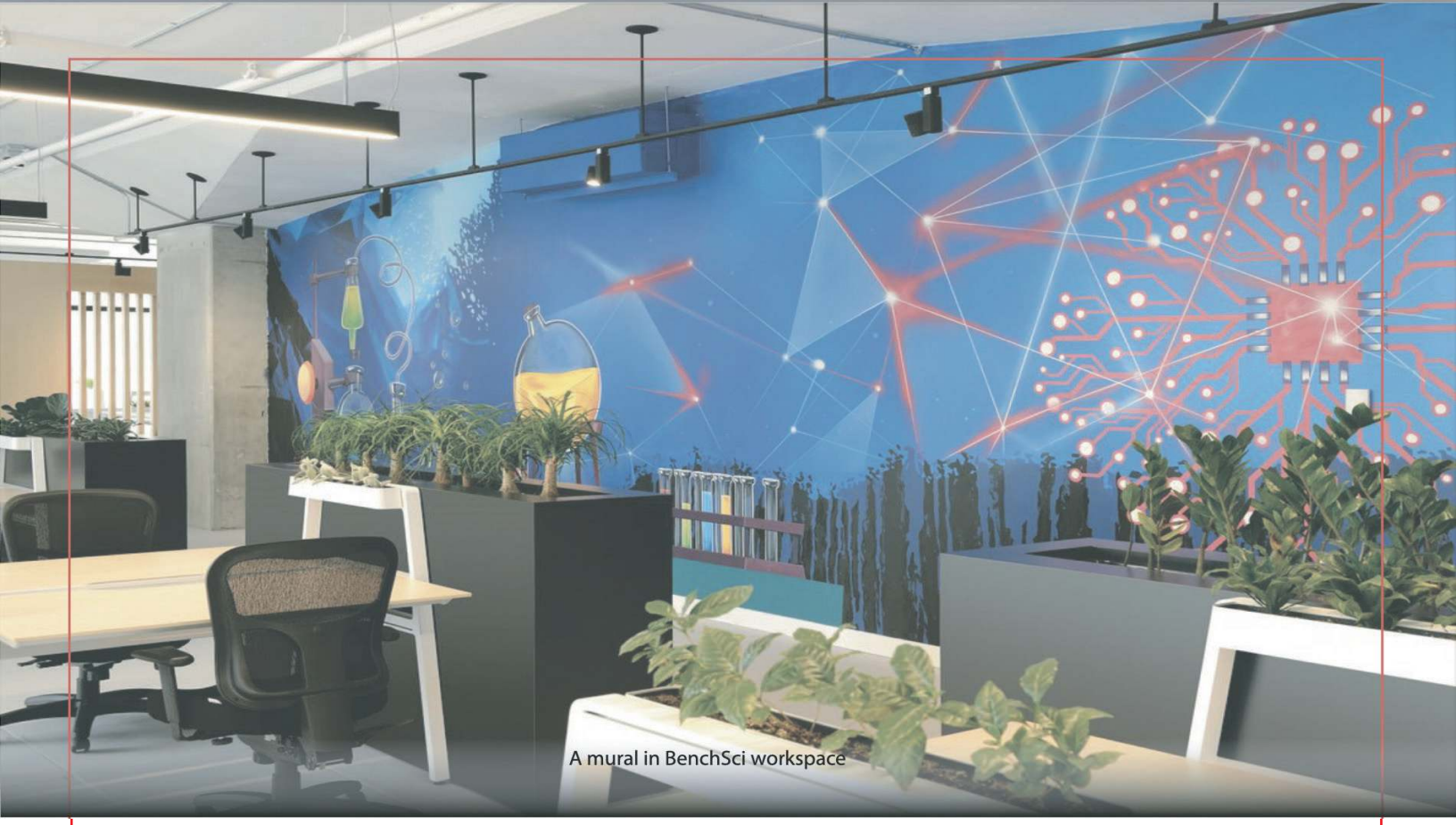
The Journey from Academia to Industry

Luís' path to BenchSci illustrates a common trajectory for modern data scientists. Starting his PhD focused on wet lab research in gene regulation and cancer, he became increasingly drawn to computational work. "I went from looking at a single gene to analyzing 30,000 genes in multiple conditions," he recalls. This shift demanded new skills, leading him to learn R programming and dive deeper into bioinformatics.

What started as a necessity evolved into a passion: "I became frustrated with the amount of time you would often have to spend on testing a hypothesis in the lab," Luís shares. "Compare that to what you can do in a computer where things happen much more quickly – you can test your hypothesis and maybe get a yes or no [answer] in a matter of days, whereas in the lab, it would take a month."

For those considering a similar path, Luís emphasizes several key points:

Skills Matter More Than Papers:
"Your papers don't really matter as much in the industry. As much as we all love [them], what matters is your skills. So what can you do? Do you know Python or SQL? Do you know how to deal with predictive analysis rather than "I have three papers in this area"? This is very unfortunate because we spend a lot of time [and] effort on these papers. It shows your commitment and dedication, but the papers do not prove any skill".



A mural in BenchSci workspace

Certificates and Bootcamps: Show, Don't Tell

"Having taken the course doesn't mean you know the content. I would take these courses as an opportunity to learn for myself, but the way that I would show a potential employer [that I have those skills] would be actual code... One good thing to have in your resume is a portfolio of projects, especially if you're trying to transition away from biology. A good idea is to have a GitHub account where you do a couple of analyses - a place where you can show your thought process, the results you get, and your interpretations [of those results]."

Essential Technical Skills for Data Analysis:

- Python programming (industry standard over R)
- SQL database knowledge
- Data analysis fundamentals
- Machine learning understanding (for data science)

Understanding Data Roles: Data Analyst / Data Scientist / Data Engineer

Luís also explained the distinction between different data-focused roles in the industry, highlighting the following three: Data Analyst, Data Scientist and Data Engineer, within the context of a Spotify user interface (UI).

"Data analysts only analyze data that has already happened," Luís explains. Spotify might test two [different] interfaces with their users simultaneously - Interface A and B, for example. The data analyst would then compare the usage of these interfaces. " You do that level of analysis, and you might build a bunch of graphs and conclude that interface A retains users 20% of the time."

In contrast, "A data scientist is building a [Machine Learning] model that can predict how much more users we can get if we implement this or that. So, it's predicting the future, using the data in the past to predict the future. Data

scientists work with A.I. and machine learning much more deeply than data analysts."

“A data analyst will have the data in front of them already, but someone has to generate that data, right?” Luís says. “So the data engineer's role is to build all the databases and pipelines that will generate that data so that downstream someone can go and analyze [it]. [Data Engineering] requires a little bit more technical knowledge that a biologist probably doesn't have at first.”

Luís emphasizes that the analytical skills developed in bioinformatics are highly transferable to these data roles. "Having experience in bioinformatics trained me really well because it involves handling vast amounts of data and making numerous comparisons," he shares. "This doesn't differ much when you're looking at user data. Let's say someone works at Spotify; they're analyzing how often a user interacts with a feature versus someone with a different interface. All those comparisons are not much different than comparing genes in two different conditions in a cell."
"Overall, any biologist that can improve their programming skills is really well-prepared to work within the world of data," Luís concludes.

Life at a Biotech Company

At BenchSci, Luís works as a Data Extraction Scientist, a role which bridges the gap between biological research and technological implementation. His position involves exploring and validating solutions the engineering team later implements into the platform. "We do more of the exploration and finding potential solutions that conform to whatever product we want to build," he explains. "We make suggestions and then send them to the engineers to build it."

Workspace at BenchSci

The work environment represents a significant shift from academia, particularly in its structured yet dynamic nature. "In the company, you're working on a team versus in an academic environment where [you're] mostly working for [yourself]," Luís notes. This team-based approach fosters a different kind of productivity, where each team member contributes their expertise to a larger whole. "Every person does one part... You're not expected to know everything and do everything," he explains, highlighting how this team structure leads to more efficient outcomes.

A typical day at BenchSci involves collaborative meetings and focused work time. "There's usually at least one or two hours of meetings every

day," Luís shares, noting that this was quite an adjustment from academia. The company operates on a two-week sprint cycle, alternating between planning sessions and implementation periods. During planning weeks, the team comes together frequently to discuss objectives and document their approach. Implementation weeks focus more on executing the planned work, with Luís juggling one to three projects simultaneously.

Perhaps one of the most striking differences from academic life is the clear separation between work and personal time. "In grad school, your work becomes a little part of you. Whereas in industry, your work is your work," Luís reflects. This boundary has contributed to better stress management and mental health, though he acknowledges this structured approach might not suit everyone's working style. Despite working remotely, he finds it easier to disconnect from work compared to the all-encompassing nature of graduate research.

As a startup, BenchSci maintains elements of both corporate structure and academic exploration. While the work follows more defined processes than academia, it still preserves the intellectual curiosity and problem-solving aspects that attract many scientists. "BenchSci is a little different because it still feels a bit like research," Luís reflects. "We still do a lot of explorations and find different ways [to] get to the solution that we need."

The Gap between Industry and Academia

Reflecting on his transition, Luís identifies a crucial gap in how academic departments prepare students for diverse career paths. "I wish the department did a little bit more effort in bringing these people in," he notes, highlighting how the reality is that most graduate students won't remain in academia.

The challenge, he explains, often stems from the academic environment itself. "People that stay in academia generally don't know how it is outside of it," Luís observes. "I talked to a lot of professors, and a lot of them wanted to help, but they didn't know how because they had never looked into that career path, nor did they know anyone who went that way."

This disconnect creates a significant challenge for students exploring their career options. While organizations like the LSCDS (Life Sciences Career Development Society) at the University of Toronto help bridge this gap through networking events and industry connections, Luís believes departments could do more. "I wish there was a bigger effort to bring some speakers to talk about where they went after grad school. I think that would be very valuable."

In the Footsteps: Advice for Future Graduates

For those considering a similar path, Luís offers practical advice:

1. Start learning industry-relevant skills early

“Try to learn those skills very early on. If you're doing an analysis, try to see if you can use Python instead of R, and use known packages as much as possible."

2. Build a portfolio of projects demonstrating your capabilities

"Show your thought process, the results you get, and your interpretations."

3. Network actively, even if it feels uncomfortable

“I am not a person who is super comfortable just reaching out to other people that I don't know, but that's how you get to know companies, what people do, and the skills that are expected of

you."

Consider entry-level positions, even with advanced degrees, where your scientific background adds value.

"A good strategy, if you're just graduating, is applying for more entry-level positions," he advises. While it might mean a lower initial salary, starting somewhere and gaining industry experience is often easier.

The intersection of biology and technology continues to grow, offering exciting opportunities for scientists willing to adapt and learn new skills. As Luís' experience shows, a background in biological research combined with technical skills can open doors to rewarding careers in the tech industry. After all, data is data.

Workspace at BenchSci

SCIENCE FICTION AND SCIENCE REALITY

The Mental Health of Storytelling

by Emily Deng

Working the graveyard shift as a graduate student sucks for a myriad of reasons, chief among them being the opportunity to overthink. One drop is enough to make a person sore with envy, and all your mannerisms drip with that same poison. Outside, the city activates its nighttime programming. The Harbord Streetglow embarks on its nightly prowl, roused by the alluring scent of you. It's dense and it contains a lethal dose.

"I could have gone home at six," you think, just as it slips past a gap in the window.

It takes life of its own, roaming around the linoleum halls, pouring its heavy breath through the cracks of ceiling boards. It has a unique, quirky personality, but also has the reliability of reference books. Mind-bending, you think. Yet, you still pretend like such a thing can be true, because it nibbles at your thoughts in a very satisfying way. Whether that is to keep you from becoming bored or to fill your head with an energizing worry, it never speaks to you directly.

"How so?" You may ask.

The mundane truth is that you've always spoken on behalf of the ideals that you hold yourself to, barely cognizant of the irony that you once killed a plant by watering it too much. You're too proud to use a map, too convinced that you remember the way from last time, and The Streetglow knows this. Hence why it beckons you awake when you should be going home to sleep.

When analyzing fiction, it's important to consider the author's intentions, but not to feel limited by them. As academics, we survive by the images and scenarios that run through our brains, feeding the stream of consciousness that helps us understand complex pathways and imagine how they operate. Yet, there's no telling where these behaviours may guide us or whether an overactive mind is a healthy one. **"Fear tweaks the vagus nerve,"** as Christopher Isherwood puts it. **"A sickish shrinking from what waits, somewhere out there, dead ahead."** It poses the question: what if the call is coming from inside the attic?

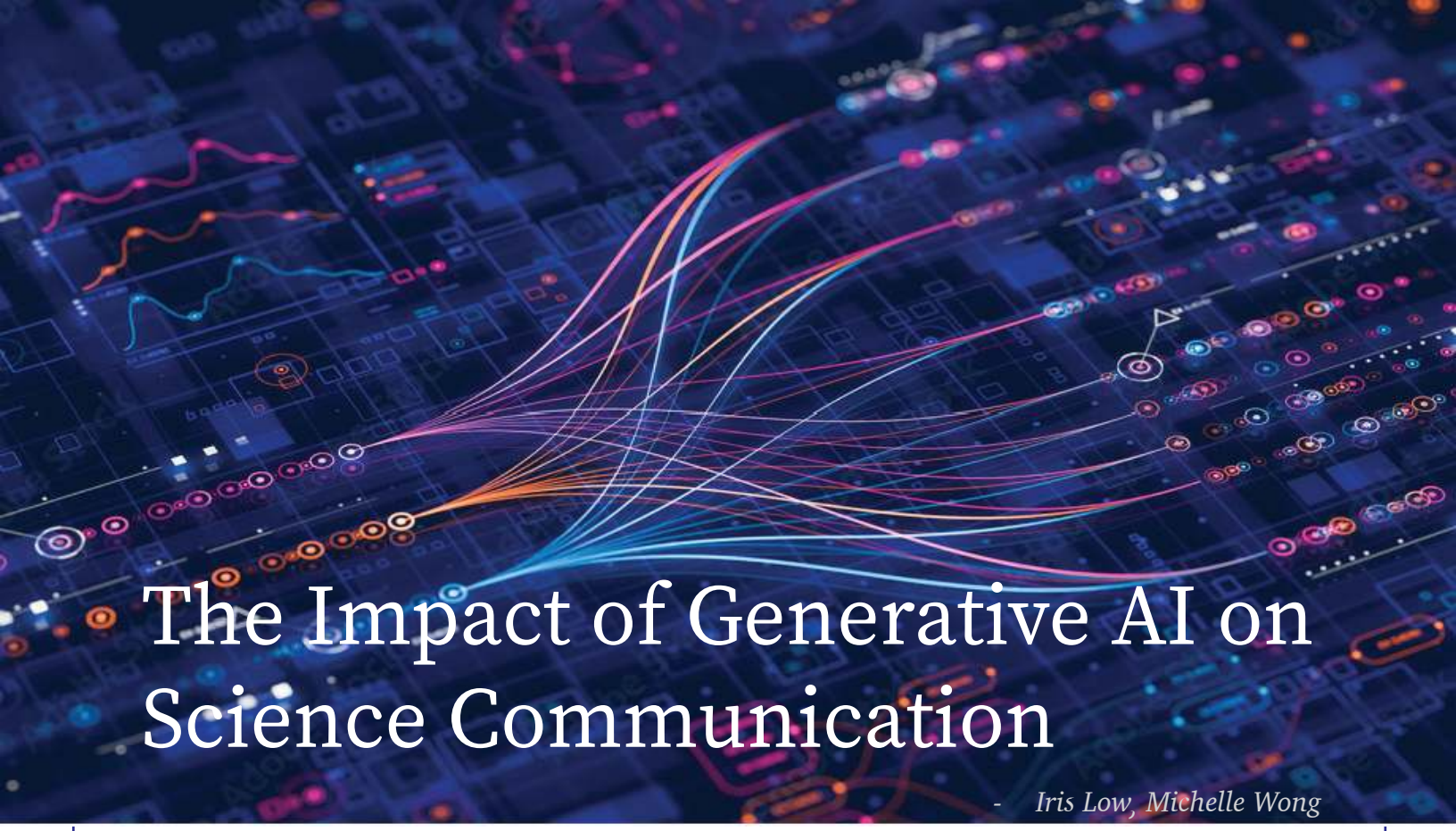
Seeing our creatures depicted on the screen gives us the opportunity to study them, both in private and as a community. In the famous foreword to JtHM by Rob Schrab, he writes that **fiction gives our creatures something to chew on. It's an essential food for our growth and without it, our creatures grow hungry and neglected.** Furthermore, having a third person perspective to our experiences gives us a common vocabulary to articulate what we feel, and understand what others are saying. What can we learn about wellbeing from media about academics?

Whiplash (2014) embraces the pursuit of perfection, rising above the crowd of critics and college-based films to surround itself with more perfect tens than Buddy Rich in a mirror maze. Whiplash tells the story of an ambitious young jazz drummer struggling to meet the demands of his profession. Set in his first year of university, Andrew Neimann's drive and talent catches the attention of Fletcher, who offers him an elusive spot in the school's top ensemble jazz band. However, his pursuit of greatness quickly dissolves into an obsession as the intimidation of failure proves to be unlike anything he has ever encountered.

On par with Neimann's double-time swing, Whiplash is a fast-paced narrative exploring how being so singularly focused can affect a person's mental and physical health. Whether it is a studio band or research group, the price of a powerhouse performance may not always be worth it. This film sheds light on the toxic culture of overachievement, putting Neimann on the path of danger as his hardworking nature is twisted by the fear of losing the one opportunity he believes will make or break his career. In addition to the external problems he encounters, with teacher-… … student relationships and competitive malice between colleagues, Whiplash delicately portrays the internal conflict growing from the pressure of academics. Neimann's evolving work-life struggle is told through series of short, disjointed conversations, which serve as the "breaths" during his time as Shaffer and suffocate as the film progresses. Yet, there are moments of light in Whiplash that place a valuable emphasis on the need for balance, showing that even the greats can't succeed without a moment to stop and regather.

The interpretation of Neimann's journey can teach us a lot about what we want to see in our academic careers. A part of becoming a successful, independent researcher is letting go of the need for approval and forming your own decision-making capabilities. It means taking a critical look at what goals are within your capabilities. It means abandoning unhealthy practices and embracing new habits. More importantly, it means sifting through opportunities, and deciding which avenues fit the future that you want for yourself.

Imagine yourself in a film. What you would do differently? Stepping into your unique identity may require stepping out of your old one. You love the details of your work, and how the weight of your samples feels in the palm of your hand. There's a beauty in the phenomena you study: crystalline proteins under a microscope, pigmented colonies growing around your plate, and live cells so delicate, you handle them like precious jewels. The Harbord Streetglow hears this and finds its way back to rest, leaving with a stomach full of wonder for what it got to see.



The Impact of Generative AI on Science Communication

- *Iris Low, Michelle Wong*

Science to non-experts

The word "science" often sounds difficult, distant, and complicated to the general public. People who do not study science would look at me in awe after I tell them what I study in school. As a graduate student doing scientific research, I am often around people who are experts in science—other graduate students, lab technicians, and professors. Therefore, science has become my daily conversation with others and part of my comfort zone. However, it has also hindered my ability to view science from the general public's perspective.

The goal and importance of science communication

Years of education and research in science have created a knowledge gap between science experts and non-experts, making it difficult for scientific experts to discuss science in a way that non-experts can understand and enjoy. With fear and misunderstanding of science due to misinformation and miscommunication, people struggle to make informed decisions for their own health and public health issues that require collective action. To break the barrier between scientific experts and non-experts, science communication aims to bridge the gap in scientific knowledge and raise public awareness of scientific findings to prevent the spread of misinformation.

Science communication under the influence of AI

Generative AI based on the Large Language Model (LLM) has transformed our daily lives and the science industry in the past few years. Primary research articles that report raw scientific data are often difficult for non-experts to digest as they are written in scientific terms and formal language. With the power of generative AI, non-experts can get a summary of a scientific research article in plain language within seconds. Public access to generative AI has facilitated the translation of scientific knowledge to non-experts and may solve many challenges associated with science communication.

What is a generative AI model?

AI is complex and multifaceted. To this day, humans are still exploring and searching for novel applications of AI. Recently, much of the

focus has been on generative AI. Unlike traditional AI models, which are primarily designed for classification or regression [1], generative AI models can create contents from various inputs, such as text, images, and audio [2]. Briefly, generative AI models learn by identifying patterns and relationships from vast amounts of data, which enables them to generate new contents using the existing data. For instance, a generative AI model trained on a dataset of images can generate new images that resemble images in the training dataset but are not exact replicates. Similarly, a generative AI model trained on a corpus of texts can write coherent and grammatically correct sentences or even articles.

Potential applications of generative AI models on science communication

Generative AI tools such as *ChatGPT, Gemini, Co-pilot*, and *Meta AI* are free and publicly accessible [3]. One standout example is GPT, short for generative pre-trained transformer. GPT, developed by OpenAI with financial support from Microsoft [4], has gained significant attention since its launch in November 2022. GPT powers a chatbot called *ChatGPT*, which is known for its ability to generate human-like responses [5]. ChatGPT can break down complex scientific concepts into understandable language, making it a powerful tool for science communication. It helps researchers and educators convey heavy scientific information to the general public, making science more accessible. However, it is crucial to use ChatGPT with caution. While it can be an excellent starting point for understanding scientific articles, it cannot and should not replace professional science communicators. Some scientists are already relying too heavily on ChatGPT to write articles or create visual content, leading to significant errors and nonsensical information [6]. GPT should be a tool to assist in the process, not the definitive solution.

Another key player in generative AI is Gemini. *Gemini* focuses on providing high-quality, context-aware responses tailored to specific domains such as technical support and customer service interactions [7]. For example, Gemini can assist in drafting and editing manuscripts in scientific publishing to ensure that the content is both accurate and engaging. This capability streamlines workflows and enhances the user experience, allowing scientists to communicate their findings more effectively.

GitHub, owned by Microsoft, is developing Github Copilot in collaboration with OpenAI, a model that is designed to improve productivity of software developers. GitHub Copilot can integrate with code editors like Visual Studio Code and RStudio to generate complete functions and entire code blocks based on the context of the user's work [8]. This tool can automate repetitive programming tasks in biology-related projects, such as generating scripts for processing and analyzing large datasets, setting up and customizing bioinformatics workflows like sequence alignment or phylogenetic tree construction, and providing templates and suggestions for statistical analyses [9]. This can be particularly beneficial for Cell and Systems Biology (CSB) graduate students who already use these Integrated Development Environments (IDEs).

Meta AI from Meta represents another significant advancement in AI because it encompasses a range of advancing AI technologies. One key focus is improving natural language generation [10], which aims to enhance user interaction and engagement. Meta AI's computer vision can assist in analyzing scientific images and data, pushing the boundaries of what AI can achieve in scientific research.

The future of science communication under the influence of generative AI models

In the realm of science communication, generative AI models are rapidly evolving to help bridge the gap between the public and experts. These tools can potentially mitigate misinformation and more effectively communicate scientific information.

However, limitations such as biases, accuracy of AI responses, and ethical concerns need to be addressed. Looking ahead, the future of science communication with AI holds great potential. For science outreach, imagine how AI can be applied within virtual science festivals, allowing participants to engage in simulated experiments. For science inreach, researchers can use AI tools to translate their findings into multiple languages with accuracy, thereby fostering global collaboration in science. Moreover, just as DeepMind's AlphaFold has revolutionized the prediction of protein structure, we are expecting to see AI algorithms that can automate data analysis to quickly identify patterns and correlations within large datasets that were challenging for traditional methods. Consider how these AI tools could impact your research endeavors. Would you employ AI in your research? What concerns or ethical considerations arise for the integration of AI in scientific research? Before using it, try to reflect on the potential benefits and challenges

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Navigating the nook : Challenges of communicating specialized science

- Miranda de Saint-Rome and Gerald Lerchbaumer

The scientific landscape evolves rapidly, making milestone discoveries from the mid-20th century already seem distant.

Over the past 50 years, the number of scientists and scientific publications has grown exponentially. As the volume of publications continues to grow, research has become more focused and technical. As a result, the language and concepts used often become highly specialized, creating barriers between different areas of expertise. This fragmentation complicates communication across disciplines, making breakthroughs in one field less accessible to others and obscuring the significance of major discoveries. Additionally, this specialized communication can make science less accessible to key stakeholders, such as policymakers, potentially reducing their interest and slowing the overall pace of scientific progress. Furthermore, this highly complex scientific environment can make it daunting for scientists trying to navigate their carreer within this maze.

In this article, we examine why we think science is becoming more specialized, share insights from an esteemed professor on the topic, and discuss strategies to address communication barriers. As engaged researchers, many of us dream of contributing to novel, exciting, and cutting edge research. However, this enthusiasm is quite often challenged by the harsh reality of science, which flows with rapid pace and creates a labyrinth of complex topics. While it is easy to find enthusiasm for grand ideas and concepts, this feeling can be swept away easily when one is confronted with all the minute details and considerations that build the foundation of great ideas.

Young researchers first spend considerable time learning these intricacies within their projects, becoming deeply familiar with every detail. Once they have gained this understanding, they must then be able to communicate their findings, simplifying complex concepts and connecting them to the broader scientific context. This process becomes more and more challenging as new discoveries are made.

To address the growing challenges of making specialized scientific findings accessible and relevant to broader audiences and within the scientific community, we first explore what makes science so complex and often hard to digest in the first place. After some research and talking to various people in scientific environments, we came to the conclusion that the primary factor driving the increase in specialization in todays science is the tremendous pressure to publish. Researchers, especially as they try to gain footing in their field, rely on frequent publications in high impact journals to advance their careers. This often leads them to concentrate on niche topics where they can produce results quickly, further reinforcing their specialization.

We further contend that this prioritization of specialization, driven by publish-or-perish pressures, can result in the isolation of scientific fields and knowledge; because of specialized language, advances in narrow domains may not be effectively communicated or integrated with others. This causes scientific breakthroughs to remain elusive or confined within a specialty, slowing progress in related fields and hindering overall scientific innovation.

This is underlined by data showing that scientific innovation and the number of publications are not directly correlated; in fact, the number of scientific publications has outpaced innovation significantly (Park et al. 2022). This lack of efficient scientific mobility may lead to the phenomenon of 'groupthink', where members of a scientific niche prioritize consensus over the critical evaluation of new ideas. This siloed approach further slows or complicates scientific progress. Interdisciplinary research, which often drives significant scientific and technological innovation—such as the development of CRISPR-Cas9 through the convergence of molecular biology, biochemistry, genetics, and bioinformatics—can become less frequent if scientific ideas are not communicated well across fields.

To gain additional insights on this topic, we interviewed Dr. Dorothea Godt, an esteemed Senior Faculty member with a distinguished career in developmental biology research. Read her perspectives on the topic on the next page.

Interview with Dorothea Godt

Have you witnessed increased specialization in science over your career?

It's more about a shift from one specialization to another rather than an increase in the number of specializations. As new techniques are developed, we can ask increasingly detailed sub-questions, which allows research to branch out in numerous directions, increasing overall complexity. A wide array of questions can be pursued, but what I've observed more is a shift in research focus over time. For example, at UofT, the number of faculty positions hasn't changed much over the years, which limits the number of research areas a department can cover. In my department, the research focus has shifted over time. Before I joined, there was a strong emphasis on fish studies in the Great Lakes. Now, Cell Biology has become an important research focus in our department, and Systems Biology has emerged as a new area of research.

If we look globally, however, there has been a substantial increase in research institutions in countries that previously had little to no research infrastructure, leading to a broader scope of specialization worldwide.

What do you think are reasons for shifts in specialization?

These changes often arise from unexpected observations in research. When researchers stumble upon something unusual, it can lead to entirely new questions that haven't been asked before. If there's enough interest and the means to investigate, this can spark a wave of research across multiple labs. A recent example is the discovery of RNA interference (RNAi). Initially an accidental discovery, RNAi developed into a crucial tool in biology, leading to a new understanding of gene modulation and sparking numerous new research questions.

Over time, as key questions in a specialization are answered, interest might wane, and researchers may shift focus. Alternatively, a barrier may be reached, where current technologies cannot advance the field further, leading to a decline in that area. Departments then look for new, exciting areas where progress is being made to refocus their efforts.

Do you think there are any benefits or opportunities of increased specialization and fragmentation of research?
Specialization is crucial for making progress, as it allows for a deep and comprehensive understanding of specific topics. Each student or researcher contributes a small piece to the overall picture, often leading to surprising discoveries. These discoveries can then spark cross-disciplinary interactions and novel questions, ultimately opening new doors for other research groups.

Do you think there are dangers to increased specializations?
Yes, there are certain risks. Highly specialized fields can become isolated, with only a few experts understanding the nuances of specific technologies or data. This isolation can lead to a situation where the field stops making real progress, even though it might seem active. This can result in a dead-end for that specialization, where it no longer contributes significantly to the broader scientific community.

Continuation - Interview with Dorothea Godt

Does a changing scientific field affect your research, and if so, how?
I've seen my research interests shift over time, influenced by the tools and knowledge available at different periods. Early in my career, I was fascinated by cell movements, but the tools to study them in a whole organism model weren't available. So, I focused on pattern formation in development, a hot topic at the time. Later, as new tools emerged and key molecules were discovered, I was able to return to my previous interest in studying cell movements. So yes, the ebb and flow of specialization and merging of specialties have significantly shaped my research trajectory.

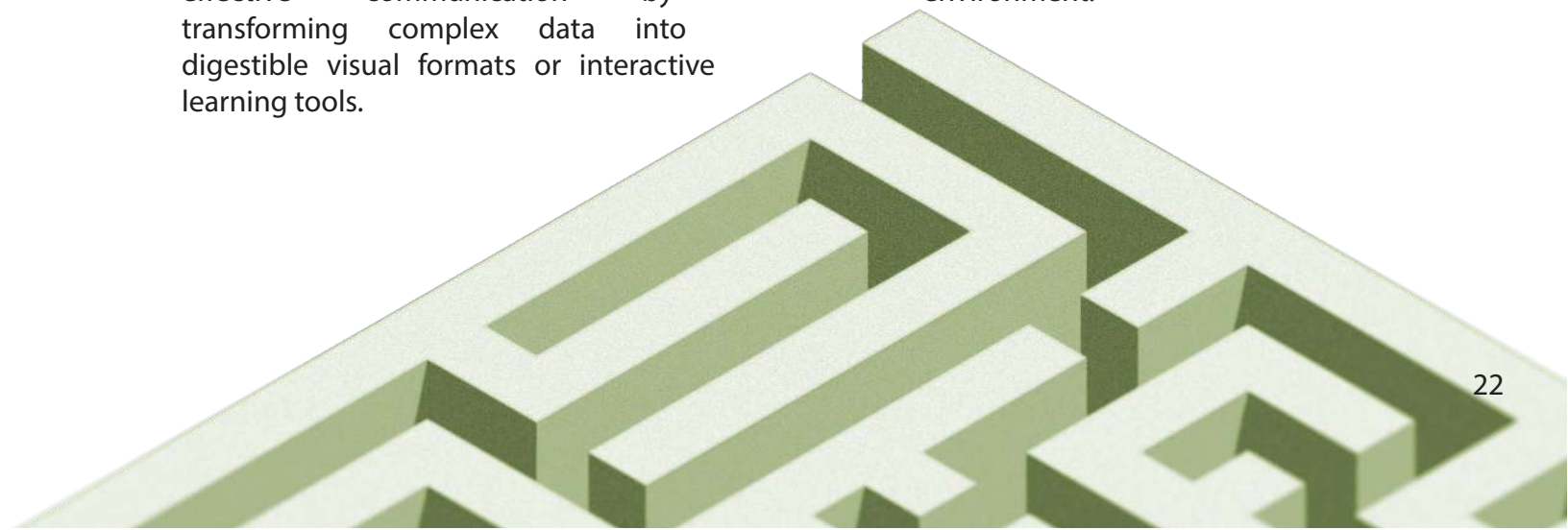
Have your personal strategies of communicating science changed over the years?
It's very important to be able to convey scientific ideas and concepts to society, and figuring out how to do this effectively is difficult. Conveying scientific ideas to society is challenging, especially since labs work on small parts of a larger puzzle. My approach hasn't changed much: attending meetings is crucial for staying updated on new developments. Inviting science reporters to these meetings could improve communication with the public.
Specialists in science communication are needed to translate complex issues into understandable terms. Researchers often use specialized language, creating barriers when communicating with the general public. Scientific communicators can bridge this gap by making complex topics accessible.

What can we do to avoid getting lost in the weeds?

In summary, while scientific specialization is necessary for progress, it creates significant communication barriers. Fortunately, as science evolves, so does technology, offering solutions to overcome some of the challenges presented by increased specialization. Machine learning and artificial intelligence (AI) have opened new avenues for researchers and the general public alike to convey and understand niche scientific topics. For example, AI-tools can assist researchers in simplifying complex concepts for both public understanding and cross-disciplinary collaboration. Many publishers have already integrated tools that utilize large language models (LLMs) to help summarize information from publications. This approach can be extended to generate easy-to-understand summaries of whole scientific papers, making it easier for non-specialists and the general public to grasp key findings. Now is the time to develop, utilize, and distribute these tools in order to make science more approachable. Additionally, virtual platforms offer new ways to visualize and explore scientific data interactively, making highly technical subjects more approachable. For researchers, these technologies can facilitate more effective communication by transforming complex data into digestible visual formats or interactive learning tools.

Leveraging social media and online communities offers another powerful way to make science more accessible, enabling researchers to share their findings directly with a global audience. Podcasts, YouTube channels, and educational webinars allow scientists to explain their work in more informal settings, making complex topics more approachable. Each of us can make an effort to post our results on Twitter, host a podcast, or practice science outreach using social media. This not only helps communicate science, but also increases personal motivation to engage with your own research.

If we can't effectively communicate our scientific discoveries, we risk rendering them irrelevant. The impact of science is not just in the discovery itself but in its ability to be understood, applied, and integrated into broader contexts. Without clear communication, even groundbreaking advancements and innovation may fail to reach and benefit the intended audience. We hope this article is able to provide some insight into why it becomes more difficult to communicate science and why we as scientists have to stay on top of technology to navigate this environment.



Small RNAs, Big Impact: Unraveling the Secrets of C. elegans Genetics

- Tammy Lee

Microscopy image of the *C. elegans*' U-shaped gonad. Germ cells proliferate from the distal end (bottom right) and develops into oocytes and embryos in the bend and proximal end (left)

Eukaryotic gene expression is complex and is tightly regulated at multiple levels during an organism's development and in response to environmental changes. Over the past three decades, studies revealed that small, non-coding pieces of RNA called small interfering RNA **(siRNA) play essential roles in regulating gene expression.**

In 1998, Andrew Fire and Craig Mello published their findings of a mechanism called RNA interference. Fire and Mello found that injecting pieces of double-stranded small RNAs into the gonad of the nematode, *Caenorhabditis elegans* leads to degradation of mRNA that corresponds to the injected sequence (Fire 1998). They first observed this effect by targeting a gene required for muscle contraction, called *unc-22*. When double stranded RNA specific to *unc-22* was introduced into the worm, it caused the worm to exhibit twitching movements, similar to those observed in worms lacking *unc-22*. This experiment was repeated to target a couple other genes known to cause atypical movements when mutated, all resulting in pronounced and specific phenotypes. They also found that mRNAs of these targeted genes are degraded upon the injection of double stranded RNA, establishing RNAi as a mechanism for post-transcriptional regulation (Fire 1998).

This pioneering study earned the Nobel Prize in Physiology or Medicine in 2006 and opened a new field in small RNA-mediated gene regulation. It was subsequently discovered that gene regulation through RNA interference occurs naturally in *C. elegans*, as deep sequencing revealed a population of endogenous small RNAs (Ruby et al 2006) of varying lengths.

Today, we understand that RNA interference mediated by small RNAs is conserved among higher eukaryotes, and play crucial roles in genome defense against viruses, repressing transposons, regulating development, cellular differentiation, and more (Reviewed in Gutbrod and Martienssen 2020).

C. elegans has become a pioneer model organism in small RNA biology, due to its transparent body, ease of cultivation, but notably its high number of argonaute proteins, 27, compared to just 2 in drosophila, 10 in arabidopsis, and 4 in mammals (reviewed in Gunter meister 2013).

Why study the small RNAs?

These questions have been at the forefront of nematode RNA biology research for the past few decades.

One intriguing aspect of small RNAs is that they can mediate the inheritance of epigenetic information across generations. In the germ cell nuclei, small RNAs can engage in the RNA interference pathway to influence genome architecture by directing the deposition of histone modification marks, thus affecting the chromatin accessibility. These changes in genome architecture cause misexpression of genes, often resulting in fertility defects. Small RNA pathways can also influence the inheri-

-tance of behaviors such as pathogen avoidance and chemotaxis (how the worm moves) across generations. For example, *C. elegans* can quickly learn to avoid the pathogenic bacteria *Pseudomonas aeruginosa* as a food source by altering its olfactory preferences upon exposure. Intriguingly, this learned avoidance behavior can be inherited for four generations!

What can we learn from nematode small RNA biology? To understand the significance of small RNAs, we can look to the groundbreaking work of researchers like Victor Ambros and Gary Ruvkun, whose recent Nobel Prize honors their contributions to our knowledge of small RNA biology in nematodes. Ambros and Ruvkun discovered microRNAs, a type of small RNAs that can silence genes by inhibiting protein production. Notably, the *let-7* microRNA discovered by Gary Ruvkun's group is crucial to developmental timing and tumor suppressor function. Since their discovery, researchers have shown that microRNAs are highly conserved and present throughout the animal kingdom. Failures and disruptions in their regulatory functions can lead to various diseases and disorders.

The complexity and versatility of small RNA-mediated gene regulation remains a relevant and important topic in developmental biology. More recently, there has been a focus on membrane-less RNA-protein condensates that surround the nucleus, called germ granules, which are thought to serve as the organizing centers of small RNA pathways. Germ granules are not unique to *C. elegans* - they are also observed in xenopus, drosophila, and zebrafish, and are important for maintaining germ cell fate, ultimately affecting species survival. The continued exploration of small RNAs promises to deepen our understanding of developmental biology and offers new avenues for addressing diseases linked to gene regulation.

- Gerald Lerchbaumer

Unlocking Bliss: The Surprising Benefits of Yoga and Meditation

-Samini Hewa

The practice of meditation and yoga originated thousands of years ago in India and was largely associated with religion and the growing popularity of these practices globally can be attributed to the health benefits supported by scientific research. The incorporation of yoga and meditation into day-to-day life alongside standard medical care can improve both mental and physical well-being. As such, the National Institutes of Health now considers these practices as a form of Complementary and Alternative Medicine.

Both yoga and meditation are classified as mind-body therapies. These types of therapies are used to promote the relaxation of body and mind by integrating techniques such as mental focus, controlled breathing, and body movements. In addition to general wellness, studies have shown that therapeutic yoga can be used to treat various conditions such as addiction, stress, anxiety, chronic pain, and irregular sleep patterns. Regular yoga practices can also enhance muscle strength, body flexibility, and cardiovascular function among other benefits.

A controlled study conducted on heart failure patients showed that meditation played a role in lowering levels of neurotransmitter called norepinephrine. This study compared two groups of patients, a group which practiced regular meditation and a group that didn't. The amount of norepinephrine in blood samples of the meditation group was lower than the control group. Norepinephrine is also involved in anxiety and this study provides evidence that meditation can be helpful in dealing with anxiety as well.

There are numerous studies illustrating the ben

efits of yoga for both mental and physical health. The practice of yoga can lead to an increase in serotonin levels while decreasing enzymes that breakdown cortisol to help reduce depression. Regular yoga sessions also help improve muscle strength which is especially important for those suffering with musculoskeletal conditions such as arthritis, carpal tunnel, and chronic pain. A clinical trial assessing the effectiveness of yoga for osteoarthritis of the knee showed that patients saw a reduction in pain following eight yoga sessions.

Both yoga and meditation can easily be incorporated into a daily routine, as they do not require special equipment. Some yoga poses can even be done sitting down which is useful for those that are sitting down for long periods of time. Listed below are a few simple chair yoga positions to try out.

Upward salute pose (Urdhva hastasana): *strengthens the legs, engages the core, and improves balance.*

- Sit with feet flat on the floor, hip-width apart.
- Raise your arms straight above your head, keeping them parallel with palms facing each other.
- Engage your core and lift slightly off the chair, as if you are hovering above it.
- Hold the position for 5-10 breaths, then lower back down to the chair.

Cat-cow pose (Marjaryasana and Bitilasana): *helps relieve tension in the back and improve posture and flexibility in the spine.*

- Sit at the edge of the chair with feet flat on the floor.
- Place hands on the knees or thighs.
- Inhale and arch the back, lifting the chest and looking up (Cow Pose).
- Exhale and round the spine, tucking the chin towards the chest (Cat Pose).
- Repeat for 5-10 breaths.

Happy baby pose (Ananda balasana): *helps stretch the back and relax the shoulders.*

- Sit at the edge of the chair with feet hip-width apart.
- Inhale and lengthen the spine.
- Exhale and bend forward from the hips, allowing the hands to reach between your legs and grab your outer shins, ankles or feet.
- Hold for 5-10 breaths, release the grip, and slowly rise back to a seated position.

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The Rhythm of Research: Prof. Shafer on Finding Patterns in Evolution, Sleep, and Scientific Life

- Ruby He

Prof. Maxwell Shafer's pioneering research is shedding new light on the evolutionary genomics of sleep. In this interview, we explore how his lab's work is unraveling the genetic and evolutionary factors behind sleep behaviors in fish species and beyond.

Prof. Shafer joined our faculty as an Assistant Professor in 2023. With a Ph.D. from McGill University and postdoctoral experience at Harvard University and the University of Basel, he brings a wealth of expertise to our department. His research has made significant contributions to our understanding of the evolutionary mechanisms underlying circadian rhythms and sleep patterns in vertebrates. His research explores the evolutionary mechanisms behind circadian rhythms and sleep patterns in vertebrates. His lab focuses on investigating the genetic and evolutionary factors contributing to diverse sleep behaviours across species, focusing particularly on fish.

By combining bioinformatics and computational genomic approaches with neurobiological and molecular comparisons, Shafer lab aims to elucidate the variations in sleep patterns among different fish species.

What brought you into academia, and what attracted you to study the evolution of sleep?

I grew up in a small town, and no one in my family had been involved in research before. Biology was always one of my favourite but I didn't really know it was a career option until my second or third year of undergrad. In grad school, I took a course on evolutionary developmental biology. That course opened my eyes to viewing traditional, medicine-based model organism research through an evolutionary lens.

From there, I was gradually drawn to papers on comparative sleep research across different species, which raised interesting questions like: 'Do other animals have the same multiple sleep states that humans do?' 'What can we learn about the mechanisms behind human sleep patterns by studying the extreme sleep behaviours of other species?' In general, it was a gradual process of discovering academia as my career path, starting with my interest in evolutionary developmental biology from the evo-devo course to this intersection of evolutionary biology, brains, and behaviours.

What future directions do you see for your research, and how do you plan to address emerging challenges in your field?

(chuckles) I can't give you a certain answer as to what the specific challenges are , as I tend to work on very different topics from time to time.

A juvenile crepuscular cichlid *Lepidiolamprologus* is most active at dawn

Max and his colleagues from Switzerland, Dr. Annika Nichols and Laura Fritschi (MSc), during field work at Lake Tanganyika in Zambia

In my postdoc, I started doing single-cell genomics. Then I went on to study behavioural comparisons, and later ancestor reconstruction and paleontology. I always want to do and learn something new, taking a broader and broader perspective—zooming out rather than narrowing in.

What role has mentorship played in your career, and how do you approach mentoring your own students?

The key to good mentorship is finding the right mentor-mentee match. I've had three supervisors: one during my undergrad and master's, one for my Ph.D., and one for my postdoc. Each one of them had a very different mentoring style, just as all the mentees they had were different. You can't necessarily be a good mentor for everyone, so you need to ensure there's a match at some point. Certain mentees need certain mentors, and certain mentors work better with certain mentees.

For my personal mentoring style, I focus on providing a lot of positive reinforcement and candid feedback to my students rather than relying on negative reinforcement. I think very few mentees respond well to negative reinforcement, and those who do will respond just as well or better to positive reinforcement.

As a grad student, I often feel that experimentation and paperwork yield negative results on a daily basis. How do you motivate your students in the face of rejections and negative feedback from the objective world?

Everyone at every level experiences a bit of imposter syndrome. Most of what we do is failure—most of our grants don't get funded, most of our students don't want to join our lab, and most of the labs you want to join are full and reject you. There's much more rejection than acceptance. However, sharing these experiences and being open about failure can normalise things and put them into proper context. If I notice someone is heading in the wrong direction, I make it clear to them by providing positive feedback first and then offering constructive criticism.

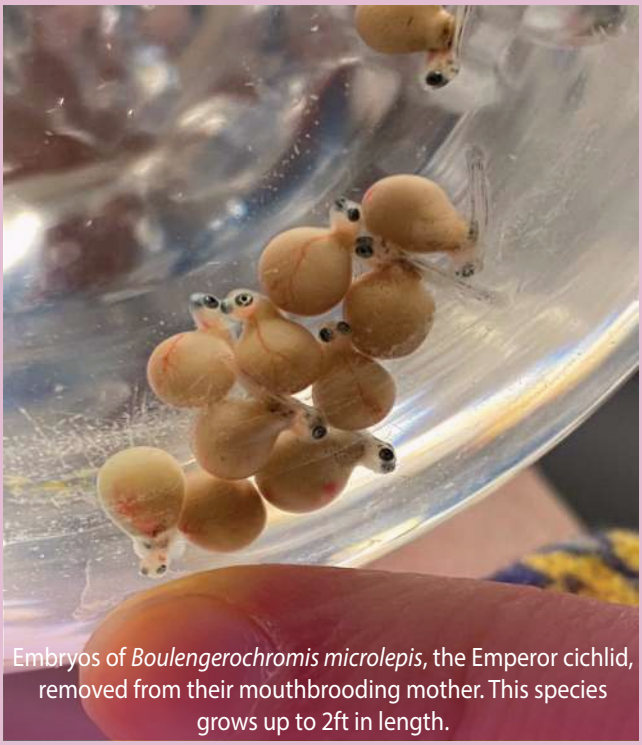
In general, what attracts you the most to biology, and do you have certain aesthetics in your research?

I really like neuroscience because it is something we understand the least compared to many other fields. Despite all the crazy tools and technology we have to monitor the activity of all the neurons in the brain at once, we still have no idea how the brain works because of its complexity. In general, no matter the field, the most important thing for me is to constantly try different things, put them in wider contexts, and compare them to similar things happening in different fields—never being satisfied with the current scope and always trying to find something that motivates me more.

With the development of the bioindustry, do you see different career paths for our new undergrad and grad students outside of academia?

The career path depends on the opportunities provided by the environment, and there are places with a deeper history in the biotech industry. When I was an undergrad, most students wanted to get into medical school and become doctors. When I was doing postdocs in Switzerland, 80-90% of the Ph.D.s there entered companies like Roche and Novartis, two of the biggest biomedical research companies in the world. So it really depends on where you are and where you will be.

Altolamprologus calvus, a nocturnal cichlid



Embryos of *Boulengerochromis microlepis*, the Emperor cichlid, removed from their mouthbrooding mother. This species grows up to 2ft in length.

Tropheops moori, a diurnal cichlid

From Video Games to Virtual Zebrafish: Prof. Lin's Trailblazing Work in Computational Neuroscience

- Maksym Shcherbina

Prof. Qian Lin joined the Department of Cells and Systems Biology as Assistant Professor in 2022. She has conducted pioneering research in systems neuroscience. Her lab dives into the neural mechanisms that underlie cognition and behaviour, using zebrafish as a model to observe brain-wide dynamics. Prof. Lin is mapping how neural circuits drive complex decision-making by leveraging computational biology and advanced imaging.

From Gaming Enthusiast to Neuroscientist

Her journey began with something far more familiar to many of us: video games. "I mainly played computer games, like Age of Empires," she recalls with a smile, noting that she still plays the game today. "Not coding [back then], just [playing] computer games." This familiarity with computers would prove to be prophetic later in her career.

Coding Sparks: Discovering a Hidden Talent

During her undergraduate years, Prof. Lin's approach to finding her scientific calling was refreshingly practical. She tried everything: structural biology, bioinformatics, and animal models, including frogs and pigeons. Through this exploration, she discovered two key elements defining her future career: a natural aptitude for coding and a preference for working with zebrafish.

The coding revelation came as a surprise to her. Despite no prior programming experience, she excelled in her compulsory C programming course. "I was bad at other courses, but I did really well in this one," she reflects. This unexpected talent, combined with a strong foundation in mathematics and physics, would later prove invaluable in her computational neuroscience work.

Exploring the World: How Travel Shaped Prof. Lin's Academic Path

Prof. Lin's path to academia wasn't initially driven by a burning desire to become a professor. Instead, it was sparked by a practical desire to see the world. "I wanted to go abroad," she remembers thinking. "The only way was to get a scholarship. And to get a scholarship, I had to be in a PhD program." This decision led her on a global journey from Singapore for her PhD, to Vienna for her postdoctoral research, and eventually to New York City when her lab relocated. Each move brought new challenges and opportunities, from learning MATLAB and English simultaneously in Singapore to help transport biological materials across continents.

Bringing Virtual Reality to Zebrafish: Innovating Neuroscience Research

Today, Prof. Lin's research combines cutting-edge virtual reality technology with zebrafish neuroscience. Her lab develops virtual environments where head-fixed zebrafish can "swim" through digital landscapes, allowing researchers to study brain activity during natural-like behaviours.

But how natural is this digital environment for the zebrafish? "It's like when I was a kid," she explains, drawing a parallel to her gaming background to describe this model of study. "The video game, the visual part was quite dumb from [a modern] standard, just pixels... but we're still enjoying it. We can still immerse ourselves into the video games we have." This insight drives her approach to developing virtu

al environments for zebrafish, starting with simple designs and iteratively improving them.

Unlocking the Mysteries of Brain Coordination

Her current work tackles one of neuroscience's fundamental questions: how different brain regions coordinate to perform complex tasks. Her approach combines virtual reality, behaviour tracking, and whole-brain imaging - taking advantage of zebrafish larvae's transparent nature to observe neural activity across the entire brain at single-cell resolution.

The technical challenges are significant, from creating natural-feeling virtual environments to analyzing the massive amounts of data generated. Her lab uses deep learning models to predict fish movement from tail posture, and they're constantly iterating on their virtual reality setups, currently on the third version of their virtual environment, built in the 3D engine, Unity.

Fostering Resilience in Research

Prof. Lin is very thoughtful in her approach to mentorship and scientific well-being. Drawing from her experiences with research pressure, she emphasizes the importance of maintaining good health alongside scientific pursuits. "Research, most of the time, we don't have positive feedback," she acknowledges, sharing how she learned to cope through exercise, martial arts, and even the comfort of her two cats.

Advice for Aspiring Computational Biologists

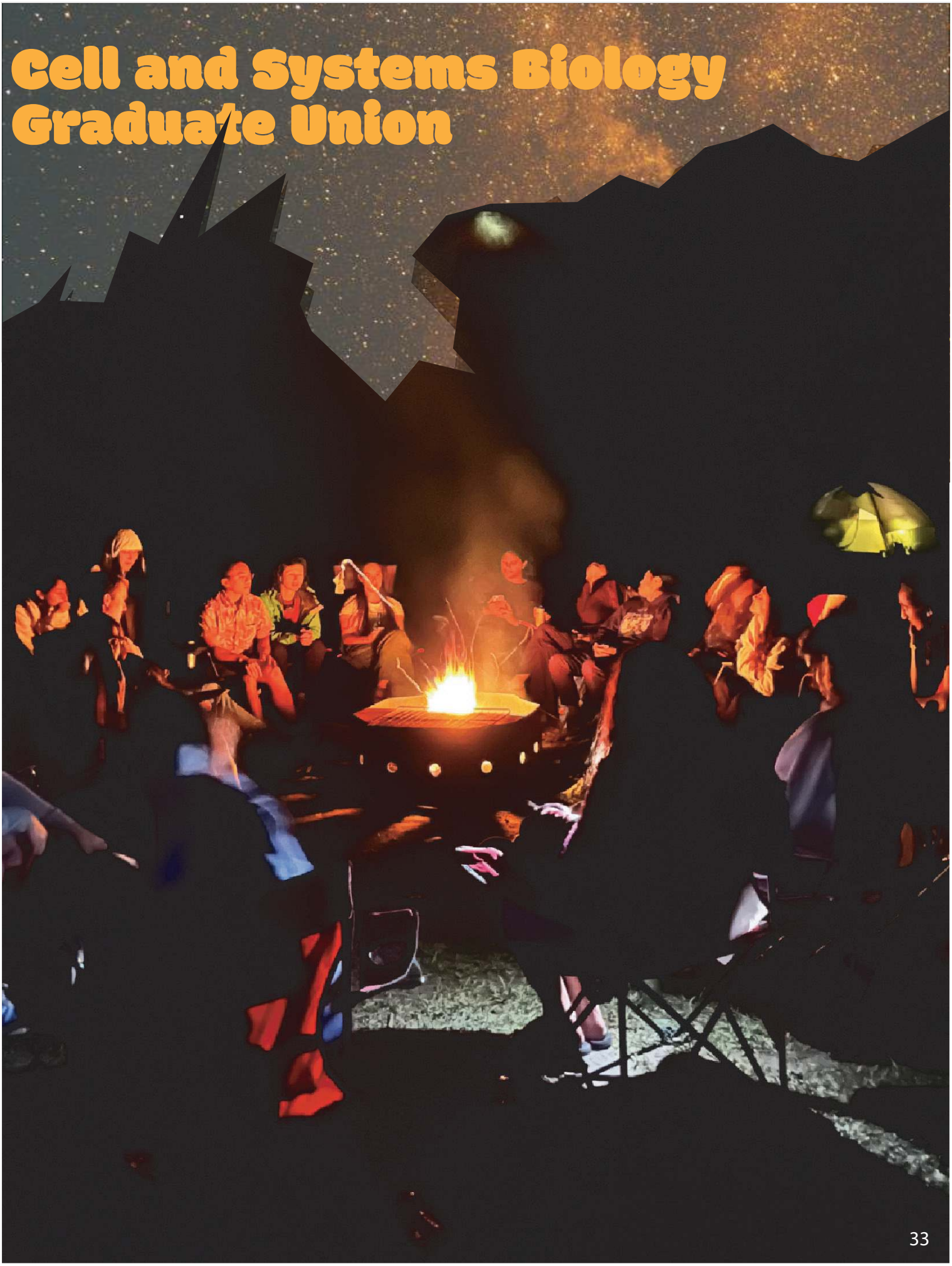
Her advice to aspiring computational biologists? Master the fundamentals of linear algebra and maintain a passion for neuroscience. But at the same time, "Everyone can bring something to the table," she emphasizes, noting how her students often surprise her with creative solutions she hadn't considered.

As artificial intelligence and computational tools continue to advance, Prof. Lin sees exciting possibilities for neuroscience research. Whether using deep learning for behaviour prediction or potentially modelling entire neural systems, she maintains a balanced perspective between technical innovation and biological understanding.

For those contemplating their career paths, Prof. Lin offers wisdom gained from experience: "It's impossible to plan early." Instead, she advocates for trying different experiences and following what feels natural, noting that sometimes fewer options can help clarify our path forward.

In her journey from casual gamer to pioneering neuroscientist, Dr. Lin exemplifies how diverse interests and experiences can converge into innovative research. Her work continues to push the boundaries of what's possible in neuroscience, **one virtual swim at a time**.

Cell and Systems Biology Graduate Union



CSBGU Bake Sale hosted by Angela (Communications Director) and Una (Ombudsperson) in March 2024.

Who we are?

Coming into graduate studies can be daunting. As it is an entirely different dynamic than undergraduate studies; with a less stringent schedule, varied social dynamics, and a more unstructured workplace. We as your **Cell and Systems Biology Graduate Union (CSBGU)** are here to make this transition easier and (hopefully) more enjoyable!

We are a diverse group of students committed to organizing engaging events and advocating for graduate students in the department of Cell and Systems Biology. The CSBGU is composed of students from various research backgrounds across all three campuses.

We work as a liaison between the department and the students. By taking part in different committees at the university, **we represent and advocate for the diverse voices of students at CSB.** One such committee is the University of Toronto Annual General Meeting where improvements to student equity, bursaries and awards, and representation by the Canadian Union of Public Employees (CUPE) are discussed.

What we do?

The CSBGU is your union. Our primary concerns are listening to and addressing your concerns and relaying them to the department, as well as promoting student entertainment to unwind! Each year, we **hold a variety of events across all three campuses, including pumpkin carving contests, trivia events, pub nights, and hosting intramural sports such as volleyball and ultimate frisbee.** Hungry on the job? Our semi-regular breakfast club is an opportunity for students to meet members from other labs over tasty pastries and other breakfast treats. Additionally, every year we host a fundraiser to raise money to donate to a charity – each year raffle tickets are sold to students and faculty for a chance to win prizes at the yearly CSB holiday party at the Faculty Club!

Each month we host trainee talks, wherein volunteers from the department present their unique and exciting research to their peers and faculty.

Stephen and Mario (Co-Presidents) with their commemorative Trainee Talk stickers given to volunteers after their seminar.

Cindy Hong presenting at the May 2024 Trainee Talks.

These talks are a fantastic opportunity to practice their public speaking skills as well as promoting interdisciplinary discussion from across the department on their research. **New to the department? Each year we also host meet the labs,** where each lab presents a poster outlining the key research being conducted in their lab, giving everyone a great opportunity to get to know their peers and the research being conducted in the department. We also **host orientation sessions for first-year grads** where they can ask senior students for advice on what advice they have for grads just beginning their thesis. These are just a handful of the events which we organize.

In addition to the events previously mentioned, we also host **monthly coffee breaks, scholarship preparation sessions,** and a myriad of other events. We are always open to new ideas for events to engage with the CSB graduate community. If you have any ideas for an event or initiative you would like to see – don't hesitate to reach out to us. We would love to hear from you!

Remember to *follow us on the official CSBGU Instagram (@CSBGU)* to stay up to date with our latest events!

Join us!

Every September, the graduate union welcomes new and returning grad students to join the union to help bring in new ideas and activities for the union and department! The CSBGU is a fantastic way to get more involved in the CSB community. If you're interested, don't hesitate to apply when elections roll around. We can't wait to hear from you!

The winners (Moses lab) of the 2023 CSBGU Pumpkin Carving Contest.

CSBGU Camping Trip August 2023
Nawrah Khader, Andrew Duncan, Mario Filice, Karan Ishii, Shanelle Mullaney, Bailey, Tatiana Ruiz Bedoya,Kathryn McTavish

Winners of the CSBGU Halloween Trivia in October 2023 ; Left to right; Denise Le, Kathryne (Undergrad in Moses lab at the time), Andrew Duncan, Karan Ishii, Fernando Valencia

Gingerbread House Building, December 2023

First Year Grad Orientation Lunch in September 2023.

Cite me !

Animal Physiology

1. Areej N. Al-Dailami, Angela B. Lange, Ian Orchard; (2024) *The glycoprotein hormone receptor (LGR1) influences Malpighian tubule secretion rate in Rhodnius prolixus* . J Exp Biol
2. Areej N. Al-Dailami, Ian Orchard, Angela B. Lange; (2024) *RhoprCAPA-2 acts as a gonadotropin regulating reproduction in adult female, Rhodnius prolixus.* General and Comparative Endocrinology

Developmental Biology

1. Tirthankar Ray, Damo Shi, Tony J. C. Harris; (2024) *Confinement promotes nematic alignment of spindle-shaped cells during Drosophila embryogenesis*. Development
2. Rebecca Tam, Tony J.C. Harris; (2024) *Centrosome-organized plasma membrane infoldings linked to growth of a cortical actin domain.* J Cell Biol

Gene Regulation and Computational Biology

1. Andrew G Duncan, Jennifer A Mitchell, Alan M Moses, (2024) *Improving the performance of supervised deep learning for regulatory genomics using phylogenetic augmentation*, Bioinformat-

Genomics and Evolutionary Biology

1. Arnaud N'Guessan, Yuan Tong, Hamed Heydari, Alex N Nguyen Ba (2024) *Refining the resolution of the yeast genotype–phenotype map using single–cell RNA–sequencing* eLife
2. PJ Oelbaum, RP Hall, DL Whyte , et al. (2024) *Reproductive populations of the Critically Endangered bat Phyllonycteris aphylla at two new locations in Jamaica.* Oryx.
3. Steven K. Chen, Jing Liu, Van Nynatten, A. et al. (2024) *Sampling Strategies for Experimentally Mapping Molecular Fitness Landscapes Using High–Throughput Methods*. J Mol Evol
4. Nicholas A Boehler, Shane D I Seheult, Muhammad Wahid, Kazuma Hase, Sierra F D'Amico, Shakshi Saini, Brittany Mascarenhas, Matthew E Bergman, Michael A Phillips, Paul A Faure, Hai–Ying Mary Cheng, (2024) *A novel copy number variant in the murine Cdh23 gene gives rise to profound deafness and vestibular dysfunction*, Human Molecular Genetics
5. Yeshoda Y Harry–Paul, Josianne Lachapelle, Rob W Ness; (2024) *The Evolution of Gene Expression Plasticity During Adaptation to Salt in Chlamydomonas reinhardtii*, Genome Biology and Evolution

Neurophysiology

1. Haushe Suganthan, Domenic D . Stefano , Leslie T. Buck (2024) *Alfaxalone is an effective anesthetic for the electrophysiological study of anoxia-tolerance mechanisms in western painted turtle pyramidal neurons.* PLoS ONE

Neuroscience

1. Benjamin Tsang, Robert Gerlai; (2024) *Nature versus laboratory: how to optimize housing conditions for zebrafish neuroscience research* Trends in Neuroscience
2. Omer A Syed, Benjamin Tsang; (2023) *Managing expectations with psychedelic microdosing.* npj Mental Health Res
3. Omer A Syed, Benjamin Tsang, Robert Gerlai (2023) *The zebrafish for preclinical psilocybin research.* Neuroscience & Biobehavioral Reviews
4. Omer A Syed, Benjamin Tsang, Rotem Petranker, Robert Gerlai (2023) *A perspective on psychedelic teratogenicity: the utility of zebrafish models* Trends in Pharamacological Science
5. Yingtian He, Xiao-lin Chou, Andreanne Lavoie, Jiashu Liu, Milena Russo, Bao-hua Liu; (2024) *Brainstem inhibitory neurons enhance behavioral feature selectivity by sharpening the tuning of excitatory neurons.* Current Biology

Virology

1. Arvin T. Persaud, Jasmin Khela, Claire Fernandes, Deepa Chaphekar, Jonathan Burnie, Vera A. Tang, Che C. Colpitts, Christina Guzzo (2024) *Virion-incorporated CD14 enables HIV-1 to bind LPS and initiate TLR4 signaling in immune cells.* Journal of Virology
2. Claire Fernandes, Arvin T. Persaud, Deepa Chaphekhar, Jonathan Burnie, Carolyn Belanger, Vera A. Tang, Christina Guzzo (2025) *Flow virometry: recent advancements, best practices, and future frontiers.* Journal of Virology
3. Deepa Chaphekar, Claire Fernandes, Arvin T. Persaud, Christina Guzzo (2025) *Comparing methods to detect cellular proteins on the surface of HIV-1 virions*. Journal of Virological Methods.

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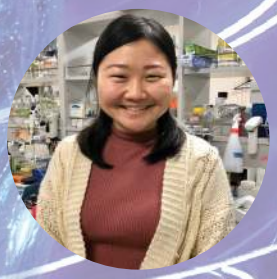

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