2023 Annual Report

Institute for
Protein
Innovation

From our President and CEO

The mission of the Institute for Protein Innovation is to advance protein science and technology to accelerate biological research and improve human health. Innovation is in our name, and we believe that research, and its subsequent reduction to practice, are key drivers of innovation.

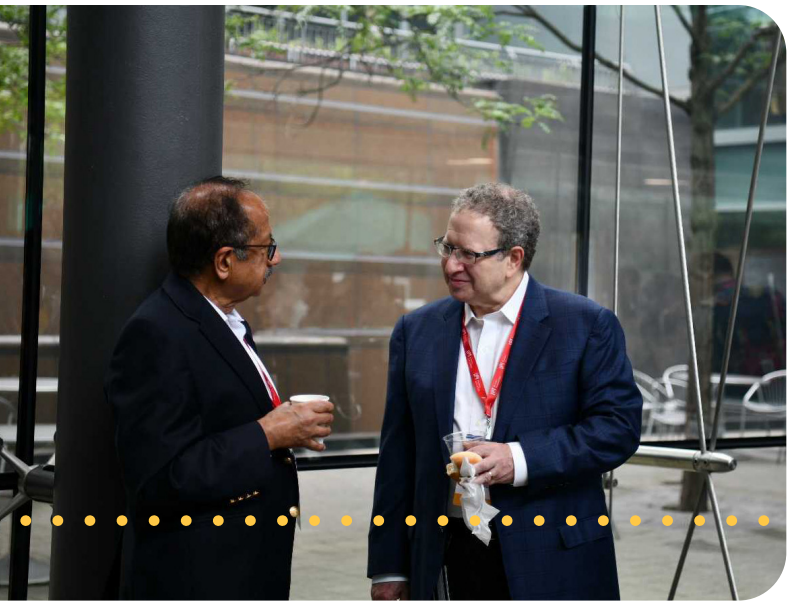
Over the last year, we have focused on innovations like creating new yeast display libraries to enhance the pool of high-quality antibody candidates for any target. We have also introduced novel nanobody scaffolds and libraries for antibody discovery to our repertoire. We have come up with new selection strategies to home in on more selective protein binders. And we are looking at machine learning tools to inform our antibody engineering efforts.

Complex problems require collaboration. Scientists need to share ideas, knowledge and data to arrive at something beyond incremental discoveries. At IPI, we are committed to sharing our ideas, methods and tools not just passively in the literature, but actively via IPI-organized workshops, classes and symposia. We have launched an education program that aims to share our protein science expertise with biomedical researchers more broadly.

We have partnered with Addgene, a nonprofit repository for research materials, to distribute our antibodies and other protein-related tools. We are delighted to report the launch of our first antibody collection, targeted to the integrin family of proteins. This collection is the first of its kind, recognizing specific integrins and, in some cases, blocking their function.

We also developed a set of epitope tag antibodies that give researchers easy and affordable access to a toolset to detect, purify and track proteins that lack more specific antibodies. As part of our commitment to make our tools and models broadly accessible, we are sharing the sequences of our epitope tag antibodies with purchasers, and making the plasmids that encode these tag antibodies readily available.

We have also opened our doors in several other ways. We have set up an antibody validation workshop model, in the spirit of the pioneering human leukocyte differentiation antigen (HLDA) workshops. We share our antibodies in sample quantities with collaborators for testing in their assays.



Ken Fasman chats with a scientist at IPI Surfacing, our June 2023 symposium on cell surface receptor biology and protein science.
IPI photo by Roushu Zhang.

Ken Fasman.
IPI photo by Caitlin Faulds.

Our partner, Addgene, has created a Data Hub through which our validators can share their data with Addgene, IPI and the broader scientific community. We will review this data and, when appropriate, integrate it into our antibody data sheets either directly or along with additional validation data.

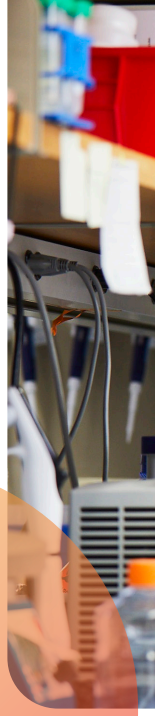
We've established an initial focus on addressing unmet needs of the neurobiology research community. In response, we created panels of antibodies focusing on axon guidance and synaptic structure. Targets involved in these processes aren't well represented in commercial antibody collections, and we believe this is a strategic area where we can make a difference. In time, our goal is to create novel protein resources for additional biological areas.

As a nonprofit, IPI can focus on unmet needs and expected impact rather than profit. At the same time, we have to think about various means of sustainability beyond revenue from antibody sales to pursue our mission into the future. We are actively developing a funding model that also includes research grants and other sponsored agreements, along with philanthropy.

We are always looking hard at research challenges where protein reagents and methods can play an active and impactful role. As we identify those gaps, we develop novel resources and make these new tools and services readily available to scientists worldwide.

Ken Fasman, Ph.D.
President and Chief Executive Officer

IPI's community-centered approach to antibody discovery: A Q&A with Rob Meijers



By Megan Talkington

Senior director of the IPI antibody platform, Rob Meijers, knows well the power of protein tools. From an extensive career in structural biology, Meijers was drawn to IPI five years ago because he saw the organization was well-positioned to discover and share much-needed synthetic recombinant antibodies for research. He helped build the IPI antibody and distribution program and now, with its launch, he's shifting focus to a large neuroscience antibody collection already emerging from the pipeline.

We sat down with Meijers to reflect on IPI's growing antibody collection and the importance of community collaboration.

Q: You're very pleased to have these new antibodies for neuronal targets. For you, what's most exciting about them?

A: Neuroscience has a great need for antibodies, for several reasons. There are not many therapeutic programs to develop antibodies in this area. And a lot of the proteins in processes like neuronal wiring and migration are highly conserved. So injecting them into mice basically will not generate great antibodies.

Another problem is that these molecular programs involve a huge number of proteins and interactions. They aren't just about one ligand binding to one receptor — these are interactomes. So what is exciting is that now, with yeast display, we can systematically discover antibodies for whole families of neuronal receptors and ligands. We don't just go after one cool target; we try to identify the protein families in greatest need of new antibodies, and then do the whole families. That approach is sort of unprecedented.

Q: How have you been working with the neuroscience community?

A: People have been very engaged. I first started talking about IPI's neuroscience aims back in 2020. I would say: We will have a very exciting set of antibodies for you to test! Now I can say: At last, we have them.

People are very excited to test these antibodies. I think they appreciate that IPI has a unique model. We're a nonprofit, and we're working to make sure our antibodies are broadly available.

Q: Is your collaborative model for antibody validation unique?

A: In a way, this is a reinvention of the HLDA workshops for antibodies against leukocyte markers, which IPI co-founder Tim Springer helped organize back in the '80s. There are also some initiatives in cancer. The YCharOS initiative is also pursuing an open model, although sort of in reverse — they're validating the antibodies of various vendors.

But what we're doing — making novel antibodies and inviting researchers to evaluate them — at the moment is pretty unique, at least in neuroscience.

Rob Meijers.
IPI photo by Pat Piasecki.

Q: Tell me about some of the researchers working with you as antibody validators.

A: They have very different backgrounds. But you can see even in their publications that they're obsessed with antibodies because they're such important tools.

Alexander Jaworski from Brown University is a great example. He's studying ROBO signaling at the axon growth cone. We first sent him antibodies in 2020. It turned out those were very wimpy antibodies. But we kept going. We at IPI figured out how to make better antibodies. And Alex now is testing something like his third panel of antibodies. Finally, he's being rewarded with something that works.

Dima Ter-Ovanesyan and his coworkers at the Wyss Institute at Harvard are looking for neuronal exosomes to use as diagnostic markers for neuronal pathologies. They need a way to pull down the neuronal exosomes, away from all the exosomes from other cell types. They've found a neurexin that very likely is a specific marker. Now they need an excellent antibody to that protein.

We're giving Dima a whole panel of neurexin antibodies to test — and he's all over it, testing the panel beyond what he needs for his purposes. For us, that's very important. We need people willing to look at whole panels, because we want to learn if our antibodies are specific among family members.

Q: What happens to the validation data that researchers collect?

A: For antibodies that succeed, everyone will be able to see the data through Addgene's Data Hub. So users will be able to evaluate whether the antibody may be useful for their application. Transparency is very important to us. And this will be a dynamic process. Even after antibodies are in the catalog, we will actively look at what the community is saying.

Q: Are you still building your community of collaborators?

Oh yes. I want to hear people's ideas about what our next antibody targets should be. And I'm looking for people who will be validators for our next panels. We really would like to create an international community of validators.

The response has been very positive. People are really happy to help the whole community get better antibodies. I'm also hopeful that they may benefit from their generosity. They can use the antibodies in their research before we start publicly distributing them. They may find something interesting!

Q: Will IPI's efforts be limited to neuroscience?

A: I started with neuronal navigation — a community that I know well from my own research and that has a core set of targets everybody needs tools to study. But a lot of these targets are also important in other areas of biology: cancer, angiogenesis, stem cell biology. My hope is that the community will grow organically.

Engineering for efficiency: André Teixeira heads antibody discovery and library design

By Megan Talkington

It's a few minutes after noon, and the lunchtime conversation at IPI turns to the antibody display library — the source material from which the team hunts for antibodies that bind to specific targets. Someone asks: What exactly is the library's composition? What makes for a good library?

"There's no one good library," says André Teixeira, IPI's new director of antibody discovery and library design. "The best library is the one that gives you what you need."

His comment reflects a hallmark of his scientific style: efficiency. In building a career in protein science and engineering, Teixeira has pursued experimental tools to maximally deliver results. And the tools he knows especially well are protein display libraries.

"André has an encyclopedic knowledge of libraries," says Rob Meijers, senior director of the antibody platform at IPI. "That's his passion. And that's exactly what we need."

Paths to impact

Teixeira's fascination with molecular interactions started when he was a child, growing up in São Paulo, Brazil.

Both of his parents — his mother, a psychologist, and his father, a mechanical engineer — imbued everyday life with scientific curiosity. For young Teixeira, the tricky molecular questions his father posed at lunchtime (for example, "Why does ice float on water, if ice and water are made of the same thing?") were especially appealing.

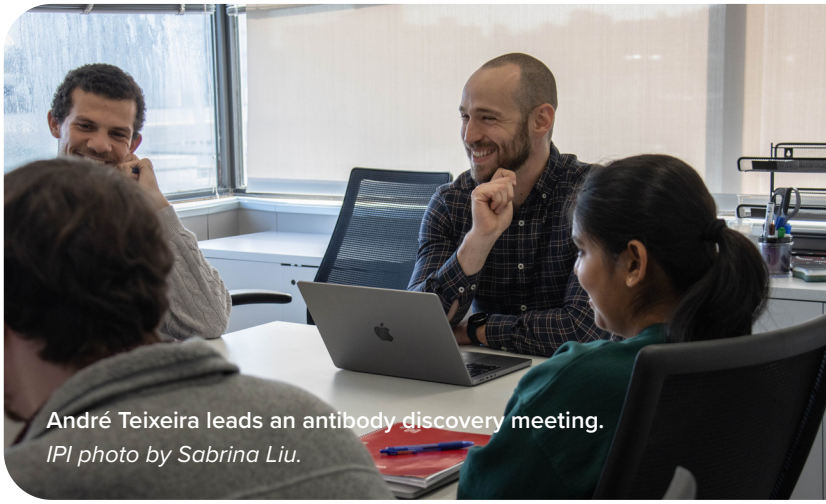
In high school, a chemistry teacher introduced an even more astonishing idea: Every living creature, including a human being, is a combination of molecules and chemical reactions — and one could intervene in those chemical processes to create desired effects.

Teixeira fixed on that idea: He wanted to find a way to contribute to the discovery and development of drugs.

He started by studying pharmacy at the University of São Paulo — and, while still a student, joined a computational lab modeling protein interactions based on physical chemistry principles. He found that proteins and their surrounding solution were so complex that computing power constrained the size of the systems he could simulate. So he created simplified models that enabled researchers, even with limited resources, to take on bigger systems.

For his Ph.D. research, also at the University of São Paulo, he moved to the wet lab to study Chagas disease, a neglected tropical disease caused by the parasite *Trypanosoma cruzi*; it primarily affects people in rural communities in Central and South America.

In studying *T. cruzi* infection, Teixeira set out to understand both sides of the battle: to identify the parasite proteins that recognize human cells, and map the antibodies that



André Teixeira leads an antibody discovery meeting.
IPI photo by Sabrina Liu.

André Teixeira. *IPI photo by Sabrina Liu.*

the human body generates to retaliate. With thousands of parasite proteins and a nearly infinite antibody response, he again needed a way to manage complexity. He turned to protein display technologies — in which, by engineering phage or yeast to brandish proteins on their surfaces for recognition, scientists can test millions or billions of interactions at once.

In 2016, near the end of his studies, Teixeira visited collaborators at the University of New Mexico. There, he met antibody engineer Andrew Bradbury, who was launching a new company, Specifica, to build antibody display libraries for discovering therapeutics. Teixeira was enthralled. He returned to Brazil to defend his dissertation, then traveled back to the U.S. to join the company.

In particular, the synthetic antibodies derived from libraries often suffered from "liabilities" like instability and indiscriminate binding. Before those molecules could become drug leads, they had to undergo extensive engineering. Teixeira and the team wanted to obviate the extra, cumbersome steps. So they systematically reengineered every aspect of their libraries — including the antibody scaffold structures, diversity and liabilities. By maximizing functional diversity and eliminating liabilities, they were able to select antibodies with drug-like properties directly from the libraries, without any further optimization.

Redirecting to research

Over time, Teixeira witnessed antibody discovery technology evolve such that it no longer bottlenecks drug development. Rather, he says, what now limits researchers' ability to find new treatments is knowledge of the underlying biology.

"There's only a handful of targets that everyone is working on," he says. "We need new targets."

> At IPI, we don't have single targets, we don't even have a few targets — we have hundreds of targets.

Enabling researchers to unravel biological mechanisms and find new therapeutic targets is exactly the challenge IPI takes on. The Institute aims to generate reagent antibodies for whole families of proteins, including proteins that haven't been well-studied. That approach paves a route away from well-trodden targets to novel discovery.

The approach also sets up for Teixeira a new design challenge: outfitting antibody engineering to generate fit-for-purpose antibodies at unheard-of scale.

"The usual antibody discovery paradigm," he explains, is "one high-value target and an entire company devoted to that one molecule." An antibody discovery operation typically pours time and resources into selecting the best binders and refining candidates through extensive protein engineering.

But at IPI, "We don't have single targets, we don't even have a few targets — we have hundreds of targets," he says. To reach the organization's mission-driven goals, he says, "we have to be efficient."

The right tools for the job

To achieve that efficiency, Teixeira and his team have been interrogating every step in their pipeline — identifying and carefully implementing changes that can achieve the most significant gains. Already, the scientists are seeing substantial increases in successful antibody discovery. Meanwhile, they're constructing and testing new libraries of antibodies built with different scaffold sequences and variable regions.

Meijers is thrilled. "Before, it took us a year to make one library," he says. "Now André is making the next library in one or two months."

News from the lab

Reaching out to the community

More than 300 attendees gathered at our first ever symposium, IPI Surfacing, to discuss progress in cell surface receptor biology and protein science. The event celebrated a generous $210 million gift from IPI co-founder Tim Springer that sustains the Institute, allowing it to focus on its mission to accelerate research and better serve the biomedical community. The symposium featured posters from early-career researchers, talks from protein scientists Christopher Garcia, Yvonne Jones, Andreas Plückthun and Junichi Takagi, and a lively panel discussion on the promise of synthetic antibodies and the challenges to universal access.

IPI Surfacing attendees fill the Joseph B. Martin Conference Center at Harvard Medical School in June 2023.

Improving libraries

At the heart of every antibody discovery campaign at IPI is a yeast display library. The library contains approximately 10 billion yeast cells, each brandishing a particular antigen-binding fragment (Fab) on its surface. In 2023, scientist Deepash Kothiwal and research associates Nick Hollmer and Youssef Atef AbdelAlim created a third generation Fab library that better mimics the naïve B cell repertoire of the human immune system, more precisely controls the frequency of each amino acid in the Fab sequences and ensures diversity of the complementarity-determining regions. These features are key to creating a potent and varied pool of potential binders. Library 3.0 is already enhancing our ability to discover strong and specific antibody candidates. Many are being tested, or are in use, by labs around the world.

Find information on IPI events here!

Hosting seminars

IPI hosted seminars in 2023 that highlighted compelling protein research and innovative approaches to protein science. Carl Laflamme of YCharOS and the Structural Genomics Consortium discussed antibody characterization and the value of open science. Alexander Jaworski of Brown University spoke on novel ligand-receptor interactions involved in axon guidance and neural circuit assembly. Thomas Biederer of Yale gave an in-depth look at approaches and tools to map synapses. And Adrian Salic detailed the intricate series of lipid handoffs that drives the transfer of ligands to receptors in the Hedgehog pathway. Thank you to all our speakers! We'll have more talks to come in 2024.

Sharing insights

Our scientists traveled near and far sharing expertise with other researchers — ahead of a burst of new collaborations emerging around antibody validation in the coming year. Rob Meijers participated in a panel discussion on antibody validation at Cell Bio 2023. Principal scientist Shaotong Zhu attended a prestigious course at Cold Spring Harbor Laboratory on Antibody Engineering & Display Technologies. And postdoctoral fellow Nirakar Basnet spent a month in Berlin, Germany, visiting collaborators and presenting data on antibodies targeting the elusive mu-opioid receptor.

Rob Meijers participates in an YCharOS-led panel on antibody validation at Cell Bio 2023.

IPI antibodies

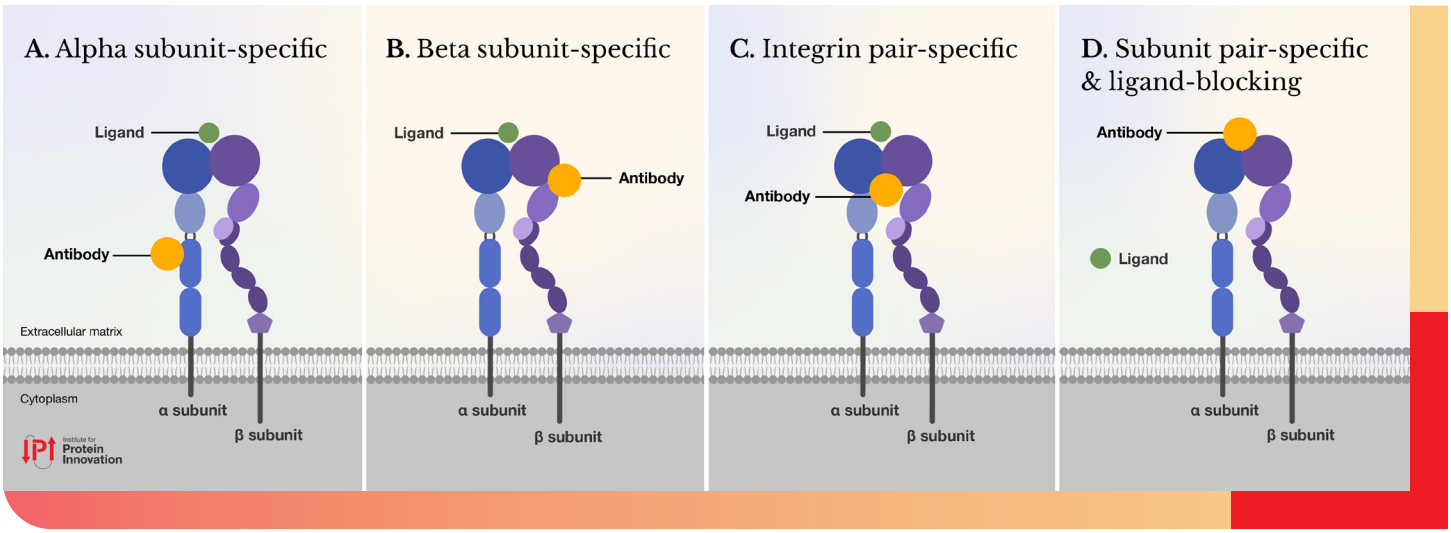
This year saw the launch of the IPI Antibody Collection, sets of antibodies targeting particular protein families and tagged proteins. Distributed through our nonprofit partner, Addgene, the antibodies are a readily available collection of protein resources for the biomedical community. Here is what's already in the collection and what will be coming soon!

Integrin antibodies

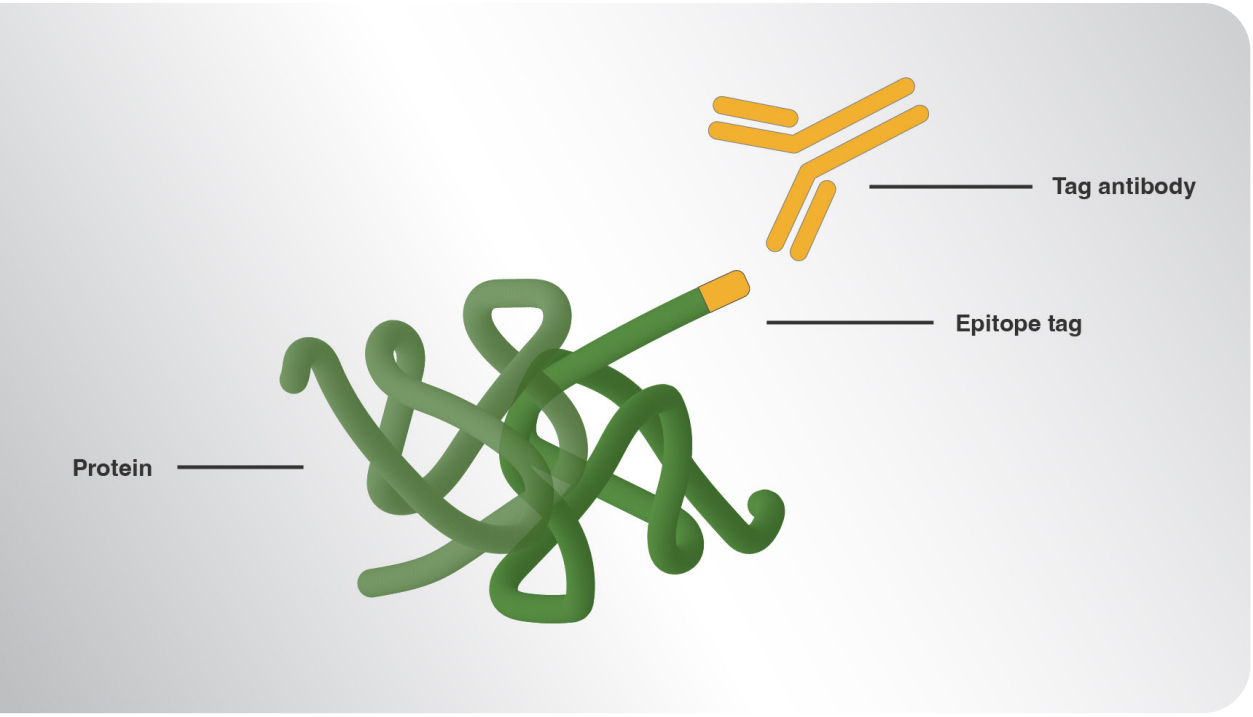
Integrins are crucial cell surface receptors involved in complex signaling pathways and the linkage of intra- and extracellular environments. IPI developed a unique set of 26 antibodies targeting integrin family members, some of which have not been specifically targeted before. The antibodies bind to discrete subunits or subunit pairs to block ligand binding, interrupt integrin function and identify integrin presence.

Amongst the anti-integrins are 11 synthetic recombinant antibodies discovered at IPI using yeast display technology, and 15 hybridoma-derived antibodies developed with Tim Springer's lab over the past several decades, then converted to recombinant IgGs at IPI.

The toolset is extensively characterized and recommended for use in flow cytometry. Scientists can use the antibodies to study signaling, test mechanotransduction or ascertain distinct receptor functions — all key to drug development.



The IPI collection contains antibodies that uniquely: (A) Bind to the alpha subunit, outside the ligand-binding pocket. (B) Bind to the beta subunit, outside the ligand-binding pocket. (C) Bind to specific subunit pairs, outside the ligand-binding pocket. (D) Bind to specific subunit pairs, blocking the ligand and receptor function. *IPI figure by Sabrina Liu*.



IPI antibodies recognize specific epitope tags, allowing a tagged protein to be detected, purified or localized. *IPI figure by Sabrina Liu.*

Epitope tag antibodies

Epitope tags are short amino acid sequences fused to a protein's N- or C- terminus. When paired with an antibody that specifically recognizes this sequence, epitope tags can help purify, detect or localize particular proteins. However, epitope tag antibodies can be expensive and, therefore, difficult to obtain.

To fill the gap, IPI developed recombinant versions of antibodies that recognize common epitope tags, including V5, Protein C, DYKDDDDK, Rho, His, Biotin, EE, GCN4 and Strep. These antibodies are now easily and inexpensively available through Addgene.

True to our open science model, we will be sharing the antibody sequences with purchasers and releasing the plasmids that encode the antibodies later in the summer.

"Making the sequences available," says Rob Meijers, senior director of the antibody platform at IPI, "allows people to make the antibody in their own lab, save a lot of money and have control over the material."

Browse our antibody catalog!

Neurobiology needs

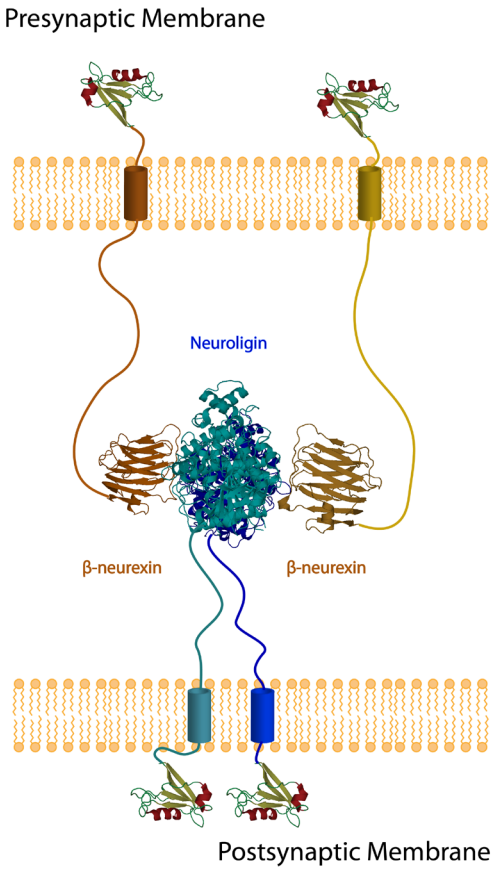
The need for reliable, specific antibodies is particularly significant in neuroscience. Thus, IPI is concentrating its efforts on key neuronal protein families, including proteins implicated in axon guidance and synapse formation.

Neurexins

Neurexins are a family of cell adhesion proteins that sit predominantly in the presynaptic membrane, mediating synaptic connection and synapse production. One of the primary binding partners of neurexin is the ligand **neuroligin**, which sits in the postsynaptic membrane. "The immediate application for IPI neurexin antibodies is to help characterize the pre- and postsynaptic sides of the synaptic cleft," says research associate Minh Anh Kieu. The ability to differentiate pre- and post-synapses might help to inform research on cognitive disorders, including schizophrenia and autism.

Semaphorins

Semaphorins are extracellular signaling proteins that guide axonal growth cones by deflecting axons away from no-go areas. Repulsion has particular importance in neural system development. Semaphorins interact primarily with **plexin** receptors and often bind with co-receptor **neuropilin**.

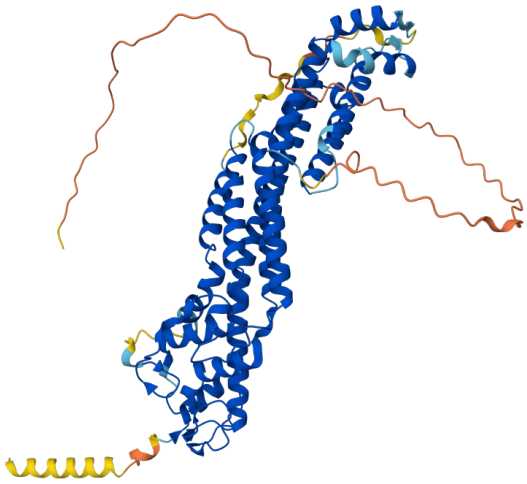


One of neurexin's primary binding partners is neuroligin. *Figure courtesy of Studentne/Wikimedia Commons.*

Are you interested in these or future IPI antibodies? We're looking for scientists who want to field-test our antibodies before full release. How does the process work? We ship you novel recombinant antibodies free of charge. You use them in your assays or studies, ahead of public distribution. In exchange, you can tell us how they perform by uploading your results to Addgene's Data Hub or joining one of our validation workshops. Reach out to antibodies@proteininnovation.org to learn more!

Glypicans

Glypicans are a family of glycosylated proteins involved in shaping tissues and organs during embryonic development. Glypicans interact with morphogens, such as **Wnt** and **netrin**, affecting neuronal cell migration. Additionally, glypicans are overexpressed in several cancers, including breast and pancreatic cancer. “There’s a lot of interest in developing anti-GPC1 antibodies and in the apparent heparan sulfate groups attached,” says senior research associate Nick Hollmer. These molecular investigations could offer insights into embryonic development and cancer.



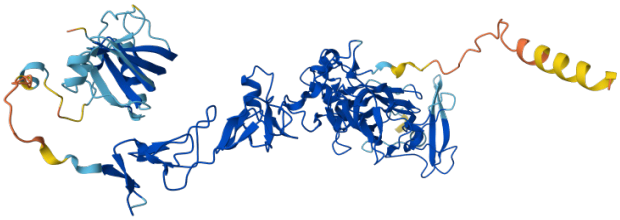
Structure prediction of human glypican-1.
Figure courtesy of AlphaFold/DeepMind Technologies Limited.

ROBO

The Roundabout or **ROBO** family of proteins are transmembrane receptors also involved in axon guidance. In the nervous system, some ROBO receptors form a complex with secreted **Slit** ligands. Together, they can regulate axonal midline crossings and are especially important in central nervous system development. “The ROBO target is one of the most important targets at IPI,” says research associate Mina Abdollahi. “We produce antibodies for ROBO1 and ROBO2, and we want to find the best candidates to produce antibodies specific for both targets.”

Netrins

Netrins are extracellular proteins that direct cell and axon migration in the early stages of embryonic development. One of their primary receptors is **DCC** (for deleted in colorectal cancer), named for its role in cancer but also essential in extending axons down the ventral midline and developing the brain and spinal cord column.



Structure prediction of human netrin-1.
Figure courtesy of AlphaFold/DeepMind Technologies Limited.

Innovation comes naturally to IPI's director of automation Curtis Walton

By Caitlin Faulds

When Curtis Walton was young, he'd disassemble household items, diligently learning about their inner mechanisms as he reassembled them.

Growing up in Sarnia, Ontario, he pulled off this exercise on the family computer, but failed on a prized clock — leaving parts and pieces askew, much to his father's dismay. In high school, he channeled this astute curiosity into the robotics team, where he engineered bots that could complete small tasks, like throwing basketballs or stacking pyramids.

His team, #1084, never made it to the finals of the FIRST Robotics Competition, but his early explorations taught him the basics of mechanization and design — skills he now adeptly applies as the director of automation at IPI.

"At IPI, we're looking across the board," Walton says, "coming up with a plan to improve productivity and discover more antibodies for the research community."

The effort is key to the Institute's maturation from a start-up-like nonprofit to a go-to organization making protein tools and knowledge easily available and accessible to the biomedical research community.

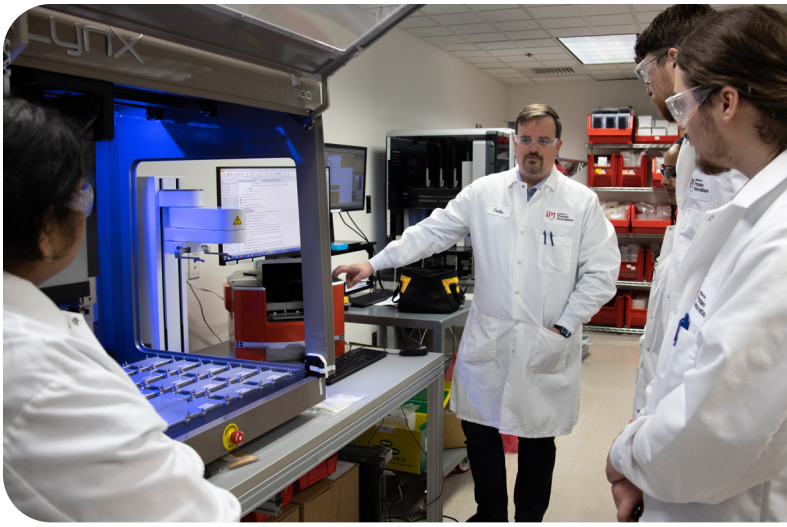
The mechanics of life

Walton's part in that mission has roots in his early robotics competitions. But at the University of Ottawa, he faced a choice: pursue programming and software engineering or become a scientist. He settled on the life sciences, excited to explore the questions of life, rather than the mechanics of clocks, computers and automatons.

Biology, he felt, could reveal molecular interactions that impact health; but chemistry could strip problems back to their fundamental chemical framework. Putting the two together and studying biochemistry, Walton could finally understand how molecules were built, why they interacted in such seemingly complex ways and how they fulfilled particular functions.

More specifically, Walton became enthralled with aminotransferases, a group of enzymes important in amino acid metabolism. These biocatalysts can be used to track disease and replace toxic heavy metal catalysts in the synthesis of enantiopure compounds, which are pure chemical compounds that exist in just one unique shape or chirality. For his doctoral research, he focused

“We’re in a very unique position to help advance the biomedical field,” he says, “and put antibodies out into the world that wouldn’t otherwise be made available.”



Curtis Walton showcases the Lynx 96VVP, an automated liquid handler widely used at IPI. *IPI photo by Sabrina Liu.*

on engineering aminotransferases to produce a variety of aromatic D-amino acids, “high-value building blocks” that are used in the synthesis of pharmaceuticals.

Always automating

From there, he took his first post-graduate position in 2018 as a scientist at a Canadian cannabinoid research startup, Hyasynth Bio. Until the mid-2010s, Canadian authorities treated marijuana as a controlled substance, making research into the pharmaceutical compounds of cannabis difficult. But with legalization in 2018, that roadblock was lifted. Hyasynth was at the forefront of the race to develop microbial-derived cannabinoids that could be used for research or market products, and they needed a protein scientist with a startup mentality — someone like Walton.

It was a “very easy transition,” according to Walton, who spent two years engineering lead candidates and identifying potential enzymes for cannabinoid production in bacteria and yeast.

By August 2020, Walton was ready for a change. He moved to the U.S. and joined a growing computational team at Conagen, a commercial biotech using enzyme and microorganism platforms to deliver synthetic biology solutions to the food and beverage, renewable materials and pharma markets alike.

As a senior scientist at Conagen, Walton was given carte blanche to lay the foundations of an automation infrastructure, gearing up the lab for more effective production. Given his background and knack for building labs — a skill he learned on the fly during grad school — he was promoted to director of computational and automated biology, where he gained daily experience running a multidisciplinary team spanning bioinformatics, protein engineering, analytical chemistry and strain engineering.

“Productivity or innovation is questioning established protocols, thinking outside of the box and coming up with new and better ways of performing engineering,” Walton says.

Fostering discovery

Walton was happy leading this charge in industry, but then he stumbled onto IPI, where the principles and protocols of an industrial pipeline were being deployed for scientific impact rather than profit. As a nonprofit, IPI was producing antibodies to families of proteins studding the cell surface, known as the cell surfaceome, and expanding access to those imperative protein tools — and the Institute was ready to scale.

“If we want to tackle the surfaceome or every single human protein, the only way we’re going to achieve that is with automation,” says Walton.

In the short term, Walton is focused on gathering the right hardware and constructing the best team. Once these foundations are in place, he aims to upgrade IPI’s systems, improve workflow and increase capacity for automation within just a few years. His end goal is to use automation to develop a robust and consistent pipeline, freeing scientists of repetitive tasks so they can allot more time to research and discovery.

“We’re in a very unique position to help advance the biomedical field,” he says, “and put antibodies out into the world that wouldn’t otherwise be made available.”

Youssef Atef AbdelAlim carries protein science lessons to medical school

By Caitlin Faulds

For IPI research associate Youssef Atef AbdelAlim, science is synonymous with patient care. He's run antibody discovery sorts, engineered protein libraries and performed fluorescence microscopy. He's rounded the clinics, organized vaccination appointments and assisted with cardiac care. At every stage, he's seen how science and medicine intertwine.

After a year and a half at IPI, he's now headed to medical school to focus on patient wellbeing as he fulfills his dream of becoming a physician.

"The connection between science and people is what drew me in," he says. "Seeing patients recover, it's just really fulfilling."

Youssef Atef AbdelAlim pipettes in the IPI lab.
IPI photo by Caitlin Faulds.

"The science of us"

As a youngster in Cairo, Egypt, then Worcester, Massachusetts, Atef AbdelAlim loved engineering and mathematics. His parents, passionate about medicine and science, encouraged him to channel these interests into biology. He remained in Massachusetts to pursue bioengineering and biochemistry at Northeastern University. He was drawn by their cooperative education program that integrates experiential learning as part of the four-year degree.

During one six-month internship, Atef AbdelAlim joined Ultivue's research and development team, working on fluorescence microscopy imagery of immune cells in cancer tissue. He gained experience with antibodies, DNA and cancerous tonsil tissue — which encouraged him to "explore medicine more," he says.

He began devoting time to extracurricular research and volunteered at a Tufts Medical School remote call center, where, during the depths of the pandemic, he helped organize more than 10,000 COVID-19 vaccination appointments for Boston residents. He also shadowed brain surgeons and anesthesiologists back in Cairo, as part of his family's annual trips to Egypt.

He learned a critical reality of modern-day medicine: "Doctors don't spend a ton of time with patients," he says, "but the impact they have on these people is huge."

He spent his next co-op in the cardiac surgery unit at Brigham and Women's Hospital (BWH) researching the efficacy of mitral valve regurgitation repair surgery, an operation that repairs a connection between the two left-side chambers of the heart. At BWH, he worked directly

with patients for the first time. While sitting in on one heart surgery, he had the opportunity to touch a beating heart.

“It’s the realest it gets,” he says. “This is the science of us.”

Contributing to protein science

In 2022, after graduation, Atef AbdelAlim wanted another perspective on medicine. He applied for a job at IPI, drawn by the Institute’s open science outlook and its mission to advance protein science in the form of antibody discovery, which he saw as playing a major — if often obscured — role in overall health goals.

“IPI is not making drugs, per se, but we’re helping to make those things eventually,” he says. “I thought that would be a cool way to contribute to human health.”

As part of the antibody discovery team, Atef AbdelAlim helped grow IPI’s yeast display library, run fluorescence-activated cell sorting and carefully winnow billions of antibodies down to just a few prime, well-binding antibody candidates. Along with director of antibody discovery and library design André Teixeira, scientist Deepash Kothiwal and senior research associate Nick Hollmer, he also reengineered the IPI yeast library to better mimic the naïve B cell repertoire of the human immune system — an exploratory project that took the better part of a year.

“The most exciting moment was when we finished the last piece of [the library], the last germline combination,” he says.

While spending his days in the lab, Atef AbdelAlim was studying for the MCAT, sending applications to more than 30 medical programs and attending zoom interviews across the U.S. and Canada.

“The application to medical schools is definitely a marathon,” he says. “Everyone has been super supportive here.”

An end to the marathon

In fall of 2024, Atef AbdelAlim will attend the Hackensack Meridian Medical School in New Jersey or McGill University in Montreal, Canada. He hopes to pursue cardiac surgery, but for the time being, he’s keeping the door open to other specialties.

Although research and antibody discovery will no longer be his day-to-day focus, he’ll bring an in-depth understanding of antibodies and the many steps necessary to build effective therapeutics. Additionally, he’s taken IPI’s experimental, scientific mindset to heart.

“Curiosity is an important skill they teach here [at IPI]. It’s important not to be shy to learn,” he says. “You’re only going to learn by making mistakes.”

IPI 2023 Scrapbook

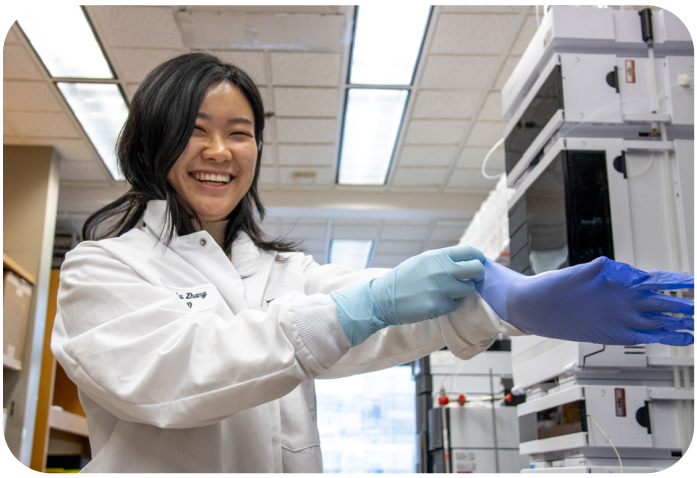
A mid-hike selfie from senior scientist Anita Ghosh, senior scientist Haiying Li, science writer Megan Talkington, associate director Haisun Zhu, research associate Miriam Li and intern Pranav Vishwanath, during the fall 2023 platform retreat.

Rob Meijers, senior director of the antibody platform, chats with director of antibody discovery and library design André Teixeira and science writer Megan Talkington.

Scientists enjoy a sunset at the 2023 platform retreat in coastal Massachusetts.

IPI integrin antibodies, ready for distribution.

UX designer Sabrina Liu plays ball during a spring picnic.



Senior scientist Roushu Zhang prepares to analyze the chemical composition of samples by high-performance liquid chromatography (HPLC).

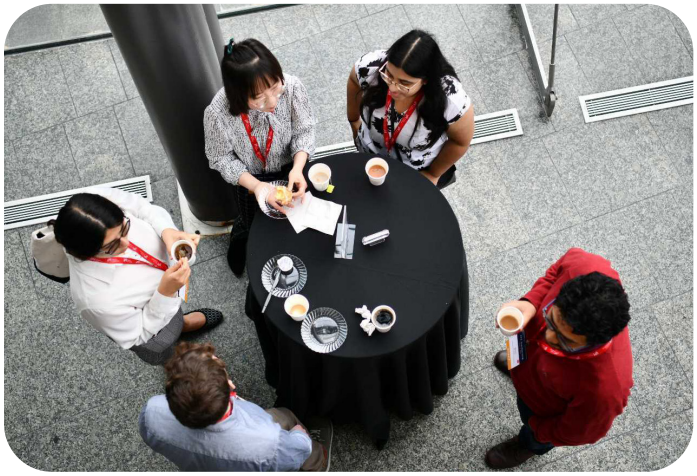
The IPI team at our fall 2023 platform retreat.

IPI photos by Pat Piasecki, Roushu Zhang, Sabrina Liu and Caitlin Faulds.

Research associate Mina Abdollahi, research associate Filmawit Belay and intern Pranav Vishwanath enjoy the fall 2023 platform retreat.

IPI Surfacing celebrated a $210 million gift from IPI co-founder Tim Springer and his wife Chafen Lu.

Research associates Minh Anh Kieu, Chang Yang and Filmawit Belay pose at the 2023 platform retreat.



Researchers gather at IPI Surfacing.

IPIers dress up in lab-themed outfits for a Halloween costume contest.

The IPI team during an outing at the New England Aquarium to celebrate the launch of IPI Surfacing.

Senior research associate Chang Yang presents work at the IPI Surfacing poster session.

proteininnovation.org

The Institute for Protein Innovation is pioneering a new approach to scientific discovery and collaboration. As a nonprofit research institute, we provide the biomedical research community with synthetic antibodies and deep protein expertise, empowering scientists to explore fundamental biological processes and pinpoint new targets for therapeutic development.

Our mission is to advance protein science to accelerate research and improve human health.

Institute for Protein Innovation

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This annual report covers the 2023 calendar year. Future reports will align with the IPI fiscal year, July 1 to June 30.
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