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INFORMATION FOR STUDENTS INTERESTED IN RESEARCH

When I first went to college, I had no idea about research. Or that I could find myself actually doing research as a student. I recall one day in my sophomore year going to see my professor. He invited me into his lab, but he was busy with two students, discussing the results of an experiment they just finished. I recall that day vividly because I saw the look of excitement on all of their faces. I didn't understand at all what they were discussing, but I could see that everyone was thrilled by what they had found and were busy reviewing the data and planning the next experiment. When he was free he spent some time answering my questions and when I asked about what he was working on, he explained his research. And, more importantly, he sensed my interest and he invited me to "sit in" on their weekly lab meetings. So, that's how it started for me. And I have never looked back. The following year I started my own project, designed my own experiments, presented my work to the group, and got to go to local scientific meetings. And I knew that this was what I wanted to do with the rest of my life. Not everyone figures it out so soon, or so easily. But research can be an exciting endeavor. It's not for everyone. But, the important question is, how do you know if it's for you?

What is research?

Simply stated, research is the search for the truth. Most scientists spend their lives trying to understand some small part of the natural world and figuring out how things work. In our lab, we generally employ the tools of molecular biology to study cells at the level of the gene. Generally, we are interested in genomics and how information that is encoded in the DNA program plays out in the life of a cell. Much of our time is spent sequencing genomes and identifying novel genes and proteins. In the past few years our lab has focused on jellyfish venom.

Why Jellyfish?

Well, first of all they're cool. Plus, when I got stung by a jellyfish in 2009, I was fascinated by the physiological response. The sting was painful, turned red, my affected skin felt hot, and began throbbing. I knew this was not life threatening (although some jelly stings can be!) but the biologist in me couldn't stop thinking about what was happening at the level of my cells. I knew that the tentacles I had brushed up against had triggered the firing of a specialized organelle – called a nematocyst or cnidocyst – and had injected me through tiny thread-like harpoons and delivered a cocktail of proteins that were now causing my physiological response. But I couldn't help but wonder "what are these proteins doing?" "How do they cause pain?" "How are they initiating an inflammation response?" "Why does my skin feel hot?" "Why is it throbbing?" A lot of good science starts this way. A casual observation in the field. A sense of wonder about an unknown organism or mechanism. A decision to probe the system and design experiments to understand what is happening. So, that's how we started to work on jellies.

And why venom? And what is venomics?

Historically, animal venoms have proven to be a rich source of neuroactive peptides. A billion years of evolution has produced a diverse collection of toxin protein families whose members are designed for defense and/or to incapacitate or kill prey. Frequently these venom proteins or peptides target cells (*i.e.*, neurons, erythrocytes) and more specifically, channel proteins that regulate the flow of ions across biological membranes. As a result, exposure to vanishingly small amounts of venom can produce intense pain, redness, inflammation and a myriad of other acute physiological effects including cell death.

Jellyfish envenomations are often painful and sometimes life threatening. However, the venom of jellyfish has not been as widely exploited as a source for neuroactive peptides and drugs. Preliminary data from our laboratories has demonstrated that crude venom isolated from the Stinging Sea Nettle contains proteins that have a profound and acute affect on both neurons and erythrocytes. Our laboratory is pioneering the emerging field of venomics which seeks to identify and catalog the genes encoding for the proteinaceous components of venom. It is our hope that this will lead to the discovery of novel pharmacophores and provide leads for the development and design of new therapeutic agents to treat pain, neuro-inflammation, and related neurological disorders.

Where do you fit in?

As a student interested, or thinking that you may be interested in research, you are in the right place. If you are motivated, willing to commit some time, and dedicated to hard work, you are in the right place. Your place is often individualized, but typically follows as such. In your first few months, you will do reading and catching up. You will be invited to meet with fellow students in our biweekly lab meetings. Here you will get to hear other students report on their experiments and be a part of group discussions to plan future experiments. Sometimes we discuss recently published papers that are relevant to our work. Your first lab experience will typically be assisting another student on their project. Then, if things go well, you are ready to go on to your own project if you choose.

What is the cost?

Typically, we want at least 10 hours a week. I look for students to start reading and getting the literature integrated into their general schema. I also expect a degree of professionalism

and seriousness. The more you put in, the more you will get. Expect some grunt work such as prepping solutions or autoclaving materials, entering data, working on projects that may not interest you initially, and some criticism. While we have a good time in the lab, we also work hard.

What are we looking for?
Interested students. With all sorts of talents. At the moment, we especially need students comfortable with coding and some experience in Python, Perl, R, or other commonly used programming languages. Web building skills are also valuable. On the molecular side it helps if you have some experience in gel electrophoresis, micropipetting, PCR, and basic microbiological technique. But none of this is required. You just need to be dedicated and willing to learn. We can teach you all these skills and more if you are a serious student.

What are the benefits?
First, you have a chance to gain experience that is on par with any you will get at a top-rated school. Secondly, you have a good chance of getting published if you work hard. You will also gain a chance of getting to know other researchers in the field. In short, you get all the benefits of working in a major laboratory with individualized attention.

What are some topics I can research?
You are not limited by topic. In fact, creative topics are encouraged as long as they may lead to a testable hypothesis that can reasonably be completed in terms of both time and equipment. It has been the lab's belief that students studying what they want to study tend to work harder. Below is a list of some recent things we have been working on, but one is truly only limited by her or his imagination.

- Jellyfish venomics
- Isolation, purification, and biophysical characterization of nematocysts
- Biochemical fractionation of cnidocyst proteins
- PCR amplification and DNA sequencing of selected jellyfish gene families
- Fluorescent proteins in jellyfish
- Transcriptome analysis of jellyfish
- Development of eDNA methodologies for field detection of jellyfish
- Phylogeny of jellyfish based on DNA barcoding
- Bioinformatics of genomic and transcriptomic libraries
- Others – just come up with a good idea and we can talk

How do I start?
So, how do you know if research is for you? If you think you might be interested, the simplest way to find out is to try it. Two initial steps. First, fill out an application. Second, read some of our publications – these are available on the laboratory website (www.gaynorlab.com). Write down questions and potential topics of interest. And of course, talk to me about your thoughts. The sooner you master your material, the sooner your lab experience can start.

Thank you again for your interest. If you have questions, comments, or concerns please contact me. I look forward to hearing from you.

Dr. John J. Gaynor