

## **An Interview with Dr. Allison Coffin**

Chinmayi Balusu

I had the honor of interviewing Dr. Allison Coffin, Ph.D., Associate Professor of Neuroscience at Washington State University Vancouver. Dr. Coffin is interested in sensory biology, and she is especially interested in how fish sense their environment and how they hear. Dr. Coffin's focus is on using fish to understand more about our own hearing, including protecting our hearing. Her research is primarily based on how larval zebrafish, which have hearing cells, respond to loud noise or damaging drugs. In this interview, Dr. Coffin talks about her path to pursuing research in hearing, the research that is currently taking place in the Coffin Lab, and the importance of research on hearing.

**Chinmayi Balusu: “How did you become interested in neuroscience? What made you become interested in hearing specifically?”**

**Dr. Allison Coffin:** “Actually, I didn't start out being interested in neuroscience. My interest in hearing led me to neuroscience, and that all came through my interest in fish. I started out wanting to study marine biology; I went to college for marine biology in Florida, and while I was there I learned that some fish can produce sound to communicate with each other. For some reason, the idea of noisy fish talking to each other underwater just fascinated me. I wanted to know more about how the fish could do that. If the fish could make sound, did that mean that they could hear what the other fish were saying? It never even occurred to me that fish have ears because we don't see their ears.

I did my Ph.D. studying fish hearing. It was during that time that I learned how we can use fish as a biomedical model to understand our own hearing as well, and I dove into neuroscience. It was a very circuitous, windy, yellow brick road.”

**Chinmayi: “That's very interesting! Are there certain types of fish that are easier to research hearing in?”**

**Dr. Coffin:** “There definitely are! In my lab, we mostly study zebrafish. Zebrafish are like the mouse or lab rat of the fish world. We study the babies, the zebrafish larvae, which are the size of an eyelash. They're great for studying hearing because they have hearing cells, which are called hair cells. These fish have hair cells in their ears and also on the outside of their body in a system called the lateral line, which helps them detect water moving around them. Since zebrafish larvae are really small, we can put an entire

fish under a microscope and see all of its hearing cells at once to try to learn more about what they're doing.

There are some other fish that are also really good to study because while zebrafish are great for working in a lab they don't actually make sound. There's another species of fish called the Midshipman fish that is found off of the west coast. The male Midshipman fish sing to attract females and the females will pick a mate to breed with based on his song. Midshipman fish are really interesting for studying hearing because we know they need to be able to hear to reproduce, especially since they breed at night."

**Chinmayi: "What are the research questions that you are trying to answer right now in your lab?"**

**Dr. Coffin:** "One of the big questions in my lab is how the hair cells, hearing cells, of the fish, die in response to different types of damage. We know that things like loud noise, which cause us to lose our hearing, kill these cells in the fish and we want to know how that happens. We want to know the different biochemical cascades that are activated in these cells to lead to their damage so that we can intervene and develop drug therapies to forgo that damage. We're asking those questions with different types of hearing loss: with noise and certain drugs. Certain chemotherapy drugs and antibiotics can cause hearing loss by killing hair cells, and we want to know how those drugs damage the hair cells. We want to know how that is similar and different when compared to the damage that loud noise does. And, we want to know how we can customize different therapies for the different types of hearing loss."

**Chinmayi: "Wow! I never knew that there was a connection between drugs and hearing!"**

**Dr. Coffin:** "For most of the antibiotics we use, there isn't a connection with hearing loss. The drugs that you're going to get if you have a bacterial infection are generally not going to cause you any problems with your hearing.

These types of drugs are very commonly used in developing countries. In the US, they're used in patients with cystic fibrosis, lung infections, and tuberculosis. They're also commonly used to treat premature infants. And, cystic fibrosis patients and premature infants have been found to have a higher rate of hearing loss than the rest of them. Is that because of the drugs they take? In part, it probably is. We really want to know how that happens.

The other question that we're studying is how fish, frogs, and birds can regenerate their hearing because mammals cannot do that. We're specifically trying to understand how changes in amino acids within proteins could influence the function of that protein. That could then lead to a difference in whether or not those cells the protein is in can regenerate."

**Chinmayi: "What is the most interesting thing you've come across in your research so far?"**

**Dr. Coffin:** "I think one of the most interesting things is that different drugs damage hearing in different ways. Chemotherapy drugs damage hearing in different ways from antibiotics. Even antibiotics that are in the same class of antibiotics can damage hearing in different ways. We need to better customize therapies to each potential type of hearing damage."

**Chinmayi: "What is your favorite part of your job?"**

**Dr. Coffin:** "There are a couple things I love about my job. First, I love working with students in the lab, whether that's graduate students or undergraduates or high school interns. Seeing them develop as scientists and having them come to me with ideas is great because I love seeing students succeed."

The other thing--most scientists will say this--is getting to be the first to learn something. For me, fluorescent microscopy, getting to look through the microscope at beautifully colored, fluorescent samples, is just awesome."

**Chinmayi: Have you faced any obstacles in the research you're doing?**

**Dr. Coffin:** "Absolutely! One big one that comes to mind is from when I was a postdoctoral researcher at Queens University in Canada. That was my only foray out of hearing and into vision. We were trying to understand a shift in the vision of rainbow trout, which was a ton of fun. The shift is when they go from fish that are swimming around in freshwater to when they're ready to head out into saltwater. We wanted to study the changes in the retina that happened during that time. This was something that the lab had done for many years but the lab had just moved to a new university and I had just joined it so I was going to try it for the first time. For the first eight weeks, I came in seven days a week to work on this experiment. Then, at the end of the experiment, we looked at the fishes' retinas and saw that nothing happened. We did some more troubleshooting, and it turned out that the retina had changed just as we expected but our detection method wasn't picking it up. That was eight weeks of seven

days a week and then what looked like nothing. Then there was another month of troubleshooting. It was definitely a big challenge and it was a very frustrating point.”

**Chinmayi: Why do you think people should really pay attention to the research that you’re doing?**

**Dr. Coffin:** “First part, I think, is because they should care about their hearing. How many people do you know that have walked out of a concert with their ears ringing? How many people have you seen that turn up their music in their earbuds so loud that you can hear it across the room? People willfully damage their hearing all the time. Without protecting our hearing from all the things we are around, we’re going to lose our hearing very quickly. We all know older relatives that have trouble hearing and that are socially isolated because they can’t communicate in conversations and they don’t know what’s going on. It’s a challenge. We really lose our connections to the people around us when we’re not able to hear well. That’s to me why people should care about hearing in general. Our research and the research of my colleagues is important because we’re trying to find ways to prevent hearing loss from happening or to regenerate hearing after it’s been lost so that we’re not socially isolated and so people can hear and enjoy conversations with friends and family.”

**Chinmayi: “I volunteer at an Alzheimer’s special care center, and many of the residents there have severe hearing loss. Like you said, they get to the point where they are frustrated because they can’t hear what we’re telling them. Is there a possibility of doing research with fish and neurodegenerative diseases?”**

**Dr. Coffin:** “To a certain degree. Because fish are so good at regenerating, they don’t show a lot of the signs of neurodegenerative disease like humans and other mammals do. That’s because fish can continue to make new neurons in different regions of the brain, of the ear, of the retina, of the spinal cord, etc. They have really remarkable regenerative capacities! But one thing we can do in the fish is mutating genes. Then, if that leads to their loss of the ability to regenerate, we can conclude that the gene is really important for degeneration. Then, we can maybe find a way to turn that gene on in humans and see if we can spark regeneration. One of my former grad students studied ALS in zebrafish. So there are definitely ways to study neurodegenerative disease in fish.”

**Chinmayi: “Do you have any advice for students interested in neuroscience?”**

**Dr. Coffin:** “Some advice, in general, is to do what you love! For neuroscience, it’s really great to get some research experience. Volunteer in a research lab, and start

when you're in high school. If you're at a school that has neuroscience research, look into summer programs. If you join at least one, you can really get that directed research time. You don't know if you will like that type of research until you try it. Talk to people in careers that you like and find out more about those careers. Have the kind of balance you want."