Researcher studies nervous system development

Using zebrafish, Ph.D. candidate Ashley Purdy hopes to set the stage for research that could cure neurodevelopmental disorders like multiple sclerosis or epilepsy

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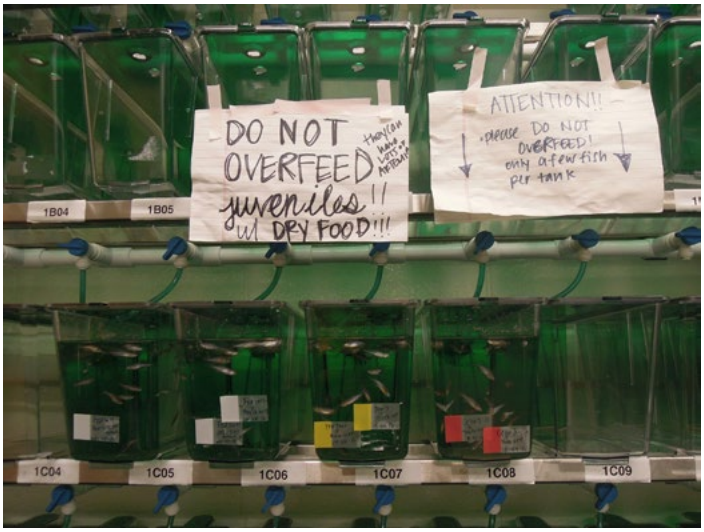
When you open your eyes in the morning, what told your brain that they needed to open? When you pull the blankets off your body and goose bumps spring up in the brisk cold of the winter sunrise, what told your skin to feel cold? When you yawn and take in a deep breath, what told your brain it needed more oxygen?

The chatty Cathys in your body are your neurons. They report to your brain, and in turn, the brain dictates to other neurons how to respond – whether it's a muscle movement,



Zebrafish that VCU researchers use to study nerve cells. (Photo by Paige Bellamy)

‘You don’t think about all the steps that are required for [a nervous system] to function normally and to have all the neurons in your brain migrate to where they need to go,’ Ashley Purdy says.

an indicator that you should get back under the covers, or just a large intake of O2.

A harder question to answer is how those gossipy neurons came to be in their exact locations when you were still just a fertilized embryo.

Ashley Purdy, a Ph.D. candidate at VCU, recently finished a master’s degree in biology looking at the development of the nervous system, and specifically at how your neurons align themselves in the spinal column.

Acting as the master mail delivery system in the body, the central and peripheral nervous systems are made up of the brain, the spinal column and nerves.

The nerve cells, or neurons, contain axons. These axons act as a post office, making sure the information packages get sent to the correct places in the body. To work correctly, the axons need proteins to form structures in the cell.

Purdy’s research renders these essential proteins null. This allows Purdy to see how each protein affects the development of the nervous system as a whole.

Your body’s “post office” often has expedited shipping in the form of a myelin sheath. This is a fatty material that preserves the electrical signal – the important package being sent from neuron to neuron, for example. Purdy’s master’s thesis centered on this sheath of cells and how it is formed.

If you didn’t realize how complicated it was to just open your eyes or break out in goose bumps, you aren’t alone.

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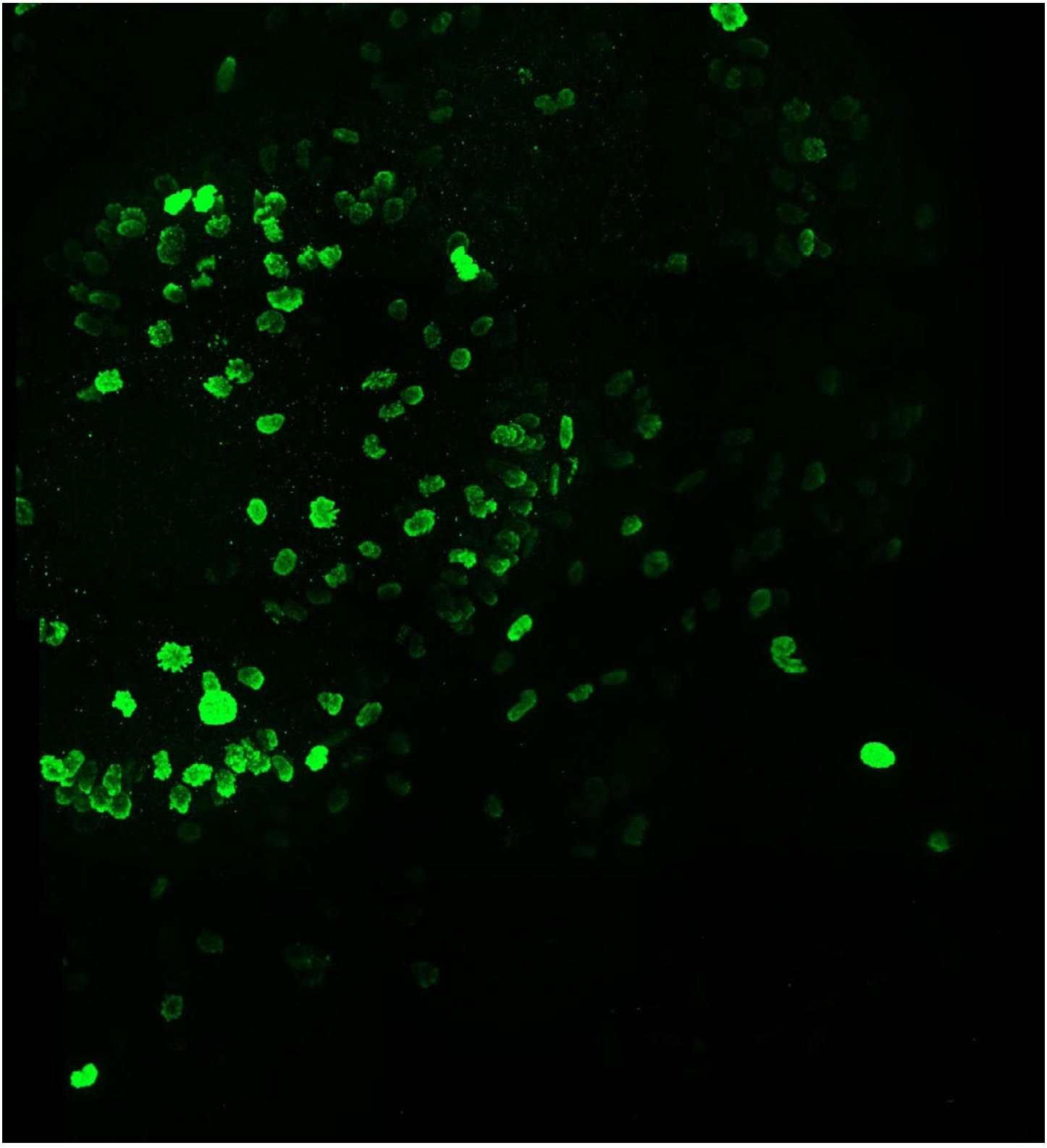
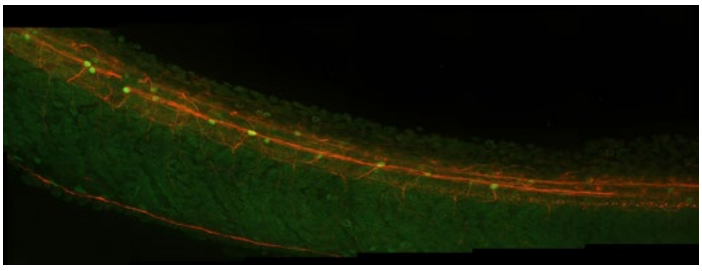


Proliferating cells in a zebrafish eye. (Photo courtesy of Ashley Purdy)

Ashley Purdy, who earned her master's degree in biology at VCU and is now pursuing her Ph.D.



A lateral view of neurons in the dorsal part of the zebrafish spinal cord. (Photo courtesy of Ashley Purdy)

required for [a nervous system] to function normally and to have all the neurons in your brain migrate to where they need to go," Purdy said.

For her master's and her Ph.D., Purdy has been working under Dr. Gregory Walsh, a developmental neurobiologist who joined VCU's Department of Biology in 2011.

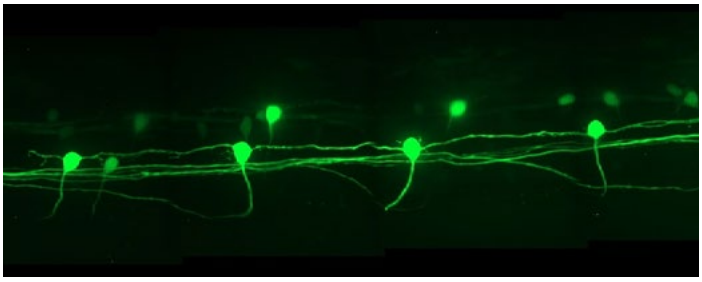
Walsh and Purdy don't just work together. They also share a similar story of "falling into" the field of neuronal development. Both began their journeys as undergraduates conducting research as an independent study and neither have strayed far from the brain since.

Since coming to VCU and establishing his lab, Walsh is happy with its progress, but he doesn't want to expand.

"I find that your interaction with each of the students decreases the more you have in the lab. [..] I don't want to get any larger because I don't want to lose that interaction," he said. "We just want to move our projects forward and try to uncover some of the molecular mechanisms that are important for neural circuit assembly."

Three Ph.D. candidates and a master's student are running a few different projects in the Walsh Lab in hopes of answering questions about how neurons and the nervous system function. Purdy hopes to do her Ph.D. project in the lab, but she hasn't fleshed out the details yet.

The research could shed light on how neurodevelopmental disorders, like multiple sclerosis or epilepsy, occur. Multiple sclerosis is a disease that damages the myelin sheath on the nerve cells, creating problems for the transmission of the electrical signals.



An up-close look at the neuron cell body and its wispy axon fibers. (Photo courtesy of Ashley Purdy)

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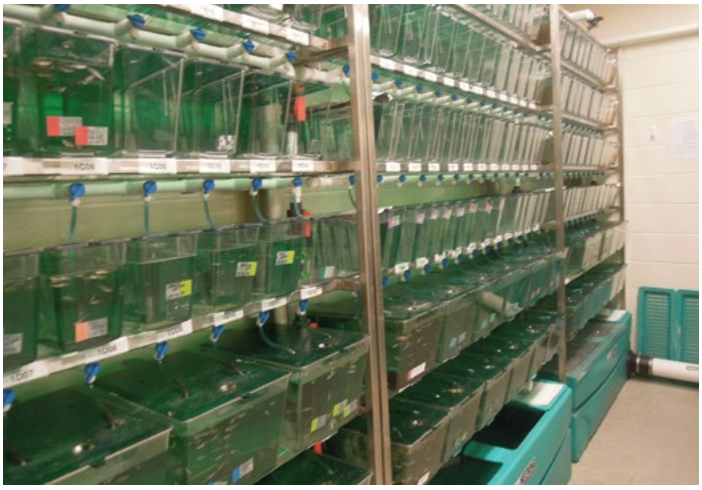

Rows of containers housing zebrafish. (Photo by Paige Bellamy)

Purdy has researched multiple proteins that, if damaged or missing, may prevent the cells from "getting to the right place, so they are unable to myelinate, which could have implications in MS down the road."

Purdy and the Walsh Lab don't use human embryos to study the development of the nervous system. They use zebrafish, a striped, freshwater minnow popular with aquarium hobbyists and research scientists alike.

One reason for using zebrafish is their unique embryos. The zebrafish embryo is transparent, which allows Purdy and other researchers to shine a laser onto the fertilized embryo and detect any changes in their development.

Another reason relates to the big picture of the study. The proteins "might behave differently in a cell culture than in an organism," Purdy said. By using the fish, the researchers can more accurately hypothesize how the human nervous system might respond when the proteins are out of commission.

In the end, after years of hard work, recognition for the researchers' important work may never come. "We aren't looking for a cure, mostly because there is lots of fundamental research that needs to be done before that can be tackled," Purdy said. "There are a lot of things that are still unknown that we need to figure out before we can make those leaps."

But when a cure for multiple sclerosis is finally found, be sure to check the works cited section at the bottom of the paper for Ashley Purdy's name. •