SIUE professor buzzing with research

Segue • SIUE

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Beyond the walls of laboratories and classrooms at Southern Illinois University Edwardsville, faculty members and students frequently collaborate on cutting-edge research projects across the University's academic disciplines.

Jake Williams, PhD, associate professor in the Department of Biological Sciences in the College of Arts and Sciences, is working on research that can certainly be described as "buzzworthy."

Photo: SIUE Photo
Jake Williams (on the left) working with a student on their bee research.

On this week's episode of Segue, SIUE's premier radio show on WSIE 88.7 FM The Sound that discusses the ideas and issues on campus and beyond, Greg Budzban, PhD, CAS dean, discusses Williams' interesting research into how insects, like honeybees or gall flies, survive under stresses associated to metabolism and freezing temperatures.

While conducting research as a doctoral student and post-doctoral researcher, Williams became fascinated with the life cycles and aging processes of flying insects. In particular, he worked with students to understand how these insects can survive being frozen solid in the winter. He discovered that when frozen solid, the insects must increase their stored food consumption and their metabolism drops. Due to climate change, he now must understand how rising temperatures effect frozen insects.

"If the temperatures are warmer and they are not eating, these insects will have to maintain their metabolic reserves to survive this critical stage in their life and survive into the spring," Williams said.

Williams works with a collaborative team of student researchers, which are comprised of both undergraduate and graduate students from across various academic areas. This research, Budzban mentions, could have major implications in the medical community.

"There is a big issue about preserving human organs for transplants," Budzban says. "Do you think this process, subjecting the organs to freezing temperatures to preserve them for later transplantation, could be possible?"

"The major challenge organisms like insects must face when they freeze is that they must limit the amount of movement of water from inside of their cells to outside the cell," Williams says. "Researchers have been successful freezing insects or single-cell organisms, but we haven't been able to successfully freeze tissues or organs in humans.

"However, certain frogs and other insects have been frozen and had viable cells, tissues and organs when thawed. If we can figure out exactly how they are able to maintain viability and try to apply it to humans, we could inevitably bank organs, and no one would ever die waiting for a transplant."

Another part of Williams' research involves how flying insects are able to withstand their normally high levels of metabolism. For example, the honeybee has the highest measured metabolic rate per mass for any animal. During flight, honeybees have a metabolic rate per mass that is three times that of a hummingbird and 30 times that of an elite human athlete. Williams wondered how these high metabolic rates are related to senescence, or biological aging, and what mechanism causes the insects to deteriorate in ability to fly over time.

"I believe this process occurs due to oxidative stress," Williams says. "Everyone hears how it's good to have antioxidants in their food, but most folks don't know what antioxidants do. Antioxidants function by taking an oxygen molecule that has an unpaired electron that needs to be donated (free radical). The electron charge as long as it remains unpaired risks damaging molecules."

"That unpaired electron can create damage like a charge of electricity," Budzban mentions.

"Exactly," Williams replies. "Antioxidants mitigate that free radical and changes it to a "native state" less-damaging molecule. Looking at honeybees that fly a lot, they show signs of senescence, and we relate that to oxidative stress. Honeybees consume so much oxygen in their normal lives. The more oxygen they consume, the greater level of oxidative stress they endure."

"I never realized how significant bee-keeping and folks that keep hives are to farmers around the world," Budzban says. "It's a multi-million-dollar industry, and now, honeybee colonies are under a significant amount of stress."

Pesticide use, loss of habitat, disease and other threats are the likely causes of colony collapse disorder, a phenomenon that was first recognized in 2006.

"Colony collapse disorder has purported the loss of at least 30 to 90 percent of colonies for given individuals or apiaries over the winter," Williams explains. "In a colony undergoing collapse, worker bees will leave the hive, which may contain the queen and a few larva. Without the worker bees, however, the colony won't survive."

In his research, along with students the University's recently-formed Honeybee Club on campus, Williams hopes to teach his students how to maintain healthy bee colonies and combat some of the issues causing bee populations to dwindle around the globe.

To hear more about Williams' "buzzworthy" research, tune in to Segue at 9 a.m. on Sunday, Dec. 3 on WSIUE 88.7 FM The Sound.

By Madelaine Gerard, SIUE Marketing & Communications