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Body Building

University of Dayton

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Engineering researcher Kristen Comfort won a five-year, $542,000 National Science Foundation CAREER award to support her quest to build a cellular model that acts more like a human body, allowing for a better understanding and visualization of human-drug interactions.

According to the National Science Foundation, CAREER awards are among the foundation's most prestigious and support the early career-development activities of teacher-scholars who most effectively integrate research and education. About 150 engineering faculty receive NSF CAREER awards annually, Comfort said.

Her research could lead to better ways to deliver medicine straight to the source of an illness – a malignant tumor or infection — without the cost and ethical concerns of animal testing.

Comfort has tested 3-D cultures, multicellular systems and fluid flow models individually, but she wants to use her award to tie it all together into more realistic systems. Comfort will set up the systems in her first year and use the rest of the term to examine how nanomaterials, tiny particles like silver used to deliver medications in the body, interact with the systems.

"Traditional tissue cultures are typically static. You sit them in an incubator and they stay there. These cultures are two-dimensional, grown in a single layer," Comfort said. "But humans are 3-D beings with systems where everything is moving. I want to use this grant to build a 3-D scaffold to support cell culture systems that mimic a human's physiological flow using a pump to reproduce capillary flow rates."

One model will have lung, liver and skin components to replicate how people inhale a material, which is filtered through the liver and settles in the skin. Another planned model will replicate an immune system. Comfort also hopes to have those systems communicate with each other.

"How are the nanoparticles moving? Are the nanoparticles depositing where we want them? Do they pool in one spot or are they spread out?," Comfort said, spelling out some of the questions she'd like to answer. "That's what I like about the multisystem; we will get a clearer picture of distribution in complex systems and whether a particular drug delivery mechanism can get to the cells to be effective. If we have 20 different drugs, this model can help us identify which one is able to be delivered to a target at high enough concentrations to be both effective and safe."

Comfort said she feels this type of testing is necessary because testing in animals is costly and time consuming. This new system could allow for a faster way to screen potential drugs without the use of animals.

"Expanding from a simple cell system to a large animal system is where most models fall apart," Comfort said. "In addition to ethical issues, the large number of nanomaterials and drugs that need to be tested means animal testing is not always an option. In our system, in addition to determining how the cells respond, we can capture the nanomaterials and examine their properties after they have been run through the system."

Comfort will be able to employ a graduate student and two undergraduate students for the five-year term.

"What I like to do with students is give them a holistic approach to research, get them thinking about the scientific method, controls, why are we doing things, analysis and big-picture thinking. It's more than just the results; for students, it’s also about the experience. If they have enough time in the lab, they will also have the opportunity to write up their results for a publication," she said. "In addition to having the resources to carry out some really exciting and innovative research, I’m thrilled to be able to use the CAREER award to introduce science to a new group of students."

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