Regional

Yousef studies the physics of life and health

Photo by Mohammad Yousef

Dr. Mohammad Yousef in his lab.

Most recent medical progress is actually the result of centuries of scientific research made possible by the continuing development of new and better investigative techniques. And not everyone who does this type of research is a physician. Some are physicists, such as Mohammad S. Yousef, an assistant professor in the department of physics at Southern Illinois University Edwardsville.

Yousef is an Egyptian scientist who was born in Kuwait City, Kuwait. He obtained his bachelor's in biophysics from Cairo University in Egypt, his master's in medical biophysics also from Cairo University, and his doctorate in molecular biophysics from the Institute of Molecular Biophysics at Florida State University. His specialty is biophysics, which is the study of the nature of living organisms. Biophysicists like Yousef work in the intersection of different scientific disciplines.

"It shares major overlaps with biology, biochemistry and physics. Biology studies life and its diversity, variety and complexity. It describes how organisms go about getting food, communicating, and sensing, etc.," Yousef explained. "Physics on the other hand looks for simplified mathematical equations that describe the physical forces that describe these processes, not only to better understand them but also to be able to predict future behaviors." There are two major fields in biophysics, what is called molecular biophysics and medical biophysics.

"In the medical part, physics produce mainly technologies, tools, methodology, to be applicable in the medical field, to diagnose diseases and treat them, such as MRI, CAT scanning, etc.," said Yousef. In the molecular realm, however, the discovery of such things as X-rays and DNA cannot provide information regarding the three-dimensional structure of a macromolecule, whether a protein or DNA itself. "It is only physics so far that can provide the most powerful technology to resolve the 3D structure of DNA or proteins," Yousef added. Many of the new applications biophysicists are working on focus on cancer and how to better understand how cancer develops and what kinds of drugs can be used for that.

"This trend is what is called rational based drug design," said Yousef. "When companies want to design a drug to fight cancer, the trend is to look for proteins that are over expressed in cancer cells – unlike in normal healthy cells – and then solve the crystal structure of the particular protein and target drugs for it. So they solve the 3D structure of this particular protein that is specific to a particular type of cancer that is expressed either within the cells or on the surface of the cells and then they will design a drug that is specific to this particular protein for this particular kind of cancer." This approach, Yousef said, has been very successful in leukemia research.

One of the most recent applications in medical biophysics is what is called nanomedicine, which is basically the delivering of substances to a particular disease treatment.

"In one delivery system you attach gold nano particles for instance," explained Yousef. "So what will happen is you have a carrier protein with a gold nano-protein attached to it and then this carrier will recognize certain receptors that are specific to a particular cancer. So basically what will happen when you deliver this system to the cells it will coat only the cancer cells with gold and then if you shine a laser the normal cells won't be affected because they are not coated with gold. The malignant cells, however, will be heated up very much because now they are coated with metal to absorb the energy from the laser and then they will melt."

Although his research is of a very high level, Yousef does not shy away from approaching kids in elementary schools to tell them abut the joys and importance of science. "I was invited repeatedly to go to several elementary schools and talk about science and technology," he said. "I always start with Egypt and Egyptians and pyramids because kids are familiar with that. And then we start to talk about why the sky is blue, why it gets orange during the sunset, etc. But I was really impressed that the educational system here in the U.S. really encourages students to think, encourages them not to appeal to authority, encourages them to research and come up with their own explanations. I was also impressed by how many thank-you cards that those kids would send me afterwards with very touching words. I loved this experience and I am ready to do it repeatedly whenever I am invited."

Aldemaro Romero
College Talk

Aldemaro Romero is the Dean of the College of Arts and Sciences at Southern Illinois University Edwardsville. His show, "Segue," can be heard every Sunday morning at 9 a.m. on WSIE, 88.7 FM. He can be reached at College_Arts_Sciences@siue.edu.