Proteins face peril and possibility as they evolve

By Matthew Cordes

One downside of this flexibility is proteins sometimes morph into shapes and structures that aggregate, causing diseases including Alzheimer’s.

In my lab at the University of Arizona, my students and I explore how evolution changes proteins, resulting in a variety of forms and functions without creating lots of harmful proteins along the way.

Lab member Katie Stewart recently transmuted a protein in a way she expected would produce the kind of aggregated structures that sometimes cause human disease. Instead, the protein metamorphosed into a kaleidoscopic array of shapes.

The protein she mutated normally binds to DNA and regulates the lifestyle of viruses in host cells. The new structures don’t appear to work this way, but if mutated further, they might be able to serve as scaffolds or building blocks for new functions.

This is the story of life and its evolution: risk, possibility and awe-inspiring view at any scale.

Improving medical diagnoses by modifying nature’s nanopores

By Craig Aspinwall and Scott Saavedra

Waiting for medical test results can be agonizing. With our colleagues and students, we are developing a new platform to diagnose diseases more rapidly using just one or two drops of blood.

Our technology uses bioengineered proteins to prepare innovative sensors that detect specific biological markers for a variety of diseases, including cancer, diabetes, osteoporosis and many more.

The identity and amount of these markers in a patient’s blood provides information about disease diagnosis and prognosis. We are initially focused on sensors for glaucoma, a leading cause of blindness.

The sensor platform consists of three components developed in our laboratories — the bioengineered sensor protein, an artificial cell membrane made of a plastic-like polymer and an innovative microchip platform that supports these elements.

The sensor proteins, the heart of the technology, are prepared by linking two different types of proteins present in all living organisms. One, a G-protein-coupled receptor, binds to a specific marker in the patient’s blood that then opens a nanopore in the second protein, an ion channel, creating an electrical signal used for analysis.

To date, all three individual components of the sensor platform have been shown to function properly, and we are now working to integrate them into a single device. We anticipate building a prototype within the next year and testing its clinical utility within three years.

Matthew Cordes is a professor of chemistry and biochemistry at the University of Arizona. His research investigates the evolution of protein molecules, which carry out most of the primary tasks of living cells.

Craig A. Aspinwall is a University of Arizona associate professor of chemistry and biochemistry. His research focuses on the development and application of new sensor technologies to investigate biological systems.

Scott Saavedra is professor and head of the UA department of chemistry and biochemistry. His research focuses on development of new biomaterials for chemical and biochemical sensing and new materials that convert solar energy into electricity.