Researchers could potentially use the artificial ribosome, called Ribo-T, to explore ribosomal functions by experimenting with its protein synthesis machine, an area that was previously untouchable.

Engineered ribosome may enable the production of new drugs and next-generation biomaterials

Researchers at Northwestern and the University of Illinois at Chicago (UIC) have engineered a tethered ribosome that works nearly as well as the authentic cellular component, or organelle, that produces all the proteins and enzymes within the cell. The engineered ribosome may enable the production of new drugs and next-generation biomaterials and lead to a better understanding of how ribosomes function.

The artificial ribosome, called Ribo-T, was created in the laboratories of Northwestern’s Michael Jewett, associate professor of chemical and biological engineering, and Alexander Mankin, director of the UIC College of Pharmacy’s Center for Biomolecular Sciences. The human-made ribosome may be able to be manipulated in the laboratory to do things natural ribosomes cannot do.

When the cell makes a protein, mRNA (messenger RNA) is copied from DNA. The ribosomes’ two subunits, one large and one small, unite on mRNA to form the functional unit that assembles the protein in a process called translation. Once the protein molecule is complete, the ribosome subunits — both of which are themselves made up of RNA and protein — separate from each other.

In a new study in the journal Nature, the researchers describe the design and properties of Ribo-T, a ribosome with subunits that will not separate. Ribo-T may be able to be tuned to produce unique and functional polymers for exploring ribosome functions or producing designer therapeutics — and perhaps one day even non-biological polymers.
Researchers have found a way to harvest industrially useful protein from yeast in much greater quantities.

From manufacturing life-saving biopharmaceuticals to producing energy-efficient biofuels, the cost-effective production of proteins will be essential to revolutionizing the future of healthcare and energy.

For years, scientists have turned to yeast as a quick and inexpensive way to mass-produce proteins for a variety of useful products. Now Keith Tyo, assistant professor of chemical and biological engineering, has found a way to gather more protein without actually making the yeast produce more.

“Tyo’s team found the proteins in yeast responsible for the uptake functions and genetically knocked them out. The team harvested two- to three-fold more protein from the yeast cells that were unable to reabsorb the secreted protein.”

Funded by the Chicago Biomedical Consortium and the Searle Funds at The Chicago Community Trust, the research paper received the “Editor’s Spotlight” in the journal Biotechnology and Bioengineering.

Being able to collect more protein product from yeast could lead to cheaper biopharmaceuticals, such as insulin, and biofuels, such as ethanol. The next step is to examine the protein-uptake roles in other organisms that researchers rely on for protein production.

“A large percentage of the cost of a gallon of ethanol goes toward making enzymes—which are proteins—to degrade the starch and cellulose for fermentation,” Tyo said. “These enzymes are made by fungal organisms like yeast. It’s a logical place to try our technology.”

BEING ABLE TO COLLECT MORE PROTEIN PRODUCT FROM YEAST COULD LEAD TO CHEAPER BIOPHARMACEUTICALS, SUCH AS INSULIN, AND BIOFUELS, SUCH AS ETHANOL.
Olvera de la Cruz's work has touched everything from the fight against cancer to the design of safer batteries.
Most of these shells buckle into an icosahedron shape, forming 20 sides that allow for high interface and surroundings. Olvera de la Cruz, Bedzyk, and Stupp recreated these shapes in the lab by altering the acidity of their surroundings. The findings could lead to designed microreactors that mimic the functions of these cell containers or deliver therapeutic materials to cells at specific targeted locations.

“If you want a very clever capsule, you don’t make a sphere, but perhaps you shouldn’t make an icosahedron either,” Olvera de la Cruz said. “What we are beginning to realize is maybe these lower symmetries are smarter.”

Although Olvera de la Cruz often creates models that benefit life sciences, she also works in the realm of physical sciences. Some of her more recent research explores ways to develop plastic batteries that are a safer alternative to current lithium-ion technology. She examines plastics known as block copolymers that are two types of polymers stuck together. They are a leading material for use as ion conductors because they self-assemble into nanostructures that both enable ion charge transport and maintain structural integrity.

Block copolymers innately have nano-channels through which ions can travel, but the charges themselves manipulate the shape of the channels. To use the material in batteries, researchers must find a way to control the shape of the nano-channels, so that the charge moves efficiently. Olvera de la Cruz and her team found that ions and counter-ions found in the nano-channels attract each other to form a salt. These salts cluster into miniature crystals, which exert a force on the nano-channels, changing the channels’ structure.

This understanding makes it possible to predict and even design a “highway system” through which ions are transported, maximizing the power of the battery.

“There is a huge effort to go beyond lithium in a flammable solvent,” Olvera de la Cruz said. “People have been looking at alternatives that are not explosive, like plastics. But they didn’t know how to compute what happens when you put in a charge. We have provided the tools to understand these systems.”

“MANY PEOPLE HAVE MOVED INTO THIS FIELD SINCE I JOINED IT. I THINK THAT’S WHY I’M STILL FASCINATED BY IT. IF YOU FIND A FIELD WHERE YOU’RE ABLE TO DISCOVER SOMETHING THAT OTHERS HAVE NOT ANALYZED, IT IS VERY REWARDING.”

MONICA OLVERA DE LA CRUZ
Doctors are more likely to try a new therapy when they are persuaded to do so by an influential colleague, reports a new Northwestern study whose findings on adopting innovations also have relevance for business, education and research.

By analyzing physician social networks, professor Luis Amaral and Feinberg School of Medicine’s Curtis Weiss examined how doctors are professionally connected and pass information to each other and how that leads to increasing adoption.

The current belief is physicians “catch” a new therapy in what is known as a contagion model. One doctor sees another doctor prescribing a drug or ordering a test, and she will catch or be infected by that new approach and start using it herself. But the Northwestern study found the art of persuasion was more effective at boosting adoption. The trick was finding the sweet spot in frequency and tone of those persuasive messages so they’re effective but not off-putting.

The nudging sweet spot? A reminder every five to seven days delivered as a strong suggestion but not an order, according to the study. “While our study is focused on critical care physicians, our findings are relevant for other settings in education, research and business where small groups of highly qualified peers make decisions about the adoption of innovations whose utility is difficult if not impossible to gauge,” Amaral said.
Building Better Batteries

Professor Monica Olvera de la Cruz and her team are researching plastic batteries as a safer alternative to current, flammable lithium-ion battery technologies.

Her research explored how two types of polymers (the orange and red chains in this image) could be connected to form block copolymer (BCP) nanomaterials. She found that the shape of the nanochannels through which the ions (shown here as green and yellow dots) travel can be controlled in BCP plastics.

Read more in her profile on page 3.