The Transfer-to-Excellence Research Experiences for Undergraduates focuses on three main research areas:

Biotechnology

Biotechnology draws upon knowledge, methods, and expertise from the disciplines of chemistry, biochemistry, microbiology, genetics, chemical engineering, and computer science. The ability to quickly engineer organisms in laboratories has dramatically transformed modern practices in fields such as agriculture, manufacturing, energy generation, and medicine. Students majoring in biology, chemistry, chemical engineering and computer science will have opportunities to study the underlying science of and enhance the research tools for the biosynethetic machinery such as:

- Pathway enzymes and biocatalysis; nano-bioreactors; genome mining for new bioactive small molecules; study of plant metabolism; novel terminators and promoters; synthetic processes to improve fermentation strains and combined bioprocessing microbes; high throughput selection and screening methodologies.

Nanotechnology

Nanotechnology employs a wide range of disciplinary approaches to the engineering of matter at the nanoscale, where novel and differentiating properties and functions are manifested at the atomic to macromolecular levels. Nanotechnology has demonstrated a strong potential to overcome critical challenges in many arenas, including electronics, energy, and medicine. Student researchers who are majoring in materials science, physics, chemistry, mathematics, and engineering will have the opportunity to conduct projects in the following areas:

- *Nanomaterials*: Properties, manipulation, and application of novel nanomaterials in 2-dimensional (2D) materials (e.g. graphene nanoribbons and Transition Metal Dichalcogenides (TMDC)) and spintronic materials (e.g. nano-engineered magnetic heterostructures)
- *Novel device concepts*: Plasmonic and metal-optics devices, magnetic nano-motors
- *Device performance*: Organic thin film transistors, solar cells

Robotics

Research in **robotics** includes development of automated machines that can take the place of humans in dangerous or unreachable environments or manufacturing processes, or that resemble humans in cognition and action via the development of the underlying models and algorithms to enable artificial intelligence. The design, construct, and operate robots, as well as their control, sensory input and feedback, and information processing involves both hardware and software engineers. Students majoring in mechanical engineering, electrical engineering, materials science, mathematics, and computer science will have research opportunities in:

- *Robots:* Materials, hardware and software components; integrated sensing, actuation, control and interface systems; and product design for biomimetic millirobots and robots for space exploration
- *Assistive Devices:* models on functioning abilities (e.g. reachable space, agility, strength, balance) of disabled versus abled people
- *Automated and Connected Vehicles*: control architecture and algorithms, estimation and prediction models, calibration processes for sensor networks, as related to vehicle traffic
- *Mechatronics:* synthesis tools and components for mechanical control at nano-scale