2015 Tulsa Undergraduate Research Challenge
JUNIOR SCHOLARS PROGRAM

The TURC Junior Scholars Program recognizes high school juniors with outstanding potential for a career in research by providing opportunities to participate in cutting-edge research projects. The program builds upon the nationally recognized Tulsa Undergraduate Research Challenge (TURC) program and includes in-depth work with a research team, access to modern instrumentation, and potential opportunities to participate in the research dialogue through publications and presentations.

Benefits of Being a TURC Junior Scholar
TURC Junior Scholars are immersed in a research atmosphere that is usually reserved for graduate students. Each scholar works with a faculty research mentor and research team on a nationally significant research project. In addition to working closely with a faculty mentor, each Junior Scholar is paired with a TURC undergraduate mentor who has considerable experience with the project from a student’s point of view. A range of modern equipment is available to support the research – such as facilities for materials fabrication, modern chemical and biological analysis facilities, and electron microscopy resources that are among the best in the southwest. TURC Junior Scholars participate in summer research presentations and are invited to TURC lectures and functions during the academic year.

Junior Scholar Research Opportunities
Research opportunities for the summer 2015 program span a range of disciplines and involve a variety of time commitments. At this time, we anticipate providing opportunities in the following project areas:

What did Neanderthals eat?
Dr. Belmaker, Department of Anthropology
By learning to look at bone remains from Neanderthals sites in Jordan, students will learn to understand why the bones are so broken up. Were they broken up by the Neanderthals themselves or by carnivores that scavenged the site after the people left? Did Neanderthals use fire or not? Over a period of four weeks, students will learn how a zoo-archaeologist works and learn to clean bone remains from archaeological sites and complete the basic analysis by learning to identify basic signs of human and carnivore modification. Students will learn to operate a microscope to identify signs both with the naked eye and through a high-powered microscope.

What was the environment like during the times of the Neanderthals?
Dr. Belmaker, Department of Anthropology
Was it really very cold during the ice age? Can we use remains of other animals such as rodents that lived in the same caves that were inhabited by Neanderthals in Israel to infer the environmental conditions, and if so how? Over a period of four weeks students will learn how a paleoecologist works. Students will learn to identify different species of rodents and which are cold-loving species and which are warm loving species. Students will learn, by using a high-powered microscope, to
identify how the rodents came to be deposited in the cave and if they were the prey of owls, and if so, of which owl.

**Paleo-Indian archaeology.**
Dr. Buchanan, Department of Anthropology
Students will participate in the processing and analysis of archaeological materials from a newly found site located near Claremore, Oklahoma. The site is situated in a rockshelter and is deeply buried with layered occupations that span the last 13,000 years. The lowest occupation in the rockshelter dates to the time of the earliest inhabitants in North America. Working in the laboratory with materials from this site, students will learn how to process artifacts and conduct preliminary analytical techniques.

**Data driven development of exercise protocols for use in outer space missions.**
Dr. Caruso, Department of Exercise and Sports Science
This summer students will continue data collection on a study that examines seated calf press exercise performance on a piece of equipment intended for use in outer space. Students will collect cardiovascular and metabolic data during workouts. In addition, prior to the performance of workouts, subjects submit to a series of measurements of their lower leg anatomy. Project results will aid the development of future exercise protocols done in outer space, as well as aid in the selection criteria for astronauts based upon their lower leg anatomy. In addition to the aforementioned project, Dr. Caruso’s laboratory is slated to examine the effect of a food supplement on exercise performance during the summer of 2015.

**Robotics laboratory.**
Dr. Diaz, Tandy School of Computer Science
The work in robotics incorporate several areas of engineering and computing. It potentially involves design, building prototypes, manufacturing, electronics and programming. There are several projects that are being investigated in the Robotics Lab to which a TURC Junior Scholar could contribute.

**Danish archaeology from St. Croix.**
Dr. Foster, Department of Anthropology
Students will work with TU faculty and doctoral students to help process and analyze eighteenth century artifacts from the Danish Fort Christainsvaern in Christainsted on St. Croix, U.S. Virgin Islands. These collections were recently excavated as a part of a larger project to understand economic and social adaptations of slaves in the Danish colony.

**Design and development of devices to aid persons with disabilities.**
Dr. Henshaw, Department of Mechanical Engineering
Dr. Henshaw's TURC projects generally relate to the MADE at TU organization (Make a Difference Engineering). MADE at TU students work on a wide variety of projects aimed at improving the lives of persons with physical or developmental disabilities. TURC Junior Scholars will collaborate with TU students and Dr. Henshaw to design, fabricate, and test various devices for persons with disabilities.

**Development of a synthetic organic chemistry method.**
Dr. Hussaini, Department of Chemistry and Biochemistry
The research focus will be the discovery of a synthetic method for the preparation of enaminones - compounds that contain a N-C=C-C=O functional group. These compounds are important intermediates in organic synthesis and have been used in the development of pharmaceuticals. Students will use copper catalysts to explore the formation of enaminones. The method will provide
an economical method for the preparation of enaminones. The successful completion of the project has the potential to impact the discovery of new drugs, insecticides and other chemicals.

**Experimental nanotechnology.**
Dr. Iski, Department of Chemistry and Biochemistry
In the Iski group students use a Scanning Tunneling Microscope (STM) to study processes which occur at a distance of a few nanometers (10⁻⁹ m). There are two complementary projects. The first investigates amino acid molecules on a gold surface with a particular focus on how strongly the molecules are binding to the underlying surface. The second uses electrochemistry to form a single, silver halide layer on a gold surface. This layer is unusually stable and the factors leading to its stability are of great interest. Both projects utilize the microscope and require computer optimization of the images. The projects provide an unusual blend of physics, physical chemistry, nanotechnology, and materials chemistry.

**Preparation and characterization of novel materials.**
Dr. Keller, Department of Mechanical Engineering
Students participating in research in Dr. Keller’s lab will work on materials science and solid mechanics projects. Ongoing research includes preparation and testing of fiber composites (carbon fiber and glass fiber), self-healing materials, nanomaterial synthesis and characterization, and general polymer science. There are also opportunities for pursuing computational and computer-based simulation projects on the behavior of composite materials. These materials have a wide variety of potential applications and are examples of materials which will be an important component in manufacturing in the future.

**Bioinformatics and computational biology.**
Dr. McKinney, Tandy School of Computer Science
Students in the McKinney Lab (http://insilico.utulsa.edu) will collaborate in research teams with undergraduate and graduate students working on cutting-edge bioinformatics and computational biology projects. Projects involve developing and applying machine learning, data mining, social network and mathematical modeling approaches to big data in biomedical science. Students will have the opportunity to gain hands-on experience in the analysis of next-generation sequence data, transcriptomic, structural and functional MRI neuroimage data, and genome-wide association data in order to predict susceptibility to mood disorders and immune response to vaccines.

**Applications of nanoparticles in real-world processes.**
Dr. Otanicar, Department of Mechanical Engineering
The Otanicar group focuses on nanoparticles for enhanced heat and mass transfer. Nanoparticles, ultra-small particles, possess many interesting properties that larger particles do not. One important area where they have impact is within the transfer of heat. Dr. Otanicar’s group performs a wide range of experiments with these types of particles for trying to limit and enhance heat transfer, control the evaporation from liquids, and selectively absorb solar radiation. Students will assist in creating and running experiments in the lab related to these types of projects.

**Reaction rates of chlorination in swimming pool water.**
Dr. Gordon Purser, Department of Chemistry
Cyanuric acid is added to swimming pools to "stabilize" the active chlorine, preventing its photodissociation. Students will plan to perform kinetic studies on the reaction of monochlorcyanuric acid with ammonium ion and other amines. The rate of the reaction will be followed by stopped-flow techniques as a function of reactant concentration, pH and temperature. The goal is to determine the rate law and measure the activation parameters.
Mechanism and rate of neutrophil damage to proteins.
Dr. Gordon Purser, Department of Chemistry
Neutrophils produce the highly reactive oxidizing agent, hypochlorous acid (HOCl), which can damage proteins through chlorination and oxidation. This damage may lead to inflammatory diseases such as atherosclerosis or arthritis. The lysine residue in proteins has been shown to rapidly undergo chlorination. HOCl has been shown to convert the ε-amine on lysine to a nitrile. It also has been shown that lysine nitrile is formed during chlorination of water containing protein residues. The goal of this study is to continue to examine the rate of conversion of 6-aminohexanoic acid, a lysine model, to the corresponding nitrile by HOCl.

Intelligent agents.
Dr. Sandip Sen, Tandy School of Computer Science
The Intelligent Agents group studies the theoretical underpinnings and practical applications of intelligent agent technology. Students will investigate theoretical issues ranging from how and when multiple agents can learn to cooperate and compete, development of norms through peer-to-peer interactions, how agents can learn to trust each other, and negotiation techniques with outcome guarantees. Practical applications that the Intelligent Agents group has developed include recommending movies and shopping options, automated meeting schedulers, purchasing items from simultaneous online auctions, crowdsourced book recommendations, and detecting and responding to cyberbullying. Students of varying interests and backgrounds ranging from freshman undergraduates to experienced Ph.D. students continue to research at the frontiers of the intelligent agents field and publish their findings at premier international venues.

Biochemistry of therapeutics and enzyme inhibition.
Dr. Sheaff, Department of Chemistry and Biochemistry
Students in the Sheaff lab may work on one of three projects. 1) Screening chemical libraries for novel drug candidates. The goal of this project is to identify molecules that have potential to further develop into new therapeutics. 2) Investigating the role of a tumor suppressor p27kip1 which is commonly deregulated in aggressive human cancers. This project aims to analyze p27 function in model cell lines with and without p2 using cell culture, inhibition assays, and evaluation of cell metabolic pathways. 3) Characterizing a luciferase inhibitor. An inhibitor to luciferase, the enzyme responsible for firefly light, has important potential applications in oceanographic bioluminescence. This project characterizes its action using kinetic techniques, enzyme assays and inhibition studies.

Responsibilities of a TURC Junior Scholar
The summer research experience is intensive and each Scholar is expected to participate five full days per week (Monday through Friday, 9:00 a.m. to 5:00 p.m.) for the duration of the program. Applicants should be aware of the requirements and time commitments when they apply.

Program Duration
The research experience may be six, eight, or ten weeks in duration, depending upon the needs of the scholar and the mentor. Generally speaking, all TURC projects will be scheduled between May 16 and August 1, 2015.

Requirements for Applicants
• Applicants must have at least a 3.5 cumulative GPA in a rigorous high school curriculum.
• Applicants must have a composite ACT score of at least 28 or a combined score of at least 1260 on the Critical Reading and Math portions of the SAT.
• Other requirements are listed on the TURC Junior Scholars Application Form.
Program Details

- **Application Procedure.** TURC Junior Scholars Program Application forms are available online at [http://www.utulsa.edu/research/Resources-for-Faculty-and-Students/Internal-Funding/turc/turc-junior-scholars-program.aspx](http://www.utulsa.edu/research/Resources-for-Faculty-and-Students/Internal-Funding/turc/turc-junior-scholars-program.aspx) or from Nona Charleston, Associate Director of TURC, The University of Tulsa, 800 South Tucker Drive, Tulsa, OK 74104-9700, nona-charleston@utulsa.edu. Applications must be received by the TURC Junior Scholars Program no later than 4:00 p.m. on Friday, March 13, 2015.

- **Decisions on Applications.** All applications will be reviewed by a faculty selection committee, and decisions will be based on merit, taking into account all information provided by applicants.

- **College Credit.** Each Junior Scholar will receive one hour of college credit from The University of Tulsa for research performed under the program.

- **Cost.** Tuition will be covered by the TURC Junior Scholars Program at no cost to the Scholar. However, this is a non-residential program and each Scholar will be responsible for his or her own housing, and personal expenses. A cash stipend of $30/week will be provided to each student for transportation and meals. There are a limited number of additional stipends which will be awarded based on documented financial need as established through a separate application process. Please email nona-charleston@utulsa.edu to apply.

The University of Tulsa does not discriminate on the basis of personal status or group characteristics including, but not limited to individuals on the basis of race, color, religion, national or ethnic origin, age, gender, disability, veteran status, sexual orientation, gender identity or expression, genetic information, ancestry, or marital status. Questions regarding this policy may be addressed to the Office of Human Resources, 918-631-2616. For accommodation of disabilities, contact TU’s 504 Coordinator, Dr. Tawny Taylor, 918-631-2315. To ensure availability of an interpreter, five to seven days notice is needed; 48 hours is recommended for all other accommodations.