Undergraduate Research Program

2016-17 WRF Fellows

Katie Bigham – Oceanography, Geology

Rian Chandra – Physics, Applied and Computational Mathematical Sciences

Ian Christen – Mathematics, Physics

Quynh Do – Chemistry, Biochemistry

Payam Farahani – Chemical Engineering

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Payam Farahani is a Senior studying Chemical Engineering with a focus in Nanoscience and Molecular Engineering. His interests lie in biomaterials and their applications in tissue engineering and regenerative medicine. Payam's research focuses on a class of biomaterials known as hydrogels, water-absorbent polymer networks widely used as 3D cell culture platforms. His fascination with these materials began in the Fall of his Sophomore year, when he began his first research experience with Professor Shaoyi Jiang. Working in the Jiang Group, Payam developed protocol to 3D print hydrogels by means of light-based polymerization. In the Fall of his Junior year, he translated the knowledge from his 3D printing project to his current research. Payam is working with Professor Cole

WRF Fellows

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2008-09 WRF Fellows

2007-08 WRF Fellows

2006-07 WRF Fellows

DeForest to develop user-programmable hydrogels able to spatiotemporally guide cell behavior. This is achieved through a light-driven reaction known as photo-mediated oxime ligation. Payam is applying this chemistry as a novel method for forming and mechanically modifying hydrogels. Using the same chemistry, he is exploring strategies to pattern proteins throughout hydrogels with micron-scale resolution. By harnessing this technology's mechanical and biochemical modification strategies, Payam intends to predictably guide stem cell behavior within well-defined, hydrogel-based environments. Following graduation, Payam plans to pursue a Ph.D. in Chemical Engineering in order to use biomaterials to further our understanding of stem cell and cancer biology. Outside of the laboratory, Payam enjoys skiing, climbing, hiking, and participating in scientific outreach. Payam would like to express his gratitude to the Washington Research Foundation for supporting his research endeavors.

Mentor: Cole DeForest, Chemical Engineering

Project Title: Photo-Mediated Oxime Ligation as a Bioorthogonal Tool for Spatiotemporal Hydrogel Formation and Modification

Abstract: Water-swollen polymer networks known as hydrogels are attractive materials from which functional tissues and organs could be developed using patient-derived stem cells. While hydrogels demonstrate biocompatibility conducive to harboring cells, they lack mechanical and biochemical aspects of the native extracellular matrix (ECM), the intricate microenvironment about which cells function. Moreover, common methods for hydrogel formation jeopardize cell viability, where free radicals present during polymerization are prone to side-reactions with encapsulated cells. We aim to recapitulate the complexity of native tissue while avoiding deleterious effects of radical-based polymerization, by developing a light-based strategy for hydrogel formation and modification known as photo-mediated oxime

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ADVISING INFO

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ligation. Photo-mediated oxime ligation's high selectivity minimizes side-reactions in the presence of cells. Moreover, the same photo-driven oxime chemistry can immobilize proteins with 3D resolution, providing a biochemical handle for directing cell fate. Preliminary studies have shown successful gelation of oxime-based hydrogel solutions within ten minutes of UV light exposure. Site-selective UV irradiation additionally yields control over the location and extent of polymer crosslinking; physical factors influencing cell behavior. Moving forward, I plan to quantify mechanical properties with varying UV exposure durations and intensities to systematically tune hydrogel stiffness. I then aim to demonstrate protein patterning within oxime-based hydrogels using site-specifically modified green fluorescent protein and RGDS peptide sequences. Following this cell culture platform's development, human mesenchymal stem cells encapsulated within oxime-based hydrogels will be predictably guided in their migration using patterned RGDS in combination with spatially-varying hydrogel stiffness. We expect hydrogels formed and modified by photo-mediated oxime ligation will open doors to elucidating stem cell biology in an environment rivaling the complexity of the native ECM. In turn, an improved understanding of stem cell behavior will serve to advance the clinical translation of stem cell-based therapies in regenerative medicine.

Hyeon-Jin Kim – Biochemistry, Chemistry

Melissa Medsker-Galloway – Computer Science, Human-Centered Design & Engineering

Manuja Sharma - Electrical Engineering

Zoha Syed - Chemistry, Biochemistry

Connor Tsuchida - Bioengineering

Nate Yazdani – Computer Science

Autumn Drop-In Schedule
Wednesdays 2:00 p.m. - 4:00 p.m.
Thursdays 10:00 a.m. - 12:00 p.m.

Notes: URP will not offer Drop-In Advising on December 18-29. Drop-In Advising will be cancelled on Wed. Jan 10

If the times above don't work for you:
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