COLLEGE OF ENGINEERING
Bio-Medical Engineering

SUMMER RESEARCH OPPORTUNITIES
FOR UNDERGRADUATE WOMEN

APPLICATION DEADLINE: MARCH 1, 2005

The Department of Bio-Medical Engineering is pleased to offer the following research project for the summer of 2005. Interested students are urged to contact the faculty member(s) directing the project that most interests them. By contacting the faculty member, you can discover more about the project, learn what your responsibilities will be and if possible, develop a timetable for the twelve-week research period.

Development of a Novel Cellular Microenvironment to Promote Capillary Formation and Enhance Wound Healing

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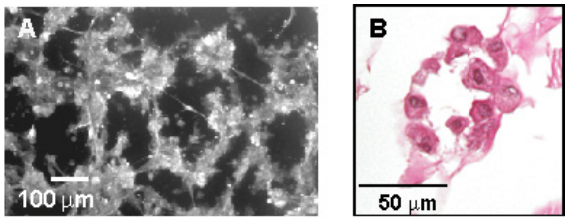
Background The goal of tissue engineering is to develop new strategies for medical treatment of numerous diseases by providing alternatives to donor tissues and organs. One of the critical issues in engineering or regenerating tissue and organs is to create an adequate blood supply to maintain live cells and promote tissue growth. In the body, formation of new capillaries (the process called angiogenesis) is critical in many physiological processes (pregnancy, wound healing) and pathological processes (tumor growth, rheumatoid arthritis). However, attempts to recreate a native-like capillary network in engineered tissues have been largely unsuccessful. This laboratory aims to understand the mechanisms of capillary formation. We would like to develop new strategies to induce a rapid angiogenic response and long-term survival of human capillary (endothelial) cells for tissue engineering applications, including wound healing and vascularization of ischemic tissues. This project will be directed towards better understanding of the complex ell-cell and cell-matrix interactions during capillary formation and creating new methods to enhance wound healing and promote better tissue repair. The figure above demonstrates that biological tubes similar to native capillaries can be formed and maintained for several weeks in the in vitro cultures.



Tube-like structures formed by human endothelial cells cultured on the surface (A) or embedded in the peptide scaffold (B). These structures are used to model capillary growth in artificially-engineered tissues.

Brief description of the project: The student will create three-dimensional constructs consisting of endothelial cells and fibroblasts or endothelial cells alone embedded in the peptide or peptide/collagen scaffolds. These constructs will be cultured for up to 2 weeks, followed by embedding in paraffin or protein and mRNA extraction. Formation of tube-like structures and cell-cell interactions (including staining for cell junction proteins) will be quantified using immunohistochemical analysis of paraffin sections. Protein expression of VEGF (one of the major player in capillary formation in the body) and VEGF receptor 2 will be assessed using Western Blot analyses. Cell survival will be assessed using TUNEL assay for apoptosis. The Specific Aim of this project is to determine how the presence of fibroblasts affects endothelial cell

survival and spatial organization in different extracellular environments.

What the Student can gain from participating in this project: The student will gain experience in cell culture, histology, molecular biology and immunohistochemistry techniques. In addition, the student will have access to the state-of-the-art fluorescent microscope and imaging system and gain skills in cell imaging and biostatistics. She will be exposed to a multidisciplinary research environment at the BME Department and will have an opportunity to participate in study design, literature review and presentations within the Tissue Engineering research group, including faculty, scientists and students.