Development of a 3-week Intensive Interdisciplinary Biomaterials Course for Non-engineering Majors

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Statement of Purpose: Students preparing for careers in the healthcare fields represent a wide variety of undergraduate majors. At smaller universities that do not contain either a biomedical sciences or biomedical engineering program, many of these students are not exposed to the fundamentals of biomaterials and devices that they will be using throughout their careers. It is for this reason that a three-week intensive May term course, Introduction to Biomaterials, was developed to introduce non-engineering students at a liberal arts university to biomaterials concepts and devices.

Methods: The 2-credit hour May term offering of Introduction to Biomaterials had only one pre-requisite course (Introduction to Biology) allowing students from any major to apply. The course was co-taught by a developmental neurobiologist and a bioengineer in order to allow a complete and well-rounded approach strongly incorporating both the biological functions of the tissue and their respective engineered materials and devices. It was designed to familiarize students with a variety of implants as well as the advantages and shortcomings in fields such as orthopaedics, cardiovascular, and tissue engineering.

Additionally, the students explored an area of specific interest through a directed, course-long research project. Groups of 2-3 students selected a single project from a broader topical area (e.g. the digestive system). Students were asked to design a new graft or device to address a known biological issue. Groups began research on a specific application within their topical area on the second day of the course. The students presented twice before the final presentation during which their design ideas were refined via information gained from literature and the course as well as suggestions from faculty and students.

Regardless of the specific area, it was important that the students understood the interactions between biological and foreign materials. To demonstrate the effect of surface properties on vascularization and biocompatibility, an experiential multi-segment lab was developed to investigate the incorporation of varying graft materials into the vascularized chorioallantoic membrane (CAM) of a day 9 (E9) chick embryo. This extraembryonic site provides a favorable environment for development of the tissue being studied without the complex preparations required for in vitro culture techniques. The extraembryonic fluids make a suitable "medium," and if the graft "takes" effectively, blood vessels of the host's extraembryonic circulation grow into the graft and vascularize it.

Students were given three materials (A, B, and C) in addition to the positive control material (eye material harvested from E4 embryos) to place into separate E9 embryo CAMs. Embryos were incubated for 7 days. At the end of the lab module, all groups harvested and imaged their grafts from the E16 embryos to assess vascularization. Data for the class was pooled (n=4 for each of 4 graft material groups). Each student group was asked to hypothesize based on the images which material (A, B, and C) corresponded to cellulose acetate, polypropylene mesh, and polypropylene non-woven fiber based on the # of blood vessels/mm^2 in addition to what they had learned in the course regarding material properties.

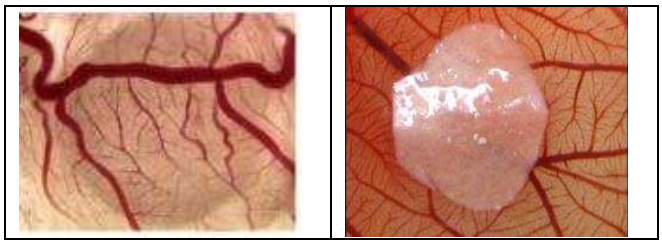

Figure 1. Sample images of two graft materials. (L) positive control and (R) sample unknown graft material

Results: The first offering of the course was a full class with a wait list. The students enrolled in the course represented four different majors, but all had the common (self-reported) goal of a future in a health care profession.

Each student group provided a detailed presentation on their semester design project that incorporated well thought out approaches to address a particular medical problem. The students will be able to use their experiences searching and analyzing literature to aid them in their future studies.

For the biocompatibility lab, student groups demonstrated that they could extrapolate material characteristics using knowledge of vascularization based on the E16 graft images.

Conclusions: A new course creating awareness of biomaterials was created that incorporated a special focus on biocompatibility of materials. The goal of the instructors to develop a course to attract and introduce students from multiple majors was met. Through the biocompatibility lab, the students were able to gain a hands-on experience of biological response to varying material properties. The students enjoyed their course-long research projects in which they developed ideas on an implantable device in an area of interest as well as felt challenged to continue seeking more knowledge. Students avidly sought to have a deeper understanding of journal articles evidenced by thoughtful questions throughout the course.

Students at the end of the course responded that they felt more prepared to enter into healthcare professions once they had completed this introductory course.