

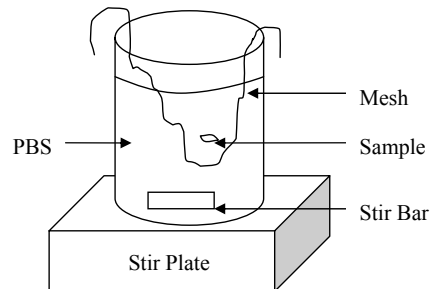
Hydrogel Diffusion Kinetics

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Background. Every year, 80,000 to 90,000 people in the US are permanently disabled due to a Traumatic Brain Injury (TBI). Tissue engineering to combat TBI involves expanding stem cells from a biopsy and cell culturing on a temporary three-dimensional scaffold. Growth factors enable the cells to differentiate into neurons. The rate of release of growth factors then depends on the degradation rate of the scaffold as well as the pore size, connectivity, and tortuosity. Diffusion profile gives valuable information about the environment for cells.

Approach. Dish tests are used to determine the diffusion kinetics out of the scaffolds. These scaffolds include collagen, chitosan and a collagen-chitosan composite, which are prepared from liquid substrate forming a scaffold after lyophilization. The

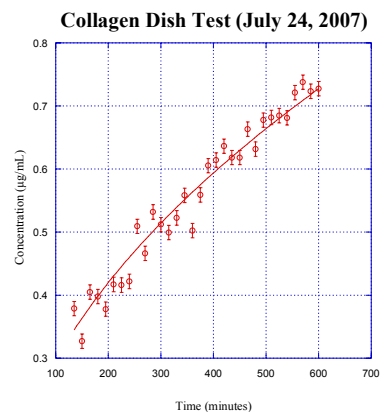
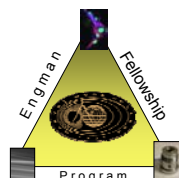
proteins to be tested include Bovine Serum Albumin (BSA) and growth factors. The pH is raised during gellation with cell media in order to promote cell viability. The scaffold is then freeze dried and then re-gelled. Proteins are added at various stages during gellation to compare diffusion profiles. The Biorad protein assay is used to measure the BSA concentration during diffusion; similarly an Enzyme Linked Immunosorbent Assay (ELISA) is used to measure growth factor concentration.



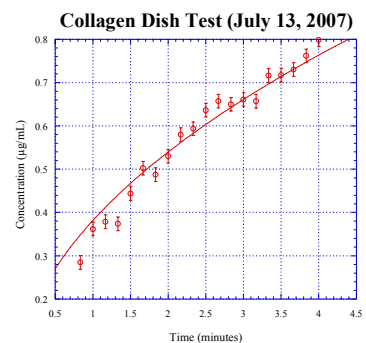
Results. Effective diffusivity values were calculated using Fick's Diffusion Law assuming one dimensional flow across a thin film with uniform initial concentration and infinite sink conditions. For collagen, diffusivity was higher when protein was added after freeze drying although this may have been due to the presence of unknown amounts of BSA in cell media.

Future Work. The team will successfully gel chitosan with BSA integrated into dry scaffold as well as test with collagen-chitosan composites. Proteins will be incorporated into dry collagen scaffolds. All the scaffolds will be tested with growth factors and analyzed with ELISA. Diffusion profiles of different growth factors after incorporating them into the various stages of scaffold synthesis and testing will be compared.

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Diffusivity: $2.5 \times 10^{-5} \text{ cm}^2/\text{sec}$



Diffusivity: $4.1 \times 10^{-3} \text{ cm}^2/\text{sec}$