

CHEMISTRY
ARTS AND SCIENCES

SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

FOR APPLICATION YEAR: 2024

PROJECT TITLE: Dendrimer-Lipid nanoparticles for transdermal delivery

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Project Description

Targeted drug delivery is an approach that focuses on the delivery of therapeutics or drugs to a specified location. This approach is preferential to other delivery methods due to enhanced efficacy of therapeutics at the site of action, reduced side effects, and minimization of exposure to non-targeted tissues. For these same reasons, transdermal delivery has become a favorable route of therapeutic delivery with the added benefits of bypassing the digestive system and initial metabolism (which often shuttles therapeutics to the liver and kidneys) and improved patient compliance due to the non-invasive nature of the treatment. Although transdermal delivery is a favorable delivery route, the permeability of the skin poses a challenge for many drugs, especially those with high molecular weights or poor lipid solubility. The stratum corneum is the topmost layer of skin and it is composed of tightly packed, flattened and dead epithelial cells embedded within a lipid matrix. This topmost layer of skin acts as the primary barrier function between the outside world and the inner components of the human body.

Due to the lipophilic nature of the skin, lipid nanoparticles (LNPs) have the potential to be ideal nanocarriers for transdermal delivery. In this proposed work, we are developing dendrimer-lipid hybrid macromolecules that self-assemble into vesicle-like nanocarriers in aqueous media. Similar to LNPs, these macromolecules consist of a polar head-group (dendrimer) and a lipid tail (lipid of choice). This structural design provides opportunity for fine-tuning as the dendrimer is synthesized in a step-wise fashion and contains modifiable end-groups, while the lipid can be any length or saturation.

A student working on this project will develop skills in synthetic polymer chemistry, polymer characterization, and potentially work with human skin ex vivo. This student should have passed Organic Chemistry as a minimum requirement.