Have fun, get paid, and travel the world: Getting involved in research at Lafayette

Department of Chemical and Biomolecular Engineering

Lafayette College
February 2015
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Independent research: CHE 390/391

Independent Study in Chemical Engineering serves to provide a high quality student-faculty experience for a range of topics, from specialized technical coursework to independent hands-on research projects. CHE 390/391: Independent Study will focus on contemporary issues from primary literature and count as a Technical Elective in the Chemical Engineering course of study. The specific topic and goals of the Independent Study are to be determined by the Instructor and the student.

Course Hours: One hour per week meeting with Instructor (minimum)
Ten hours per week laboratory or project work (minimum)
THE EXCEL SCHOLARS PROGRAM

Lafayette’s EXCEL Scholars Program enables high-performing students to assist faculty members with their scholarship. The purpose of the EXCEL Program is to encourage collaboration in learning between faculty and students. The work of the student must, therefore, be research-oriented and not administrative in its primary emphasis. EXCEL Scholars may work part-time during the academic year or full-time during the Summer and the Interim Session.

Participation in the EXCEL Program is an honor reserved for those students who have achieved distinction in their academic program at Lafayette. To be eligible as an EXCEL Scholar, students should have completed their first year at Lafayette and should maintain a cumulative GPA of 3.25.

http://researchsupport.lafayette.edu/research-by-students/
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**Honors thesis research: CHE 495/496**

An Honors Thesis in Chemical Engineering serves to provide outstanding students with a high quality student-faculty research experience during the senior year. Candidates for honors must have and must maintain a cumulative GPA of 3.00 and ChBE Departmental GPA of 3.20. The specific research topic of the Honors Thesis should be discussed well in advance of the senior year with the Instructor.

**Course Hours:**
- One hour per week meeting with Instructor (minimum)
- Ten hours per week laboratory or project work (minimum)
Getting involved: Ferri

Optimization of Voxel Resolutions in Materials Additive Manufacturing
Duration: 1 years; (with renewal upcoming)
Funding organization: ExOne Company
People involved: 6 (PI and undergraduates)
Engineering the cell-surface interaction

- **Overarching principle:**Manipulate biomaterial properties, *(bulk: modulus; surface: chemistry, topography)*, to selectively control the cell-material interaction.

- For the relevant cell type, evaluate the following parameters on the biomaterial:
  - Cell morphology: microscopy, image analysis (spreading, circularity)
  - Cell adhesion: microscopy, immunofluorescence, adhesion assays
  - Cell differentiation: gene and protein expression, soluble signaling
  - Cell proliferation: DNA quantification
  - Cell-vitality: live/dead quantification using ViCell

L. Anderson
Gene Expression by Real-time RT-PCR

Mechanistic Cell Adhesion Analysis using mRNA Microarrays

Cell Morphology by Confocal Microscopy

Thermoresponsive Polymer Brush Fabrication and Cell Culture

Gene Expression by Real-time RT-PCR

Mechanistic Cell Adhesion Analysis using mRNA Microarrays

Cell Morphology by Confocal Microscopy
What skills will I learn?

- Sterile cell culture
- Real-time RT-PCR
- Microscopy (phase contrast, confocal)
- Polymer fabrication (nanofibers, microspheres, 2D films)
- UV-vis spectrophotometry

What positions are open?

- EXCEL: Summer and AY 15-16
- Honors Thesis
- Independent Study
Investigation of protein expression and cell function in biomolecular engineering applications

Central question: How does the regulation of cell protein expression affect cell function and inform the engineering of better materials?
Experimental skills:

- Sterile cell culture
- Immunohistochemistry
- Confocal microscopy
- Protein electrophoresis and western blot
- Fluorescence spectroscopy
- In vitro cell function assays

Availability:

- Honors Thesis: AY 2015-2016 (Juniors)
- EXCEL: AY 2016-2016 (Sophomores and Juniors)
Polly R. Piergiovanni

Current Research Interests

• Development of experiential activities in food engineering
• Kinetics of dye – textile adsorption
• Developing engineering students’ critical thinking skills

Independent Study Projects available for Fall 2015
Research Interests
Polly R. Piergiovanni

• Adsorption thermodynamics and kinetics
Sustainability and Engineering

Nutraceuticals, Antibiotics, Steroids

Lipid, Protein, Starch, Other

Biodiesel, Glycerol, Polymers, Surfactants

Bioethanol, Bioplastics, Food additives

Animal Feed, Nutrient Recycling

Energy and the Environment
CO₂ as a green solvent

Extraction

Pressure

Triple point

Solubility of organic dyes in CO₂

Melting

Freezing

Vaporization

Condensation

Sublimation

Deposition

Energy and the Environment
Biodiesel Production Process

Cultivation → Harvesting → Extraction → Conversion

Biodiesel conversions in CO₂

Triglyceride + 3CH₃OH ⇌ CH₂OH
C O COR
CH₂ O COR
CH₂ O COR
Methanol

CH₂OH
C O H
CH₃OH
Glycerol

+ 3R − COOCH₃
Methyl esters (biodiesel)

Biodiesel cold flow properties

Energy and the Environment

All research opportunities are available.
Green Faculty Collaboration

• A major disadvantage of using biofuels is **cold flow properties**.
  • Impacts ability for engines to run
  • Interested in how particular components of oils and additives influence cold flow properties.
Keeping Things Flowing Under the Sea...

- Issue faced in petroleum transportation
  - Cold water temperatures $\rightarrow$ crystallization (cloud point) $\rightarrow$ deposition and gelation (pour/gel point)
  - Chief component of deposits: n-alkanes (waxes)
  - Impacted by presence of other materials
Equipment/Skills

• Conducting measurements of flow properties important in the energy industry.
• Rheometry
• Differential Scanning Calorimetry

Opportunities available:
EXCEL scholars (SU 15 and AY 15-16)
Honors Thesis and Independent Study (AY 15-16)
Interested in Research?

• **EXCEL Scholars (pay)**
  - SU 15: Talk to faculty ASAP
  - FA 15 or AY 15-16: Decision by late summer
  - SP 16: Late summer best, possible if decision made by FA15

• **Honors Thesis (seniors only, credit only)**
  - The earlier, the better
  - For non-seniors, get a feel for research via Excel or independent study (not requirement for honors thesis)

• **Independent Study (credit only)**
  - Not difficult to arrange, but based on faculty availability