Course Syllabus: CHEM-346L

Bioanalytical Chemistry – an undergraduate research laboratory course on the
discovery of novel enzymes from combinatorial libraries of environmental DNA

Tues: 2:15 - 5:30 pm (Atwood 353)
Thurs: 2:30 - 3:30 pm (Emerson 401)

Credits: 2

Prerequisites: Chemistry/Biology 301

Instructors: Stefan Lutz, Emerson 205  sal2@emory.edu

Office hours: Tuesday: 5:30 – 6:30 pm or by appointment

TA: Myfanwy Hopkins, Emerson 260

Office hours: Thursday: 3:30 – 4:30 pm

Content: The laboratory course centers on the discovery of novel enzymes from complex mixtures of environmental DNA (eDNA) in soil samples. An incredibly rich diversity of life can be found in regular dirt. Millions of microorganisms exist in each cubic inch, however only a tiny fraction has actually been successful cultured in the laboratory. Researchers in academia and industry alike are interested in tapping this biological resource for new drugs and the genes that synthesize them. One successful method to harvest the genetic diversity from these “uncultivable” bacteria and fungi is to lyze all cells in a given soil sample and isolate the mixture of DNA from all inhabitants, so called eDNA. Following the cloning of the partially digested eDNA fragments, the pieces are transferred into bacteria and combinatorial screening and selection techniques are employed to identify colonies expressing proteins (from the eDNA fragment libraries) with desired activities. Subsequently, the genes that encode a phenotype of interest can be located, isolated, and their protein product characterized by simple kinetic measurements.

The class (10-15 students) will be divided into teams of three or four students. Each team will collect their individual soil sample and retrace the individual steps of eDNA isolation, cloning, screening, isolation, and characterization. The teams will select one activity (e.g. antibiotic resistance, proteolytic activity, lipid hydrolysis – see course webpage for complete listing) for which they will screen their library. The unique nature of each team’s soil sample guarantees a distinct composition of the resulting eDNA libraries which is likely to generate previously unknown proteins with interesting properties. In the process, the students will not only find opportunities to directly implement their classroom theory but will acquire practical knowledge of the basic experimental techniques and will experience a taste of true research.

Texts: The course will use research publications. No textbook is required though a general biochemistry textbook is recommended (e.g. Garrett&Grisham, Voet&Voet). Visit the course webpage for a listing of current references: http://lutz4.chem.emory.edu/CHEM346L/web-content/index.html

Course objectives: The course will introduce students to the basic experimental techniques of biological chemistry. As student teams work on their individual soil/eDNA sample, taking it from dirt to an isolated and characterized protein, they will be trained in methods such as PCR, electrophoresis, cloning, and protein purification. In this research-based course, students will also have the opportunity to develop important problem-solving skills, overcoming hurdles that arise from the unique nature and origin of each soil sample. The course represents an ideal preparation for students that plan on joining a research laboratory in their junior/senior years.

Grading: Student evaluation will reflect the research environment; grades will be based on the quality of verbal presentations in group meeting, lab notebooks, and a final poster presentation/manuscript (publication style).