Medicinal Chemistry in Jamaica: An International Perspective
Chemistry 260

Detailed Course Description

Medicinal chemistry is the application of chemistry in the context of human medicine. In this course students will gain an appreciation for the drug development process, including how biologically active natural products are isolated, how the structure of a drug relates to its activity, and how basic research into the biochemical mechanism of disease leads to the targeted development of drugs. Students will go beyond a traditional classroom medicinal chemistry course, participating in an international conference on medicinal chemistry and gaining first-hand experience in the daily routine of academic research labs at the University of the West Indies in Kingston, Jamaica. Issues relating to medicinal chemistry in a developing-world context, medicinal plants, and the chemical basis of folk medicine will be discussed.

We will be using a textbook specifically designed for undergraduate use, *An Introduction to Medicinal Chemistry*, by Graham Patrick ($45). In addition, this course will also include the opportunity to attend an international conference on medicinal and natural product chemistry. The Mona Symposium, held at the University of the West Indies (UWI) in Kingston, Jamaica, will provide an opportunity for students to meet professional medicinal chemists and graduate students from around the world in a casual environment focused on science.

Besides the Mona Symposium, Chemistry 260 will provide extensive opportunities for cross-cultural learning.

- Working out of the chemistry department at UWI, students will meet graduate students and professors doing research in natural products isolation, characterization, and synthesis.

- There will be opportunities to work with a group of undergraduates at UWI who will be enrolled in the laboratory course, C32N, *Organic Chemistry in Medicine and Agriculture*. We hope to design a joint laboratory experience that will involve undergraduates from both institutions to get to know each other and work together to carry out the isolation and characterization of a biologically active natural product from an indigenous Jamaican plant.

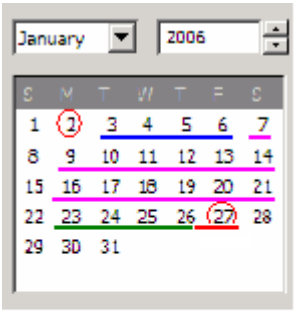
- Social events including a softball game, a cricket match, and an ice cream social will mix St. Olaf students and UWI students in a casual setting.

- Field trips and guest lectures related to Jamaican history, culture, and economy will complement the medicinal chemistry aspect of the course.

- Students will spend 2-3 days at the Discovery Bay Marine Laboratory, a research facility associated with UWI on the north coast of Jamaica. Here students will learn about current research projects relating to the discovery of marine natural products with antimicrobial activity. Students with scuba diving certification or an interest in snorkeling will be able to explore the local coral reefs and tidal areas first hand.

Overall Itinerary

Monday, Jan. 2	depart MSP; arrive Montego Bay, Jamaica; bus to Kingston
Tues-Fri, Jan 3-6	Mona Symposium, UWI
Sat, Jan 7 – Sun, Jan 22	mornings in seminar-style class; afternoons and Sundays: free or field trips
Mon-Wed, Jan 23-25	Discovery Bay Marine Laboratory and north shore environs
Thursday, Jan 26	travel to Montego Bay; free time, final banquet
Friday, Jan 27	depart Montego Bay for MSP



Mona symposium
Seminars/field trips
Discovery Bay Marine Lab
Montego Bay (R&R)

Course Prerequisites and Credits

Chemistry 248 and 254 (organic chemistry and synthesis lab) are required; the course counts toward the chemistry major and toward the biomedical studies concentration.

Course Goals

Three principal course goals include:

I. introducing students to the science of medicinal chemistry;
II. providing students with an "immersion science" experience in an international setting; and
III. involving students in another culture.

Specific Student Objectives and Means of Assessment

Specific student objectives and means of assessment will be designed for each of the three principal course goals. Student assessment will involve a mix of participation (15%), quizzes and exams over the textbook material (35%), nonlab written work (40%), and lab-based written work (10%).

I. *Introducing students to the science of medicinal chemistry (70%)*

a. Students will attend an international symposium. During the symposium, students will be required to take notes in an "academic journal" (10%) and participate in daily discussions recapping their experiences and clarifying the chemistry involved. (5%)

b. Students will learn the basic science of medicinal chemistry by reading and discussing *An Introduction to Medicinal Chemistry*, by Graham Patrick. Class participation (5%), short quizzes (15%), and a final exam (20%) will assess student understanding of this material. In addition, students will carry out a laboratory project in a scientific manner, record their observations, and summarize their findings (10%).

c. Students will participate in the guest presentations and field trips and include observations and insights via academic journaling (5%).

II. *Providing students with an "immersion science" experience in an international setting. (20%)*

a. In association with the Mona Symposium, students will interview one or more symposium participants and write a short report relating to that person's perspective of medicinal chemistry, how they got involved, and what it is like to do science in this area. (10%)

b. Students will write short summaries of research projects currently under way by one or more graduate students at UWI. (10%)

III. *Involving students in another culture. (10%)*

a. Direct interaction with similarly-aged undergraduates at UWI. Assessed only in terms of participation.

b. Students will carry out a small nonlaboratory (i.e. library) research project focused on a particular medicinal plant intrinsic to Jamaican culture. Essentially an "ethnomedicine" project, this will be written up and assessed accordingly (10%).

Daily Schedule

The daily schedule will depend upon where we are in the above proposed itinerary:

- During the conference, students will be occupied with attending talks, socializing with and interviewing conferees, and participating in evening "debriefing" sessions where students will share their experiences with their peers and pick up on the chemistry necessary for a full understanding of their next day of scientific "immersion."

- For the next two weeks, students will have a 2-hour classroom experience during the morning built around the textbook and then, in the afternoon, take part in a variety of experiential activities designed to get students thinking about how medicinal chemistry is carried out in the "real world." Proposed activities include interviewing graduate students and professors at UWI, taking field trips to scientific and cultural sites, and guest presentations by health professionals, professors in the area of medicinal and natural products chemistry, Peace Corps and USAID staff, and others.

- Three Sundays will be free days with possible organized cultural events in the vicinity of Kingston.

- During the last week of January we will move to the Discovery Bay Marine Laboratory for three days of instruction and relaxation on the north shore. This venue will be the base for visits to some of the more tourist-oriented areas of Jamaica, including Dunn's River Falls, Glistening Waters, Green Grotto Caves, and Cranbrook Flower Forest.

- We will conclude the interim with a day in Montego Bay, in the heart of the resort area of northwestern Jamaica.

Housing

Students will be housed in a secluded townhouse complex in the Liguanea/New Kingston area about a mile from the Mona campus. These two-level townhouses include a fully equipped kitchen, living room, dining room, and patio downstairs and two bedrooms, each with two beds and its own bathroom, upstairs.

Safety

The Mona campus is in one of the loveliest, safest areas of the city. Nonetheless, Kingston is known for a relatively high level of crime and violence. Like all cities, that violence is mostly restricted to specific areas, and prudent behavior can minimize one's exposure to this violence. There are places one simply does not go, either at night or during the day, and there will be strict rules relating to traveling around the city. We will have three graduate student liaisons who can accompany students on excursions, and we will have our own private bus transportation for group travel.

Course Outline

Throughout the course, specific drugs will be discussed in terms of their molecular structure and how that structure relates to their specific function within known biochemical pathways. This outline will be adjusted based upon the background and interests of the students selected for the course and the time available. Sessions will be in the form of seminars, with individual students or groups of students responsible for preparing handouts, initiating the discussions and providing additional input based on past coursework.

PART I: Drug Action

definition of "drug"

drug targets: lipids, carbohydrates, proteins, nucleic acids

drugs targeting proteins: enzymes and receptors, catalyst inhibition, agonists and antagonists, sensitization and desensitization, tolerance and dependence, transmembrane receptor structure, ion channels, G-protein coupled receptors, kinase-linked receptors, cytoplasmic receptors

drug action at nucleic acids: intercalating agents, alkylating agents, chain cutters, nucleotide mimics

PART II: Drug Discovery, Design, and Development

drug discovery: diseases, targeting, bioassay, lead compounds

drug design: drug metabolism and pharmacokinetics, prodrugs, manufacturing issues, clinical trials

drug development: pharmacophores, drug modification strategies

PART III: History of Drug Development

antibacterial agents: sulfa drugs, penicillins, cephalosporins, clavulanic acid, thienamycin, olivanic acids, nocardicins, vancomycin, valinomycin, gramicidin A, rifamycins, streptomycin, tetracyclines, chloramphenicol, erythromycin, ciprofloxacin

cholinergics, anticholinergics, and anticholinesterases: nicotine, muscarine, carbachol, atropine, hyoscine, tubocurarine and related compounds, dyflos, sarin

adrenergics: adrenaline, noradrenaline, L-dopa, amphetamine, ephedrine, propranolol and related beta-blockers, reserpine

analgesics: aspirin, opium, codeine, quinine, strychnine, cocaine, lysergic acid diethylamide, morphine, oxymorphine, enkaphalins, endorphins, GABA