

CHEM-4703

Advanced Topics in Metabolism

Course Description: This course builds on prior courses in metabolism focused on the core pathways of fuel metabolism/catabolism and anabolism. Topics include xenobiotic metabolism, redox metabolism, and metabolomics. Important applications to medicine and human health (cause, treatment, and/or diagnosis of disease states) are explored.

Background information: Our introductory and intermediate biochemistry courses (like those almost everywhere) focus on the “core” areas of intermediary metabolism: catabolism (usually taught from a fuel metabolism perspective) and anabolism (the biosynthesis of biomolecules). These areas provide an important foundation to the understanding of metabolism, but there are many other important (and interesting) aspects of metabolism to explore. A study and understanding of these additional aspects of metabolism are important to both chemists and biochemists, with applications including an understanding of human health (over 200 diseases and even the aging process itself are linked to a redox imbalance); nutrition (the role of antioxidants in a healthy diet; an understanding of the underlying biochemical reason for why common food additives such as nitrites and nitrates are carcinogenic); environmental and pharmaceutical science (understanding metabolism of xenobiotics including pharmaceuticals); diagnostics (using metabolomics to developing non-invasive diagnoses of disease); and even plant breeding (e.g. how to develop a non-browning apple). These and (if time permits) other aspects of advanced metabolism will be explored.

Class meetings	Fridays, 2:30 – 5:30; 1RC019
Instructor	D. Vanderwel
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PREREQUISITES: Students should have CHEM-2202/2203 and either CHEM-2502 or CHEM-3502/3503.

COURSE TOPICS:

Xenobiotic Metabolism:

- Introduction
- Phases I and II of metabolism.
- Enzymes involved in metabolism of xenobiotics
 - Monooxygenases and family of cytochrome P450s
 - others
- Biochemical implications
 - Activation / elimination of xenobiotics
 - Pharmacological responses (drug interactions)
 - toxicity, cancer

Metabolomics:

- Introduction
- Approaches
 - Target analysis
 - Metabolite profiling
 - Metabolomics
 - Metabolic fingerprinting
- Applications
 - Toxicity, functional genomics, nutrigenomics.
 - Non-invasive diagnosis of early disease states

Redox Metabolism

- Introduction
- Endogenous and Exogenous Sources of Reactive Oxygen Species (ROS) and Reactive Nitrogen Species (RNS)
- Harmful / beneficial effects of ROS and RNS
- Endogenous protection against ROS and RNS
- Oxidative balance and oxidative stress
- Redox signalling and control
- Applications
 - “Browning” of fruits and vegetables.
 - Disruption of redox balance
 - Reperfusion injuries (stroke, organ transplantation)
 - Cause/correlation with disease and aging

The above topics will be covered in more or less detail, and additional topics of interest may be added, as time permits.

COURSE MATERIALS:

When background (review) information is required, relevant chapters will be assigned from a free on-line text (Biochemistry “Free For All” Version 1.3, 2018, by Kevin Ahern, Indira Rajagopal and Taralyn Tan). This e-book is available for free download at the link indicated below. Note that the iBooks version can run on an iPad or a Mac running iBooks; the PDF version can be used on any computer. <https://biochem.science.oregonstate.edu/content/biochemistry-free-and-easy>.

Required readings from other sources will be provided either as handouts, web-based references, on Nexus, or on Reserve in the Library. A portion of class time will be devoted to the discussion of papers in the current literature.

NEXUS:

I will be posting some information for this course on the NEXUS server (<http://nexus.uwinnipeg.ca/>). Material that will be posted includes lecture ppts, assigned readings, learning objectives, assignments, etc.

COURSE GRADING:

Term Test	20%
Assignments	10%
Essay	20%
Final exam (3hr)	50%