



THE OHIO STATE UNIVERSITY

SYLLABUS: BIOPHRM 5050

MOLECULAR BASIS OF OXIDATIVE STRESS (ON-LINE COURSE)

SPRING 2023

Course overview

Instructor

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Office hours: By appointment

Credits

Successful completion of this class will be rewarded with 2 graduate credits.

Course description

Aerobic evolution has provided living organisms with a myriad of biochemical pathways for oxygen transport and sensing, energy production, and antioxidant defense mechanisms. This course will introduce students to the importance of oxygen and reactive oxygen species (ROS) in the regulation of cell function, cell signaling, immune response and their toxicology at unregulated concentrations. The inter-relationship between reactive species and development of diseases, as well as how various antioxidants (both natural and synthetic) can be employed in the treatment of these diseases will be the highlights of lectures and discussions.

Course learning outcomes

The course's goal is for the students to be able to understand the molecular basis and mechanisms of the initiation of oxidative damage to biomolecules and how these oxidative events could impact cellular metabolism and could translate into the pathogenesis of some disease states.

Upon completion of the course, students should be able to:

- a. Understand the nature, origin and effects of oxygen and oxygen-derived reactive species on biomolecules and cellular functions.
- b. Identify key mechanisms of oxidative stress in disease states.
- c. Know the diagnostic methodologies employed in the investigation of oxidative stress.
- d. Introduce to variety of potential therapeutic strategies that could minimize, ameliorate or reverse the progression of oxidative stress-related disease conditions.

Course materials

Required

Frederick A. Villamena, Ed. *Molecular Basis of Oxidative Stress: Chemistry, Mechanisms and Disease Pathogenesis*, Wiley & Sons, 2013.

Frederick A. Villamena, *Detection of Reactive Species in Biology: From Fluorescence to EPR*, Elsevier, 2017.

Course structure

This is an on-line course. Lectures are posted on Carmen every Monday no later than 9 am. The first 10 weeks of the course is dedicated toward lectures and the remaining weeks are allotted for student journal on-line presentations. There are a total of 5 quizzes. Students are required to

participate in a journal article discussion and participation is graded. For the student presentation, students are assigned with a journal article on oxidative stress as it relates to a particular disease state and have to give 20 minute on-line oral presentation with Q&A portion to be posted. Final Exam is a take-home exam based on a chosen journal article. Under an honor system, the exam could only be taken individually. No sharing of answers or group effort is allowed for all the quizzes and final exam.

Course schedule

Week 1-3

(January 9-29)

I. Introduction

II. Chemistry of Reactive Species

- Definition of Reactive Species
- Classification of Reactive Species
- Thermodynamic and Kinetic Considerations of RS Reactivity
- Sources of Reactive Species
- Methods of Detection

Week 4-5

(January 30-February 12)

III. Mechanisms of Oxidative Damage

- Lipid Nitration and Peroxidation
- Post-Translational Protein Modification
- Mechanisms of Oxidative Damage to Carbohydrates
- Nucleotide Oxidation

Week 6-7

(February 13-26)

IV. Mechanisms of Oxidative Stress

- Down Regulation of Phase II Enzymes
- Mitochondrial Dysfunction
- NADPH oxidase activation

- Cell Signalling
- **Midterm Exam**

Week 8-10

(February 27- March 19)

(Note that March 13-17 Week 10 is Spring Break)

V. Role of Free Radicals in Diseases

- Cancer
- Stroke and Neurodegenerative Disease
- Ischemia and Reperfusion
- Atherosclerosis
- HIV
- Cystic Fibrosis

Week 11-12

(March 20-April 2)

5 Free Radicals in Diagnosis and Therapeutics

- Biomarker of Oxidative Stress
- Therapeutic Strategies

Week 13-15

(April 3-23)

6 Student Journal On-Line Presentations

Final Exam Week

(April 24-May 2)

7 Final Exam

Grading

The OSU standard grading scheme of A to E will be implemented in this course. Quizzes (40%); Discussion (30%); Final Exam (10%) and Presentations and Q&A Participation (20%).

Accommodations for accessibility

Requesting accommodations

If you would like to request academic accommodations based on the impact of a disability qualified under the Americans with Disabilities Act and Section 504 of the Rehabilitation Act of 1973, contact your instructor privately as soon as possible to discuss your specific needs. Discussions are confidential.

In addition to contacting the instructor, please contact the Office for Disability Services at [614-292-3307](tel:614-292-3307) or ods@osu.edu to register for services and/or to coordinate any accommodations you might need in your courses at The Ohio State University.

Go to <http://ods.osu.edu> for more information.

Academic Misconduct

Academic misconduct is defined as any activity that compromises the academic integrity of The Ohio State University or subverts the educational process. Academic misconduct of any nature will not be tolerated and will be reported to the OSU Committee on Academic Misconduct (COAM) following the procedures and policies outlined at <http://oaa.osu.edu/coam/home.html>