G O A

Student Program

Biochemistry: Medicine, Drugs & Addiction

LENGTH OF COURSE: 14 WEEKS

Course Overview

Discover the fascinating science behind medicine and drug interactions, exploring how substances impact the human body at the molecular level. You'll dive into the chemistry and biology of a substance's mechanism of action, effectiveness, and safety. Learn how drugs interact with molecules like receptors and enzymes to create therapeutic effects, and tackle complex topics such as tolerance, addiction, and withdrawal. The course also investigates the historical context of drug discovery, legalization, regulation, and addiction recovery treatment.

This course is essential for aspiring healthcare professionals, pharmacists, or biochemists, offering a foundational understanding of drug mechanisms and development. Moreover, if you're simply curious about how substances interact with your own body to make informed personal choices, this course provides practical, valuable knowledge. You'll gain insights into the science of healing and the effects of drugs on the body, alongside an appreciation for the unintended consequences of substance overuse, misuse, and abuse on individuals and society at large.

Pre-requisites

Students enrolling in this course should have taken or should be concurrently enrolled in Chemistry.

Competency-Based Learning

GOA courses use a competency-based learning approach in which students build both GOA core competencies and course-specific ones. Throughout the semester,

we assess outcomes tied to each competency to track student progress with the goal of students leaving the course able to use and apply these competencies well beyond the final day of the semester.

Course Competencies & Outcomes

GOA students learn in practical, hands-on ways, which include the following core competencies:

Communicate and empathize with people who have perspectives and experiences different from your own.

- *Empathize*: You communicate various considerations and challenges for everyone impacted by substance use, addiction, and chemical dependence.
- *Context*: You explain how biological, political, and social factors affect access to and research on drugs and other substances.
- *Perspective Taking*: Your communication, analysis, and reflection reveal you consider the perspectives of other people and groups and are able to distinguish those perspectives from your own.

Curate and create content relevant to real-world issues.

- *Description*: Accurately identify and comprehensively describe fundamental biochemical structures and processes.
- *Analysis*: You explain the mechanism of action of a particular substance at the molecular level.
- *Critique*: You effectively assess the credibility and appropriateness of sources when supporting claims and assertions.

Reflect on and take responsibility for your learning and that of others.

- *Connection*: You share ideas and resources with your peers that encourage them to think more deeply
- *Specificity*: Your ideas are supported by examples or references to biochemical concepts and terminology.

Course Outline

Weeks 1 - 3	GOA Orientation & Module 1: Brain Basics
COMPETENCIES: • Curate and create content relevant to real-world issues. • Reflect and take responsibility for your learning and that of others.	
DESCRIPTION: The module introduces students to the foundational biology and chemistry of the human brain. Students explore the structure and function of key brain regions, investigate how neurons transmit signals, and apply their learning to real-world	

examples of neural communication. Through discussion, simulation, and targeted readings, students begin to build a shared vocabulary and understanding of how the nervous system is organized and functions at the molecular level. This foundation sets the stage for deeper exploration into how drugs can alter or interfere with these pathways.

EXAMPLE ASSESSMENT:
Students participate in a collaborative guided discussion to apply their knowledge of brain structures and communication.

Weeks 4-5	Module 2: Introduction to Psychopharmacology

COMPETENCIES:

- Curate and create content relevant to real-world issues.
- Reflect and take responsibility for your learning and that of others.

DESCRIPTION:
In this module, students explore the chemistry behind how drugs interact with the nervous system. Topics include neurotransmitters, drug classifications, mechanisms of action, and routes of administration. Students learn how molecules such as serotonin and dopamine affect behavior and mood, and how various drugs influence those systems. The module includes case-based learning and structured jigsaw-style discussions to examine real examples of drug interactions and effects.

EXAMPLE ASSESSMENT:
Students analyze a case study and contribute to a neurotransmitter jigsaw discussion, synthesizing their findings into an explanatory infographic or written summary that illustrates the action of a selected drug on specific neurotransmitter pathways.

Weeks 6-7	Module 3: Central Nervous System Depressants

COMPETENCIES:

- Curate and create content relevant to real-world issues
- Communicate and empathize with people who have perspectives and experiences different from your own
- Reflect and take responsibility for your learning and that of others.

DESCRIPTION:
This module investigates CNS depressants such as alcohol and benzodiazepines, focusing on their effects on the brain and body. Students examine the short- and long-term consequences of depressant use, including tolerance, dependence, and withdrawal. Instruction includes a blend of direct content delivery and independent research, allowing students to compare various substances and analyze their social and biochemical implications.

EXAMPLE ASSESSMENT:
Working in pairs, students conduct research and prepare a presentation comparing different CNS depressants. Each partner presents on a specific substance, highlighting its mechanism of action, risks, and legal status.

Weeks 8-10	Module 4: Stimulants

COMPETENCIES:

- Curate and create content relevant to real-world issues
- Communicate and empathize with people who have perspectives and experiences different from your own
- Reflect and take responsibility for your learning and that of others.

DESCRIPTION:
Students explore the class of stimulants including caffeine, nicotine, methamphetamine, and prescription medications like Adderall. Emphasis is placed on how these drugs impact neurotransmission, energy, focus, and behavior. The module includes critical discussions on legality and societal perceptions, helping students compare how similar molecular actions can lead to very different legal or social responses.

EXAMPLE ASSESSMENT:
Students synthesize their findings in a multi-part group presentation, addressing both legal and illegal stimulant substances. Presentations include pharmacological detail as well as an evaluation of cultural and regulatory contexts.

Weeks 11-13	Module 5: Pain

COMPETENCIES:

- Curate and create content relevant to real-world issues
- Communicate and empathize with people who have perspectives and experiences different from your own
- Reflect and take responsibility for your learning and that of others.

DESCRIPTION:
This module focuses on the concept of pain and how it is managed medically and pharmacologically. Students study pain perception, opioid mechanisms, and the complex challenges of pain treatment, including ethical considerations and public health issues such as the opioid epidemic. The module also serves as the launch point for the Capstone project, where students begin brainstorming and planning their final investigations.

EXAMPLE ASSESSMENT:
Students will begin this module by unpacking the Vioxx case study, exploring the complex issue of transparency between drug manufacturers and patients. The unit will then connect this historical event to the opioid crisis, examining how a similar withholding of crucial information led to devastating outcomes.

Week 14-16	Module 6: Antidepressants and Capstone
COMPETENCIES: • Curate and create content relevant to real-world issues • Communicate and empathize with people who have perspectives and experiences different from your own • Reflect and take responsibility for your learning and that of others.	
DESCRIPTION: In the final module, students explore both traditional and emerging approaches to treating mood disorders, with a focus on antidepressants and psychedelics. Students investigate the biochemical pathways affected by these drugs, compare their mechanisms of action, and evaluate current research on their effectiveness, risks, and regulation. At the same time, students finalize and refine their Capstone projects, which synthesize course content into a deeper exploration of a student-selected topic related to drug design, impact, or policy.	
EXAMPLE ASSESSMENT: To conclude the semester, students will reflect on addiction treatment programs. Applying what they've learned about drugs, use, and regulation, students will develop a more comprehensive or effective solution for a specific facet of addiction recovery.	

Required Materials

Material: The text of all required readings will be provided
Access: Provided in course
Cost: No purchase needed