

## Overview

### Module Description

This module seeks to infuse experience with AI models into chemistry laboratory courses with the goal of training students on how to recognize AI works and how to responsibly and ethically utilize AI models in higher education. Students will undertake several modules where they will first use AI to compare its answers to the answers they come up for several problems, including some basic chemistry and math as well as some predictive work in an integrated research project part of the lab sequence. Students will then critique the effectiveness of the AI models in providing correct information as well as examine the methodology of the AI-generated responses. Finally, students will explore the potential uses and pitfalls of using predictive AI within the broader chemistry field (such as designing new molecules or protocols).<sup>1</sup> Discussion of ways that AI can specifically enhance knowledge in the field of chemistry<sup>2</sup> will be critical to developing new career tracks (mirrored by many universities cluster hiring of AI scientists<sup>3</sup>).

### Learning Outcomes

- Students should recognize capabilities and limitations of AI models.
  - Recognize patterns in AI responses.
  - Examine the integrity of the answers provided.
- Students should be able to describe the ethical implications of using AI models in their work.
  - Can AI models assist them in learning? Designing quizzes, flashcards, mnemonics.
  - How can abusing AI for quick answers harm them, their peers, or others?
- Students should design processes to utilize AI models (current and future) to advance chemistry research.
  - Examine characteristics of soil types and ions to predict level of interaction.
  - Need for accessible data to train AIs.

### Module Organization and Timeline

#### Class Discussion and Assessment on Topic #1: What is AI? How Can We Recognize It? (Week 2-3)

Class discussion on the introduction to AI, covering its definition, practical applications such as machine learning and natural language processing, and how AI generates responses based on existing data without creating original ideas. The discussion also explores how humans can identify AI-generated content through pattern recognition, using tools like AI detection software and literary forensics. The topic concludes with an assessment, including a quiz on AI development and the ability to distinguish between AI-generated and human-generated writing.

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<sup>1</sup> Artificial Intelligence in Chemistry: Current Trends and Future Directions. Zachary J. Baum, Xiang Yu, Philippe Y. Ayala, Yanan Zhao, Steven P. Watkins, and Qiongqiong Zhou Journal of Chemical Information and Modeling 2021 61 (7), 3197-3212  
DOI: 10.1021/acs.jcim.1c00619

<sup>2</sup> <https://thegradient.pub/how-ai-is-changing-chemical-discovery/>

<sup>3</sup> <https://www.insidehighered.com/news/2015/05/01/new-report-says-cluster-hiring-can-lead-increased-faculty-diversity>

## **Class Discussion and Assessment on Topic #2: What are the Ethical Concerns Centered around AI Use? (Week 7-9)**

This activity involves demonstrating AI-based chemistry question answering during the pre-lab session, followed by a discussion on the ethics of using AI and ensuring AI safety. Students will also be encouraged to analyze patterns in AI responses, create their own questions for AI models, and explore ethical considerations further using the Montreal Declaration. (<https://montrealdeclaration-responsibleai.com/the-declaration>).

## **Class Discussion and Assessment on Topic #3: How Can We Responsibly Use AI in Chemistry? (Week 10-12)**

The discussion covers the use of AI models in chemistry, focusing on topics such as protein structure and the availability of PDB. It also addresses the challenges of accessing sufficient data to train AI effectively. Additionally, student participation in in-class and Discussion Board responses will be encouraged, followed by a post-test on Canvas. Moreover, the potential use of AI by students to generate study guides will be explored.

Each topic is designed to take about 20-30 minutes of class time.

- Out of class readings/quizzes.
- In-class lectures, discussion, and examples

## **Assignments and Final Exam**

During the semester, there will be two assignments and one final exam.

### **1. Assignment #1: Discussion Board - WSSU Scenario**

This assignment asks students to choose between two scenarios where AI could be applied in administrative roles at Winston-Salem State University (WSSU) to enhance student support through better predictions and targeted guidance. Each scenario includes three questions, and students must thoughtfully respond to one of these questions and engage with at least one peer's comment. The exercise encourages students to consider how AI might impact their categorization and future predictions, reflecting on its potential benefits and ethical implications.

### **2. Assignment #2: Design, Answer, and Evaluate Chemistry Question**

For this assignment, students are required to create a chemistry question, input it into an AI tool of their choice, and report the AI's response. They must then critique the accuracy and quality of the AI's answer, evaluating whether it correctly addresses the question, follows the right process, and provides a clear explanation. Finally, students should reflect on the ethical implications of using AI for such tasks, referencing the Montreal Declaration for guidance.

### **3. Final Exam**

For this final exam question, students are asked to evaluate an AI-generated response to a chemistry problem. They should critique the accuracy and completeness of the AI's answer, considering what grade they might receive if they submitted it as-is. Additionally, students must discuss two ethical concerns associated with using ChatGPT for exam answers.

## Assessment Rubric

The student's work will be assessed using the AAC&U Ethical Reasoning VALUE Rubric available at VALUE Rubrics - Ethical Reasoning | AAC&U ([aacu.org](http://aacu.org))

For this course, different evaluation criteria were applied for different assignments. For convenience, the AACU Value Rubric is also provided below:

### ETHICAL REASONING VALUE RUBRIC

for more information, please contact [valuel@aacu.org](mailto:valuel@aacu.org)



#### Definition

Ethical Reasoning is reasoning about right and wrong human conduct. It requires students to be able to assess their own ethical values and the social context of problems, recognize ethical issues in a variety of settings, think about how different ethical perspectives might be applied to ethical dilemmas, and consider the ramifications of alternative actions. Students' ethical self-identity evolves as they practice ethical decision-making skills and learn how to describe and analyze positions on ethical issues.

*Evaluators are encouraged to assign a zero to any work sample or collection of work that does not meet benchmark (all one) level performance.*

	Capstone 4	Milestones 3                      2		Benchmark 1
<b>Ethical Self-Awareness</b>	Student discusses in detail/analyzes both core beliefs and the origins of the core beliefs and discussion has greater depth and clarity.	Student discusses in detail/analyzes both core beliefs and the origins of the core beliefs.	Student states both core beliefs and the origins of the core beliefs.	Student states either their core beliefs or articulates the origins of the core beliefs but not both.
<b>Understanding Different Ethical Perspectives/Concepts</b>	Student names the theory or theories, can present the gist of said theory or theories, and accurately explains the details of the theory or theories used.	Student can name the major theory or theories she/he uses, can present the gist of said theory or theories, and attempts to explain the details of the theory or theories used, but has some inaccuracies.	Student can name the major theory she/he uses, and is only able to present the gist of the named theory.	Student only names the major theory she/he uses.
<b>Ethical Issue Recognition</b>	Student can recognize ethical issues when presented in a complex, multilayered (gray) context AND can recognize cross-relationships among the issues.	Student can recognize ethical issues when issues are presented in a complex, multilayered (gray) context OR can grasp cross-relationships among the issues.	Student can recognize basic and obvious ethical issues and grasp (incompletely) the complexities or interrelationships among the issues.	Student can recognize basic and obvious ethical issues but fails to grasp complexity or interrelationships.
<b>Application of Ethical Perspectives/Concepts</b>	Student can independently apply ethical perspectives/ concepts to an ethical question, accurately, and is able to consider full implications of the application.	Student can independently (to a new example) apply ethical perspectives/ concepts to an ethical question, accurately, but does not consider the specific implications of the application.	Student can apply ethical perspectives/ concepts to an ethical question, independently (to a new example) and the application is inaccurate.	Student can apply ethical perspectives/ concepts to an ethical question with support (using examples, in a class, in a group, or a fixed-choice setting) but is unable to apply ethical perspectives/ concepts independently (to a new example).
<b>Evaluation of Different Ethical Perspectives/Concepts</b>	Student states a position and can state the objections to, assumptions and implications of and can reasonably defend against the objections to, assumptions and implications of different ethical perspectives/ concepts, and the student's defense is adequate and effective.	Student states a position and can state the objections to, assumptions and implications of, and respond to the objections to, assumptions and implications of different ethical perspectives/ concepts, but the student's response is inadequate.	Student states a position and can state the objections to, assumptions and implications of different ethical perspectives/ concepts but does not respond to them (and ultimately objections, assumptions, and implications are compartmentalized by student and do not affect student's position.)	Student states a position but cannot state the objections to and assumptions and limitations of the different perspectives/ concepts.