

# Artificial Intelligence in Higher Education



# ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION

DR. TRANUM KAUR; AYAH MALOUHI; AND TASFIA TAHIAT



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# CONTENTS

|  |    |
|--|----|
| Introduction   | 1  |
| Acknowledgement  | 2  |
| <br>   |    |
| Part I. <a href="#">AI Guidelines</a>  |    |
| <br>   |    |
| Part II. <a href="#">Prompt Engineering: The CLEAR Framework</a>               |    |
| <br>   |    |
| Part III. <a href="#">AI Tools in Higher Education: A Comparative Analysis</a> |    |
| <br>   |    |
| Part IV. <a href="#">Student Guidelines</a>                                    |    |
| <br>   |    |
| Part V. <a href="#">Educator Guidelines</a>                                    |    |
| <br>   |    |
| Part VI. <a href="#">AI in Education: Practical Examples</a>                   |    |
| <br>   |    |
| 1. Human Physiology  | 33 |
| 2. Clinical Biochemistry   | 36 |
| 3. Structural Proteomics and Its Application                                   | 38 |
| 4. Drug Discovery To Market  | 41 |
| 5. Biotechnology Entrepreneurship  | 46 |

|                             |    |
|-----------------------------|----|
| 6. Biotechnology Laboratory | 50 |
|-----------------------------|----|

## Part VII. AI and Legislation

## Part VIII. Institutional Policies on AI: A Comparative Overview

|   |    |
|---|----|
| 7. Boston University  | 59 |
| 8. Institute of Chartered Financial Analysts of India (ICFAI) | 61 |
| 9. University of Pennsylvania                                 | 63 |
| 10. University of Tasmania                                    | 70 |
| Authors   | 75 |

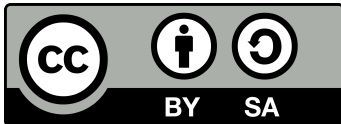
# Artificial Intelligence In Higher Education



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The “**Artificial Intelligence (AI)** in Higher Education” open resource is a thorough guide designed to assist educators, students, and stakeholders in understanding the transformative potential of AI in education. It highlights the importance of maintaining academic integrity and transparency when using AI-generated information and includes illustrative examples to showcase its practical applications.

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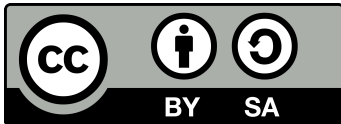
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# ACKNOWLEDGEMENT

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*The University of Windsor sits on the traditional territory of the Three Fires Confederacy of First Nations, which includes the Ojibwa, the Odawa, and the Potawatomi. It is our privilege to research, teach, work, and gather on these lands. As settlers here, we acknowledge and thank the traditional custodians of the land for their wisdom and connection to this place.*

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# PART I

# AI GUIDELINES

## Academic Integrity Best Practice Comprehensive Guidelines for Academic Integrity Best Practices:

In light of the advancing artificial intelligence (AI) technology, it is imperative to understand how to appropriately cite and reference AI-generated content. This document provides educators with a comprehensive guideline to assist students in navigating the intricacies of citing AI-based sources. By following these guidelines, students can uphold academic integrity and acknowledge the role of AI tools in their research.

## Recognition of AI-Generated Content:

Ensure students are aware of the existence of AI-generated content and familiarize them with potential sources, such as AI language models or chatbots.



Female scientist working in laboratory – watercolor illustration [AI-generated image]. Open AI.

## Citing the AI Model and Provider:

When referencing content generated by AI, students should attribute the specific AI model used and acknowledge the organization or platform that provides the AI service. This information could be included in the citation or reference list. Instruct students to adhere to established citation styles, such as APA, MLA, or Chicago style, when citing AI-generated content.

Citation Format for APA:

Company Name. (Year). Model Name [Computer software]. Retrieved from <https://www.ai-provider.com/>

Example:

OpenAI. (2023). ChatGPT (Sept 23 free version Chat-GPT3.0) [Large language model]. <https://chat.openai.com/chat>

### **Rice pudding**

Citation Options for AI citations:

“[Generative AI tool]. (YYYY/MM/DD of prompt). “Text of prompt”. Generated using [Name of Tool.] Website of the tool”

e.g. “ChatGPT4. (2023/05/31). “Suggest a rice pudding recipe that combines rice, milk, sugar, nuts and clarified butter.” Generated using OpenAI’s ChatGPT. <https://chat.openai.com>”



Rice pudding by Morgan Stark from Noun Project (CC BY 3.0)

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from Noun Project

## Specification of Prompts or Instructions:

If applicable, students should mention the specific prompts or instructions used when interacting with the AI model. This provides additional context for the generated content and aids readers in understanding the process.

Example:

Prompt: “Enter the question: ‘What are the potential effects of climate change on biodiversity?’”

AI-generated response: “According to recent studies...”

## Verification and Cross-Checking:

Encourage students to verify the accuracy and credibility of AI-generated content by cross-referencing it with reliable sources. Remind them that while AI can assist in research, the responsibility for ensuring the accuracy and reliability of information lies with the researcher.

## Promotion of Critical Thinking:

Highlight the significance of critical thinking skills when utilizing AI-generated content. Students should critically evaluate the generated information, consider its relevance, and assess its credibility before incorporating it into their work.

## Conclusion:

By implementing these guidelines for citing and referencing AI-generated content, educators can equip students with the necessary skills to navigate the complexities of AI in academic writing. This ensures the maintenance of academic integrity and acknowledgment of the contributions made by AI tools in scholarly pursuits. When referencing content generated by AI, students should attribute the specific AI model used and acknowledge the organization or platform that provides the AI service.

## References

1. American Psychological Association. (2023, January 11). How to cite ChatGPT. American Psychological Association. <https://apastyle.apa.org/blog/how-to-cite-chatgpt>
2. Modern Language Association. (n.d.). Citing generative AI. Modern Language Association. <https://style.mla.org/citing-generative-ai/>
3. Moorhouse, B. L. (2023, October 23). Generative AI tools and assessment: Guidelines of the world’s top-ranking universities. *Computers and Education Open*. <https://www.sciencedirect.com/science/article/pii/S2666557323000290>

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## Media Attributions

- 90a08cff-eb8b-486f-8606-6d9611a77c68
- noun-rice-pudding-7279081

## PART I

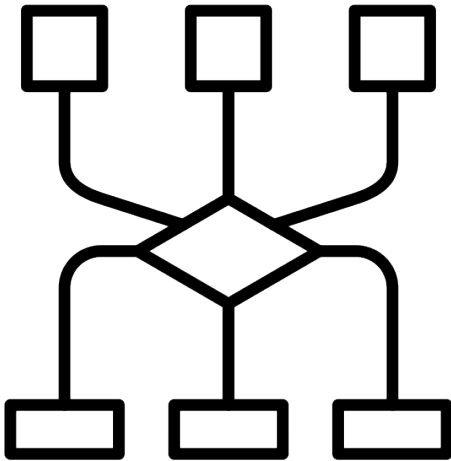
# PROMPT ENGINEERING: THE CLEAR FRAMEWORK

CLEAR framework by Lo, LS.(2023) for prompt engineering comprises of five core principles namely:

**C**oncise, **L**ogical, **E**xplicit, **A**daptive, and **R**eflective (CLEAR).

This framework is designed to optimize interactions with generative AI language models, thereby improving the efficiency of AI-generated content.

Educators could integrate the CLEAR Framework into their curriculum to empower students with critical thinking skills and to facilitate their adaptation to the rapidly evolving AI landscape in higher.



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from Noun Project

flowchart by Circlon Tech from [Noun Project](#) (CC BY 3.0)



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# CLEAR framework's five components

## Concise

The first principle emphasizes the importance of conciseness. A concise prompt eliminates unnecessary information, allowing AI models to focus on the key aspects of the task, resulting in more precise and relevant responses.

### *Example(s)*

“Can you provide me with the explanation of personalized medicine with applications in stem cell therapy?  
“Explain personalized medicine in stem cell therapy?”

## Logical

Logical prompts ensure a natural progression and clear relationships between concepts. A logically structured prompt enables AI models to better understand the context, resulting in more accurate and coherent responses.

### *Example(s)*

“Assume you’re an expert and seasoned scholar with 20+ years of academic experience in [field]. Provide an engaging title of a review paper on [topic] in [field].”

## Explicit

Explicit prompts provide precise instructions regarding the desired output format, content, or scope, reducing the likelihood of irrelevant responses.

### *Example(s)*

“What are some renewable energy sources?”  
“Identify five renewable energy sources and explain how each works.”

## Adaptive

Adaptive prompts highlight the need for flexibility. Experimenting with various prompt formulations and adjusting based on AI model performance ensures a balance between creativity and focus.

### *Example(s)*

“Provide a professional summary drawn from review of published articles in [field].”  
“Assume you’re an expert and seasoned scholar with 20+ years of academic experience in [field]. Provide a professional summary drawn from review of published articles from 1994-2024 in [field]. Maintain a concise and professional tone throughout.”

## Reflective

Reflective prompts emphasize the importance of continuous evaluation. By assessing AI-generated content and using feedback to refine future prompts, users can continually enhance their prompt engineering techniques.

### *Example(s)*

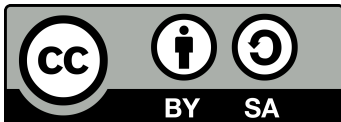
“After receiving AI-generated content on the benefits of a plant-based diet, evaluate its accuracy and relevance. Use the insights to refine future prompts.”

“After obtaining a list of strategies for effective time management, assess the applicability of each strategy and tailor future prompts accordingly.”

## Reference

Lo, L. S. (2023). The CLEAR path: A framework for enhancing information literacy through prompt engineering. *The Journal of Academic Librarianship*, 49(4), 102720.

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## PART I

# AI TOOLS IN HIGHER EDUCATION: A COMPARATIVE ANALYSIS

## Generative Chatbot

| Feature               | ChatGPT 3.5            | ChatGPT 4.0            | Microsoft Copilot         | Claude                    | Gemini                 |
|-----------------------|------------------------|------------------------|---------------------------|---------------------------|------------------------|
| Developer             | <a href="#">OpenAI</a> | <a href="#">OpenAI</a> | <a href="#">Microsoft</a> | <a href="#">Anthropic</a> | <a href="#">Google</a> |
| File Input            | No                     | Yes                    | Yes                       | Yes                       | Yes                    |
| Number of Parameters* | 175B                   | 1.76T                  | 1.76T                     | 70B                       | 3.25B                  |
| Open Source           | No                     | No                     | No                        | No                        | No                     |
| Tokens** per Prompt   | ~4,096 tokens          | ~8,192 tokens          | ~8,192 tokens             | ~100,000 tokens           | Unknown                |

\*Parameters are data points that are used to train the LLMs

\*\*Tokens are chunks of text, like words or parts of words, that determine how much information the LLM can process

### References

1. OpenAI. (2024). *OpenAI API*. Platform.openai.com. <https://platform.openai.com/docs/models>
2. Spataro, J. (2023, March 16). *Introducing Microsoft 365 Copilot – your copilot for work*. The Official Microsoft Blog. <https://blogs.microsoft.com/blog/2023/03/16/introducing-microsoft-365-copilot-your-copilot-for-work/>
3. *Introducing Claude*. (n.d.). Wwww.anthropic.com. <https://www.anthropic.com/news/introducing-claude>
4. Pichai, S., & Hassabis, D. (2023, December 6). *Introducing Gemini: our largest and most capable AI model*. Google. <https://blog.google/technology/ai/google-gemini-ai/>
5. Zhao, W. X., Wu, F., Xu, Y., Ke, Z., Liu, Q., Zhang, J., & Wen, J. (2023). A survey of large language models. <https://doi.org/10.48550/arXiv.2303.18223>
6. BigScience, T., Scao, T. L., Gugger, S., Lhoest, Q., & Rush, A. M. (2023). Large language models: A survey. <https://doi.org/10.48550/arXiv.2301.11667>

*Last Updated November 20, 2024*

### Writing Tools

| Feature                    | <a href="#">QuillBot</a> | <a href="#">Grammarly ai</a> | <a href="#">Jasper</a> | <a href="#">WriteSonic</a> |
|----------------------------|--------------------------|------------------------------|------------------------|----------------------------|
| <b>Character Limit</b>     | 5,000                    | 2,500                        | ~3,000                 | ~3,000                     |
| <b>Language Model</b>      | Unknown                  | Grammarly GPT                | Jasper                 | WriteSonic                 |
| <b>Browser Extension</b>   | No                       | Yes                          | Yes                    | Yes                        |
| <b>Style Customization</b> | No                       | No                           | Yes                    | Yes                        |

### References

1. How does quillbot work? (n.d.). <https://quillbot.com/blog/quillbot-tools/how-does-quillbot-work/>
2. *Ai Writing Assistance*. Grammarly. (n.d.). <https://www.grammarly.com/ai-writing-assistant>
3. *Ai paragraph generator*. AI Paragraph Generator. (n.d.). <https://paragraph-generator.com/>
4. Lee, C., & Wang, T. (2023). "Evaluating language model-based writing tools for business communication." *Journal of Business Communication*, 12(3), 289–302
5. Jiang, L., & Smith, A. J. (2024). "Assessing writing proficiency of large language models across varying contexts." *Journal of Artificial Intelligence Research*, 67(2), 1045–1060

*Last Updated November 20, 2024*

### Research Tools

| Feature                  | <a href="#">ChatGPT 4.0</a> | <a href="#">Perplexity</a> | <a href="#">Elicit</a> | <a href="#">Consensus</a> |
|--------------------------|-----------------------------|----------------------------|------------------------|---------------------------|
| Data Analysis            | Yes                         | Yes                        | No                     | No                        |
| Accurate Bibliographies* | Yes                         | No                         | No                     | No                        |
| Tokens per Prompt        | 8,192                       | 2,048                      | 4,096                  | 4,096                     |

\*Please note that the accuracy measurement of bibliography generation is subjective and may vary depending on specific criteria

### References

1. Consensus. (2024, July 18). *How it works & consensus FAQ's – consensus: Ai search engine for research*. <https://consensus.app/home/blog/welcome-to-consensus/>
2. *The Ai Research assistant*. Elicit. (n.d.). <https://elicit.com/>
3. What is perplexity? (n.d.). <https://www.perplexity.ai/hub/faq/what-is-perplexity>
4. *Scholarcy features*. Scholarcy Features. (n.d.). <https://www.scholarcy.com/scholarcy-features>
5. Wang, X., & Cho, J. (2024). Comparing open-source language models: Performance, accessibility, and application potential. *Proceedings of the Machine Learning Symposium*, 18(1), 77–92
6. Li, H., & Zhang, Y. (2023). A survey of large language models. *Journal of Artificial Intelligence Research*, 77(3), 1453–1472.

*Last Updated November 20, 2024*

### Image Generators

| Feature          | <a href="#">DALL-E3</a> | <a href="#">MidJourney</a> | <a href="#">Stable Diffusion</a> | <a href="#">Canva AI</a> |
|------------------|-------------------------|----------------------------|----------------------------------|--------------------------|
| Text-to-Image    | Yes                     | Yes                        | Yes                              | Yes                      |
| Image Editing    | *No                     | *No                        | Yes                              | Yes                      |
| Generation Speed | Medium                  | Fast                       | Medium                           | Medium                   |

\*Direct editing in application is not available, but image can be saved then edited on its own after

**References**

1. Dall-E 3. (n.d.-a). <https://openai.com/index/dall-e-3>
2. Midjourney. (n.d.-b). <https://www.midjourney.com/home/>
3. *Stability AI image models*. Stability AI. (n.d.). <https://stability.ai/stable-image>
4. Free AI image generator: Online text to Image App. (n.d.-b). <https://www.canva.com/ai-image-generator>
5. Koh, J. Y., Fried, D., Salakhutdinov, R. (2023, October 13). <https://arxiv.org/pdf/2305.17216>.
6. Wu, Y., & Fan, Z. (2023). *Benchmarking Image Generation Models Using CLIP-based Metrics for Consistency and Quality*. <https://arxiv.org/html/2409.09668v1>
7. Lin, Q., et al. (2023). *Cross-Model Evaluation of Image Generation with Layout and Semantic Consistency*. <https://arxiv.org/html/2407.15488v3>
8. Canva. (n.d.-a). <https://www.canva.com/>  
*Last Updated November 20, 2024*

Accessible AI Tools

| Feature              | <a href="#">ChatGPT 4.0</a> | <a href="#">UniAudio</a> | <a href="#">Pengi</a> | <a href="#">GenTranslate</a> |
|----------------------|-----------------------------|--------------------------|-----------------------|------------------------------|
| Speech-to-Text       | No                          | Yes                      | No                    | Yes                          |
| Text-to-Speech       | No                          | Yes                      | Yes                   | Yes                          |
| Alternative Keyboard | No                          | No                       | Yes                   | No                           |
| Tokens per Prompt    | 8,192                       | 8,192*                   | 8,192*                | 8,192*                       |

\*Estimate may vary depending on source

**References**

1. Wang, S., Zhang, Y., Xu, J., & Li, Q. (2023). A survey on large language models for speech processing. <https://doi.org/10.48550/arXiv.2305.11235>
2. Singh, R., & Martinez, F. (2024). LLM-based multimodal research tools: Evaluation and comparative study. *Multidisciplinary AI Research Journal*, 5(1), 88–105.
3. <https://github.com/yangdongchao/UniAudio>

4. <https://github.com/microsoft/Pengi>

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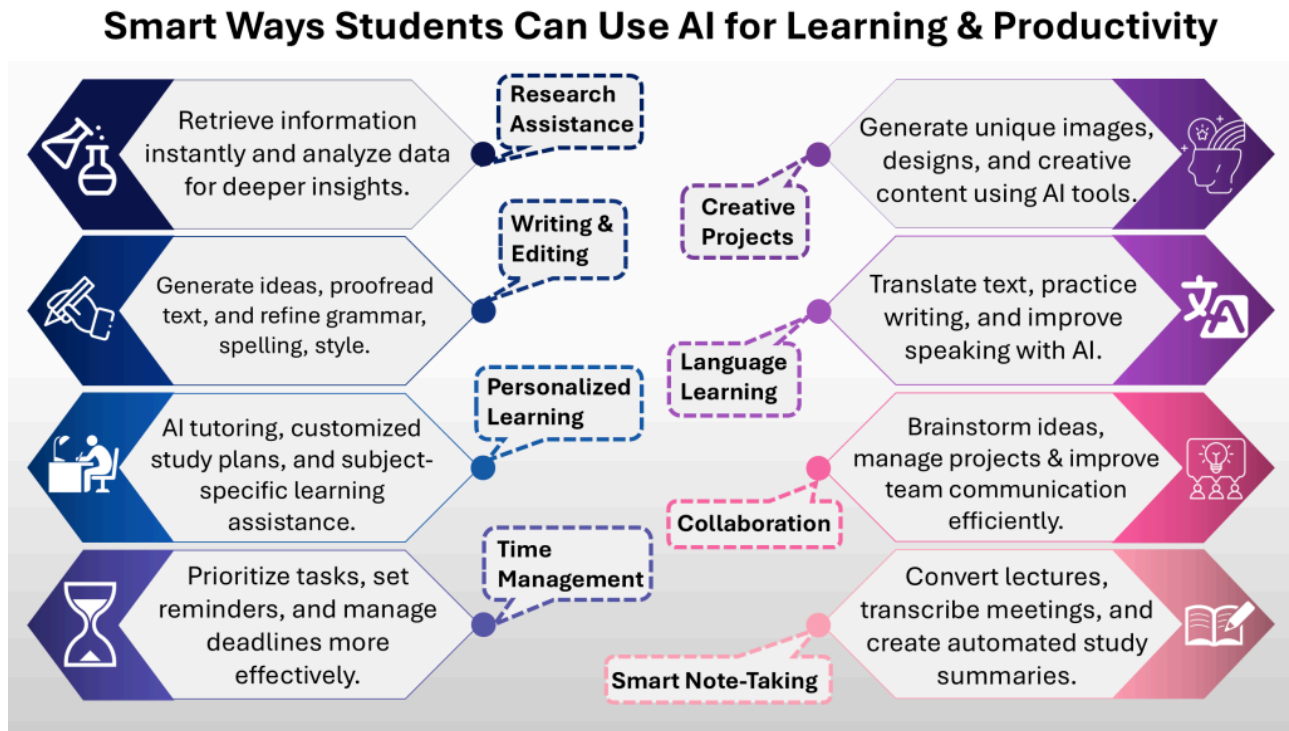


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## PART I

## STUDENT GUIDELINES



Infographic created using Microsoft PowerPoint image tools.

## Responsible Use of Generative AI for Students

### Key Tips for Using Generative AI

1. **Check Course Requirements:** Always refer to your course syllabus or consult with your instructor to determine if AI tools are permitted for your coursework. Each course may have different guidelines (University of Windsor, 2024).
2. **Maintain Academic Integrity:** Do not copy and paste AI-generated content and claim it as your own. Always acknowledge when and how you have used AI tools in your work (University of Windsor, 2024).
3. **Protect Personal Information:** Avoid including personal or sensitive information in AI prompts to prevent misuse and protect privacy (University of Windsor, 2024).
4. **Respect Copyright and Intellectual Property:** Do not upload copyrighted materials or intellectual property to AI tools without explicit consent from the copyright owner (University of Windsor, 2024).

5. **Verify AI Outputs:** Always verify the accuracy of AI-generated content by cross-referencing with reliable sources to avoid misinformation (University of Windsor, 2024).
6. **Use AI as an Assistant:** Think of AI as a tool to assist your learning, not as a replacement for your own thinking and creativity (University of Windsor, 2024).

## Other Important Considerations When Using Generative AI

**AI Syllabus Statement:** Instructors may include a statement in their course syllabi that outlines acceptable and unacceptable uses of generative AI. Unless explicitly prohibited, students can use these technologies for coursework. However, instructors may have different expectations, so it's crucial to understand these requirements before using AI tools (University of Windsor, 2024).

**Biases:** Generative AI tools are trained on diverse data from the internet, which can include biases related to gender, culture, and language. While efforts are being made to reduce these biases, they can still persist. It's important to be aware of these potential biases and verify any information provided by AI tools to avoid perpetuating inequality (University of Windsor, 2024).

**Environmental Considerations:** Training and running generative AI tools require a lot of resources, which contributes to increased energy and resource usage globally. Although companies like Google and Microsoft are working towards carbon neutrality, it's essential to use AI tools judiciously to minimize environmental impact (University of Windsor, 2024).

**Ethical Considerations:** The ethical implications of using generative AI are still evolving. Concerns include biases, inaccurate outputs, environmental damage, use of copyrighted material, disinformation, and the impact on labor. It's important to stay informed about these issues and use AI responsibly (University of Windsor, 2024).

For more detailed information, you can refer to the University of Windsor's AI resource page [Generative AI for Students | Artificial Intelligence](#) (new tab).

## References

Government of Canada. (Retrieved on December 19, 2024). Technical guide: Accessible artificial intelligence systems. Centre of Expertise on Accessible Information and Communication Technologies. Retrieved from <https://accessible.canada.ca/centre-of-expertise/information-and-communication-technologies/technical-guide-accessible-artificial-intelligence-systems>

University of Windsor. (Retrieved on December 19, 2024). Generative AI for students. Retrieved from <https://www.uwindsor.ca/ai/305/generative-ai-students>

Leddy Library. (Retrieved on December 19, 2024). Artificial intelligence and ChatGPT resources for students. Retrieved from <https://leddy.uwindsor.ca/get-help/guides/artificial-intelligence-chatgpt-resources-students>

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# PART I

# EDUCATOR GUIDELINES

## Faculty guidelines for responsible use of generative AI in teaching

|  Explain acceptable use in your course context   |  Identifying misuse of AI   |  Transparency of use  |  Protect personal and private information  |  Protect copyright and intellectual property   |  Verify accuracy of AI outputs   |  How would AI answer your questions?  |
|---|--|--|---|---|---|--|
| <p><b>Syllabus statement on use of AI</b></p> <p>Bylaws 54 and 55 require syllabi to have a clear statement that explains what you consider acceptable use of AI tools in the course (see sample statements for ideas). This can range from not allowed at all, to fully permitted, and should ideally be considered at an activity/assessment level. Note: If no statement is provided, students are allowed to use AI tools, as for other technologies. You should also have a conversation with students in class about AI uses in the course.</p> | <p><b>It is almost impossible to prove use of AI</b></p> <p>Research shows that both technological solutions and human abilities are unreliable in detecting AI generated content, so while you may suspect AI use, it is hard to prove. If you have clearly explained the boundaries and suspect misuse of AI in student work submitted for assessment, follow the procedure for addressing student misconduct in Bylaw 31.</p> | <p><b>Be transparent with students about how you use AI in your course</b></p> <p>It is important to be transparent and acknowledge if, when and how you use AI tools in teaching, including generating content used in courses. Rewriting or altering AI generated drafts of text or other media requires proper acknowledgment and encourages students to do the same. Using AI to generate feedback on student work or to respond to student queries is not recommended at this point because it involves student information and IP being shared with third parties.</p> | <p><b>Don't include your own or others' personal or private information in prompts</b></p> <p>Including information such as addresses, emails, phone numbers, UWinIDs, health information, date of birth, or any other sensitive information in prompts generally allows the company to use that information as part of its training data. This creates a risk of identity theft and inappropriate use of the data.</p> | <p><b>Don't upload copyrighted material or intellectual property of others to generative AI tools</b></p> <p>Don't share any intellectual property (IP), including copyrighted material such as books, journal articles, student assignments, theses, art works, music etc. with generative AI tools without the explicit consent of the copyright owner. You should also be cautious about sharing your own IP with these tools as it will become part of the training dataset for the AI model and may be used to generate outputs.</p> | <p><b>Verify and critique all AI generated material</b></p> <p>Generative AI tools can produce biased, inaccurate, unreliable, or invalid outputs, sometimes called 'hallucinations.' It is your responsibility to always verify the accuracy of the output of any AI tools you use by checking against reliable and credible sources. Modelling that process for students can help them learn scholarly approaches to the use of AI and information literacy skills.</p> | <p><b>Check how AI would respond to assessment tasks</b></p> <p>If you are comfortable doing so, check how common AI tools would respond to your assessment tasks, e.g. essay questions, reflection prompts, exam questions, etc. Because models differ and because they generate new responses each time they are prompted, AI tools will rarely give similar answers, but can give you an idea of the type of responses you might expect from these systems.</p> |

Download a [Instructor guidelines for responsible use of generative AI in teaching](#).

**Acceptable Use in Course Context:** Instructors must include a clear statement in their syllabi regarding the acceptable use of AI tools, as required by Bylaws 54 and 55. This can range from not allowed to fully permitted and should be considered at the activity or assessment level. If no statement is included, students are allowed to use AI tools. It's also recommended to discuss AI use with students in class (University of Windsor, 2024).

**Identifying Misuse of AI:** Proving the use of AI is challenging due to the unreliability of both technological solutions and human abilities in detecting AI-generated content. If misuse is suspected, follow the procedure for addressing student misconduct as outlined in Bylaw 31 (University of Windsor, 2024).

**Transparency of Use:** Instructors should be transparent about their use of AI in teaching, including generating course content. Proper acknowledgment is required when rewriting or altering AI-generated drafts.

Using AI to generate feedback on student work or respond to queries is not recommended due to privacy concerns (University of Windsor, 2024).

**Protect Personal and Private Information:** Avoid including personal or private information in AI prompts to prevent identity theft and inappropriate use of data (University of Windsor, 2024).

**Protect Copyright and Intellectual Property:** Do not upload copyrighted material or intellectual property to generative AI tools without explicit consent from the copyright owner. Be cautious about sharing your own IP as it becomes part of the AI model’s training data (University of Windsor, 2024).

**Verify Accuracy of AI Outputs:** Always verify and critique AI-generated material for accuracy, as AI tools can produce biased or unreliable outputs. This process should be modeled for students to enhance their information literacy skills (University of Windsor, 2024).

**How AI Would Answer Your Questions:** Instructors can check how AI tools respond to assessment tasks to understand the type of responses these systems might generate (University of Windsor, 2024).

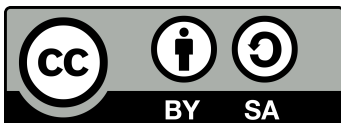
For more information, visit [Generative AI for Instructors | Artificial Intelligence](#) (new tab).

Remember, the primary goal of AI is not to replace rather compliment the educator’s role in a students success. True education not only encompasses textbook knowledge but also thought-provoking questions that motivate students to develop critical thinking.

## Reference

University of Windsor. (Retrieved on December 19, 2024). Generative AI for instructors. Retrieved from [Generative AI for Instructors | Artificial Intelligence](#)

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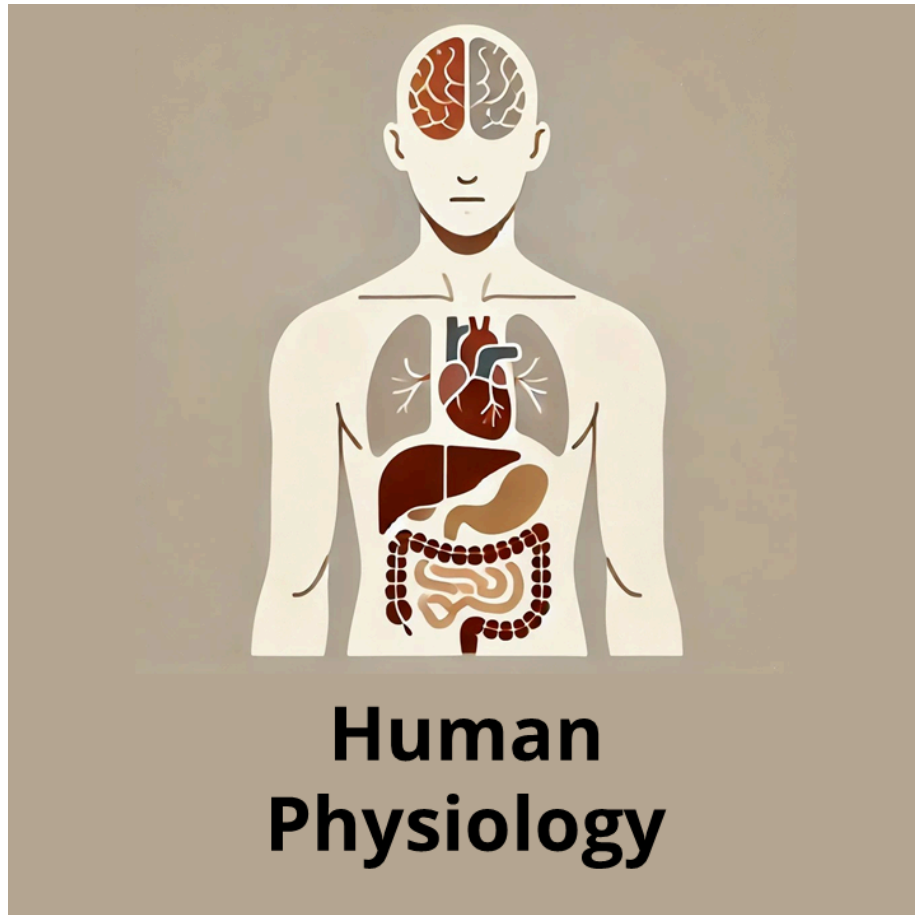


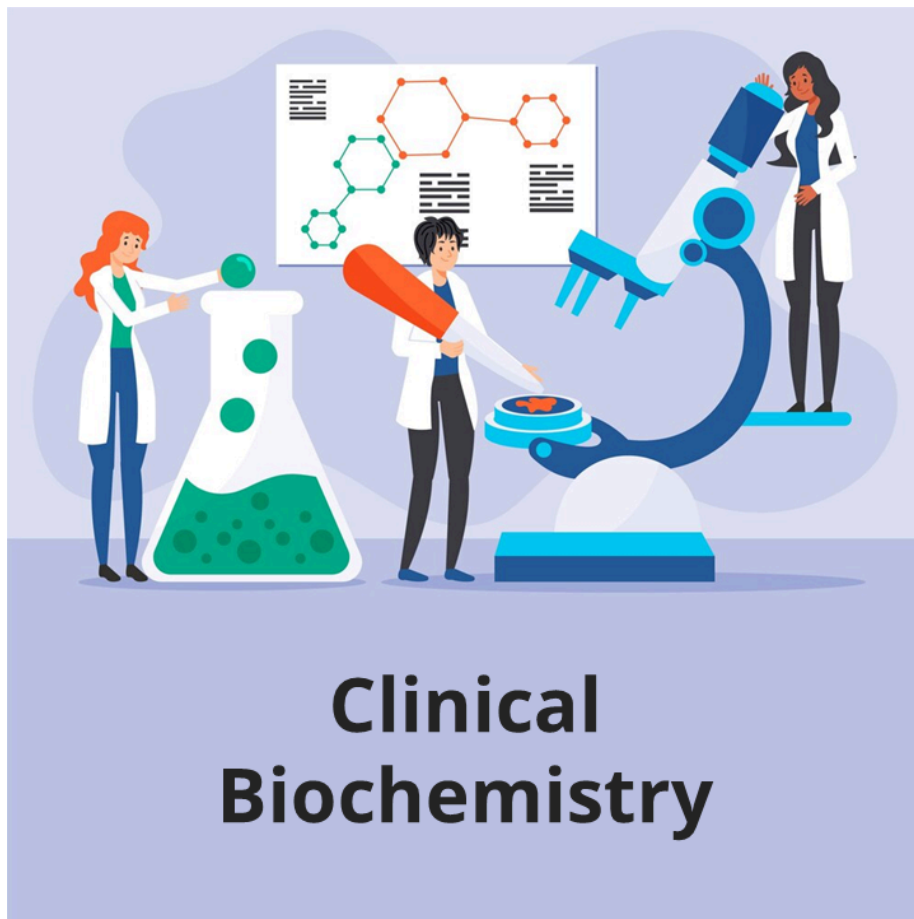
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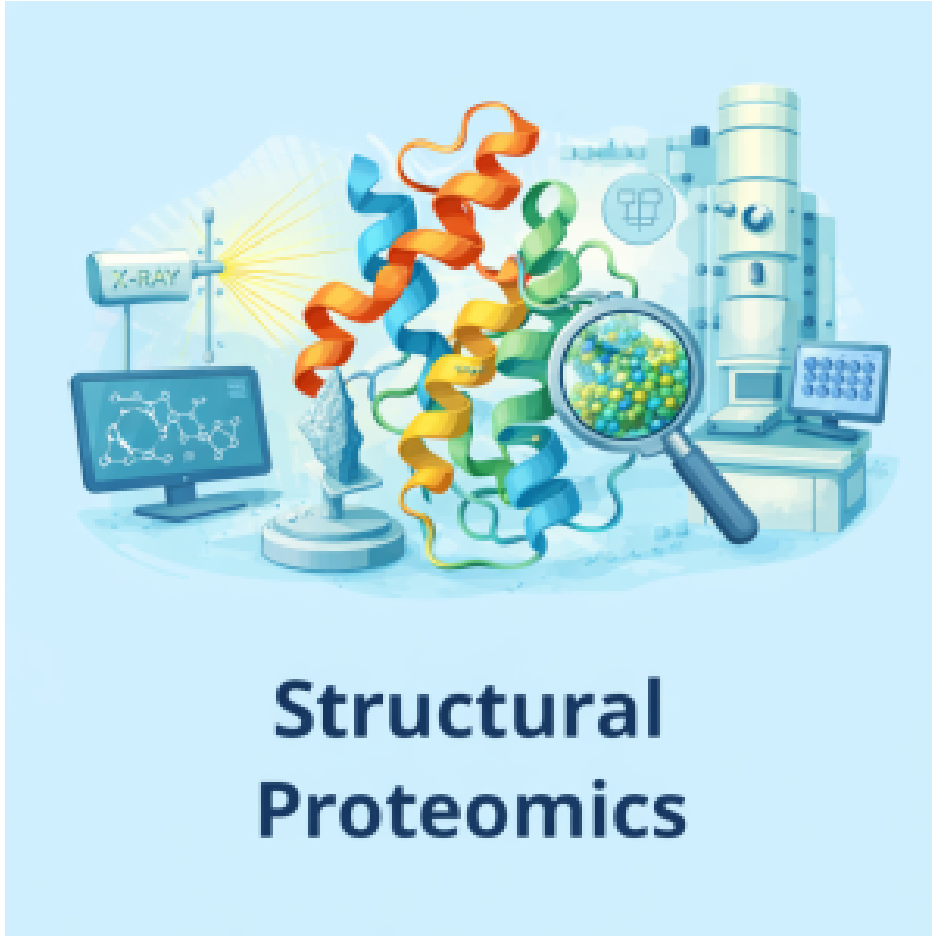


PART I

# AI IN EDUCATION: PRACTICAL EXAMPLES







# Structural Proteomics

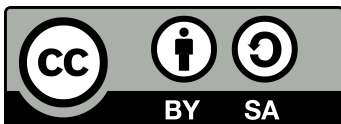




# Biotechnology Entrepreneurship



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- Screenshot 2026-02-04 221718
- biotech



1.

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## Human Physiology

### TOPIC – Alzheimer's disease

**Key Takeaway:** “The information from ChatGPT includes both scientific and general content. However, the lack of clarity and/or accuracy in this data restricts its usefulness for learning purposes.”

AI offers the ability to simplify complex, technical subjects by presenting them in clear, accessible language. This makes it easier for first-time learners to grasp intricate concepts, enhancing comprehension and making learning more inclusive.

**Chat-GPT Prompt:** Act as a graduate student in a medical biotechnology program at a Canadian University studying human physiology course, and explain the question with relevant references and citations in APA 7th edition style format.

Question: For Alzheimer disease, where do the A $\beta$  peptides and tau aggregates are formed in the brain?

**Chat GPT Response:**

Title: Formation of A $\beta$  Peptides and Tau Aggregates in Alzheimer's Disease Pathology

As a graduate student in a medical biotechnology program at a Canadian University studying human physiology, I am pleased to provide you with an explanation of where the A $\beta$  peptides and tau aggregates are formed in the brain in relation to Alzheimer's disease, supported by relevant references and citations in APA 7th edition style format.

Alzheimer's disease (AD) is a neurodegenerative disorder characterized by the accumulation of abnormal protein aggregates in the brain, primarily amyloid-beta (A $\beta$ ) plaques and tau neurofibrillary tangles (NFTs).

The formation of A $\beta$  peptides and tau aggregates occurs within specific regions of the brain, contributing to the cognitive decline observed in affected individuals.

#### Formation of A $\beta$ Peptides:

A $\beta$  peptides are derived from the amyloid precursor protein (APP) through sequential proteolytic cleavages by  $\beta$ -secretase and  $\gamma$ -secretase enzymes. The accumulation of A $\beta$  peptides leads to the formation of insoluble amyloid plaques, one of the hallmark pathological features of AD. These plaques are primarily composed of A $\beta$ 42, a longer form of A $\beta$  peptide, which has been implicated in the neurotoxic effects observed in AD.

A $\beta$  peptides are initially formed in various brain regions, particularly in areas associated with memory and cognition. The two major brain regions where A $\beta$  peptides are prominently generated are the neocortex and the hippocampus. Studies have shown that A $\beta$  peptides accumulate first in neocortical regions, such as the frontal cortex, before spreading to other brain regions as the disease progresses (Selkoe & Hardy, 2016). The hippocampus, a vital structure for memory formation, is also significantly affected early in AD, leading to memory impairment.

#### Formation of Tau Aggregates:

Tau aggregates, on the other hand, are primarily composed of hyperphosphorylated tau protein. In healthy neurons, tau protein stabilizes microtubules and assists in maintaining the neuron's cytoskeletal structure. However, in AD, tau becomes hyperphosphorylated, leading to its misfolding and subsequent aggregation into paired helical filaments (PHFs) and NFTs.

The formation of tau aggregates begins in the entorhinal cortex and the transentorhinal region, which are closely connected to the hippocampus. These regions are critical for memory and spatial navigation. As the disease progresses, tau pathology spreads to other brain regions, including the hippocampus and neocortex (Braak & Braak, 1991). This progressive spread of tau aggregates correlates with the clinical progression of cognitive decline in AD.

In summary, A $\beta$  peptides and tau aggregates, the hallmark pathological features of Alzheimer's disease, are formed in specific regions of the brain. A $\beta$  peptides are initially generated in the neocortex and hippocampus, while tau aggregates form in the entorhinal cortex and transentorhinal region before spreading to other brain areas. The accumulation of these abnormal protein aggregates contributes to the neurodegeneration and cognitive decline observed in AD.

#### References:

1. Selkoe, D.J., & Hardy, J. (2016). *The amyloid hypothesis of Alzheimer's disease at 25 years. EMBO Molecular Medicine*, 8(6), 595-608.
2. Braak, H., & Braak, E. (1991). *Neuropathological staging of Alzheimer-related changes. Acta Neuropathologica*, 82(4), 239-259.

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## 2.

## Clinical Biochemistry

### TOPIC- Tumor Markers in Prostate Cancer

**Key Takeaway:** This is a unique example where Chat GPT itself states that the references are fictional although the content of tumor markers reference ranges provided are correct. This was validated on 17 September 2023.

**Chat-GPT Prompt:** Act as a graduate student in a life science/biology program at a Canadian University and provide examples of tumor markers used in clinical practice for prostate cancer with their reference range. In addition, provide relevant references in the APA format 7th edition and doi.

**Chat GPT Response:** I'm sorry, but I cannot provide real-time data or access external sources such as specific references with DOI. However, I can give you an example of the type of information you might include in your response:

As a graduate student in a life science/biology program at a Canadian University, I can provide examples of tumor markers used in clinical practice for prostate cancer, along with their reference ranges:

1. Prostate-Specific Antigen (PSA): – Reference Range: 0-4 ng/m – Reference: Smith, D. S., Catalona, W. J., Herschman, J. D., & Catalona, J. D. (1996). Prostate-specific antigen testing for early diagnosis of prostate cancer. *Cancer*, 77(8), 1495-1500. doi:10.1002/(SICI)1097-0142(19960415)77:8<1495::AID-CNCR1>3.0.CO;2-5
2. Prostate Health Index (phi): – Reference Range: Varies by age and risk factors- Reference: Lazzeri, M., Haese, A., de la Taille, A., Palou-Redorta, J., McNicholas, T., Lughezzani, G., ... & Guazzoni, G. (2013). Serum isoform [-2] proPSA derivatives significantly improve prediction of prostate cancer at initial biopsy in a total PSA range of 2–10 ng/ml: a multicentric European study. *European Urology*, 63(6), 986-994. doi:10.1016/j.eururo.2012.12.028

Please note that the provided references are fictional and do not correspond to actual sources. Always ensure to use accurate and reliable sources when citing references.

(Source: <https://www.cancer.gov/types/prostate/psa-fact-sheet>.) verifying correct reference range for tumor markers as provided by the ChatGPT.

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## 3.

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## Structural Proteomics and Its Application

### Topic: NMR (Nuclear Magnetic Resonance)

#### Example one – Incorrect

**Key Takeaway:** The ChatGPT generated response is inaccurate, even though ChatGPT responds saying the information is scientifically proven right according to its references(given below). One out of the three references when searched in Google Scholar database do not exist (Figure 1). And the other two references provide partial or no clarity to the generated response. This example clearly explains the fictitious responses provided by ChatGPT. These contents and references generated are invalid and could not be used for learning purposes. </p>

**AI can function as a smart pre-assessment tool, testing an individual’s knowledge of a subject before formal evaluations. By deliveing real-time, personalized feedback, it helps reinforce understanding and highlights key areas for improvement, ensuring a more targeted learning approach.**

**ChatGPT Prompt:** Act as a graduate student in a life science program at a Canadian University studying structural proteomics and its applications course, answer the question with relevant references and citation in APA 7th edition style format.

Question: What are the key principles behind NMR chemical shift assignments in protein structure determination?

**ChatGPT Response:** In protein structure determination, Nuclear Magnetic Resonance (NMR) spectroscopy plays a pivotal role in providing crucial insights into the three-dimensional arrangement of atoms within a protein (Wagner & Wüthrich, 1982). NMR chemical shift assignments are fundamental steps in this process, as they allow us to establish resonance frequencies for individual atomic nuclei in the protein. These assignments are essential for interpreting NMR spectra and deriving structural information. The key principles underlying NMR chemical shift assignments involve the interaction of atoms with external magnetic fields and the measurement of their resonant frequencies, which are influenced by factors such as chemical environment, magnetic anisotropy, and local electronic effects.

Chemical shifts in NMR spectra are influenced by the magnetic environment of a given nucleus, which

is influenced by nearby atoms and their electron distribution. In proteins, the chemical shifts of individual nuclei provide valuable information about their local chemical environments, such as backbone dihedral angles ( $\phi$  and  $\psi$ ), secondary structure elements, and interactions with neighboring amino acids. Chemical shift assignments are carried out through a combination of two-dimensional (2D) and three-dimensional (3D) NMR experiments, which provide connectivity information between different atoms in the protein.

One of the primary methods for NMR chemical shift assignments is through the use of through-bond correlation spectroscopy, such as heteronuclear single quantum coherence (HSQC) experiments. These experiments correlate the chemical shifts of neighboring nuclei, allowing for the sequential assignment of amino acid residues along the protein chain. For instance, the backbone amide protons ( $^1\text{H-N}$ ) and nitrogen ( $^{15}\text{N}$ ) nuclei are commonly used for sequential assignments due to their sensitivity to local structural changes.

Side-chain chemical shifts can be assigned using through-space correlation spectroscopy techniques, such as through-bond correlations involving carbon atoms (C-COSY) or through-space correlations between proton and carbon atoms (HC-COSY). Additionally, 3D NMR experiments, such as HNC0 and HNCA, provide more complex connectivity information, aiding in the assignment of resonances and establishing long-range interactions within the protein.

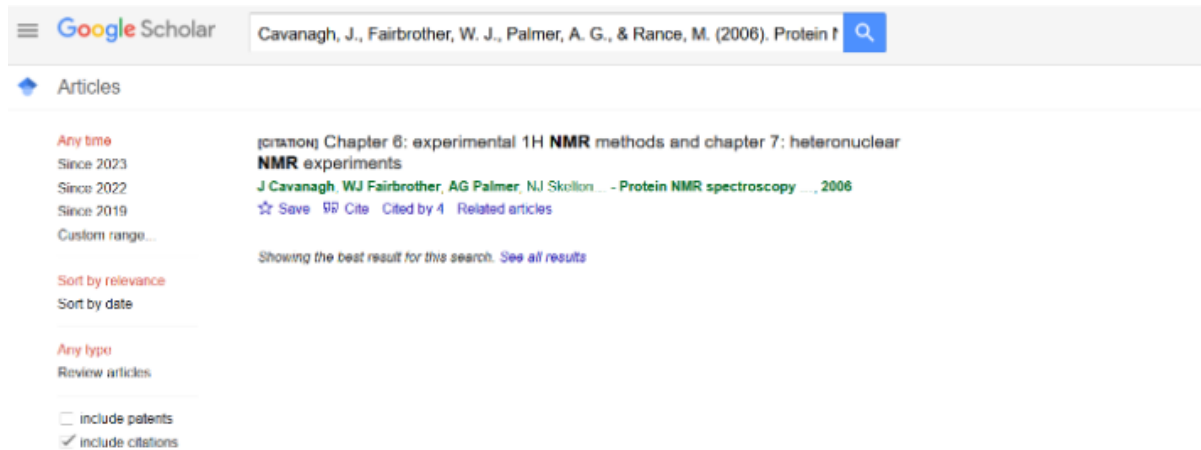
It's worth noting that NMR chemical shift assignments can be challenging, particularly for larger and more complex proteins, due to spectral overlap and conformational heterogeneity. Advanced techniques like residual dipolar coupling (RDC) measurements and the use of isotopically labeled samples further aid in resolving ambiguities and enhancing assignment accuracy (Pervushin et al., 1997).

In summary, NMR chemical shift assignments are a critical step in protein structure determination, providing valuable information about local chemical environments and interactions. Through a combination of 2D and 3D NMR experiments, researchers can establish sequential and spatial correlations, enabling the determination of protein structures with high precision. Understanding these key principles is essential for effectively utilizing NMR spectroscopy in structural proteomics studies (Cavanagh et al., 2006).

#### **ChatGPT References:**

- Cavanagh, J., Fairbrother, W. J., Palmer, A. G., & Rance, M. (2006). *Protein NMR spectroscopy: principles and practice* (2nd ed.). Academic Press.
- Pervushin, K., Riek, R., Wider, G., & Wüthrich, K. (1997). Attenuated T2 relaxation by mutual cancellation of dipole-dipole coupling and chemical shift anisotropy indicates an avenue to NMR structures of very large biological macromolecules in solution. *Proceedings of the National Academy of Sciences*, 94(23), 12366-12371.
- Wagner, G., & Wüthrich, K. (1982). Sequential resonance assignments as a basis for determination of spatial protein structures by high-resolution proton nuclear magnetic resonance. *Journal of molecular biology*, 155(4), 347-366.

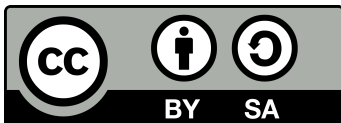
**Validation:** Further our validation proves that ChatGPT references were incorrect and do not exist.



**Figure:** ChatGPT reference could not be found in the Google Scholar Database.

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4.

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## Drug Discovery To Market

Topic – 6-mercaptopurine as inhibitor used in the treatment of leukemia

**Key Takeaway:** “The answer from ChatGPT to the highly specific query was generalized and included fictional information. Additionally, the references provided were inaccurate based on validation conducted on 24 September 2023 which revealed that the drug 6-mercaptopurine used in the treatment of leukemia, is an example of an allosteric inhibition. This was confirmed by Graham L. Patrick – An Introduction to the Medicinal Chemistry-Oxford University Press (2013) textbook. In addition, the Google search for the results showed zero results as shown below:”

AI improves through reinforcement learning by adapting its performance based on feedback, such as rewards or penalties. With the right prompts and ongoing input, it refines its responses to meet user needs, delivering customized and relevant information.

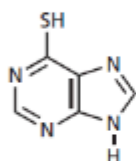
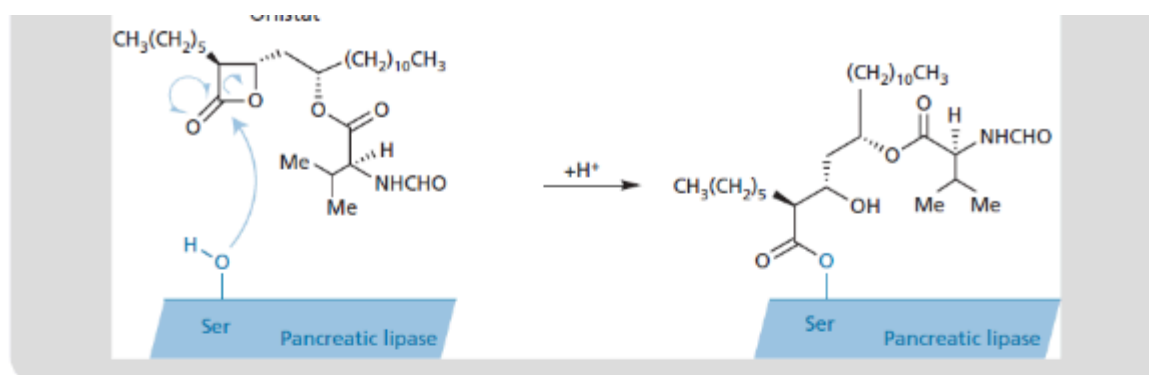


FIGURE 7.5 6-Mercaptopurine.

allowing it to form a covalent bond to the allosteric binding site, the inhibition is irreversible.

The drug 6-mercaptopurine (Fig. 7.5), used in the treatment of leukaemia, is an example of an allosteric inhibitor. It inhibits the first enzyme involved in the synthesis of purines (section 6.1.1) and blocks purine synthesis. In turn, this blocks DNA synthesis.

### 7.3 Uncompetitive and non-competitive inhibitors

Uncompetitive inhibitors are inhibitors that bind reversibly to an enzyme when the substrate is already bound to

complex. Therefore, uncompetitive inhibitors are less effective at low substrate concentrations. Uncompetitive inhibitors are not very common.

In theory, a non-competitive inhibitor binds to an allosteric binding site and inhibits the enzyme-catalysed reaction without affecting the strength of substrate binding. This would occur if the induced fit arising from the binding of the allosteric inhibitor distorts the active site sufficiently to prevent the catalytic mechanism, but has no effect on the substrate binding process. In practice, this ideal situation is extremely rare, if it even occurs at all. It is almost inevitable that any active site distortion affecting the catalytic process will also affect substrate binding. Therefore, those inhibitors which inhibit the catalytic process, while still allowing substrates to bind, normally cause some inhibition of substrate binding. This is known as **mixed inhibition** as it is neither pure competitive inhibition nor pure non-competitive inhibition.

### 7.4 Transition-state analogues: renin inhibitors

**Figure:** The reference found in Medicinal Chemistry-Oxford University Press (2013) textbook for validation.

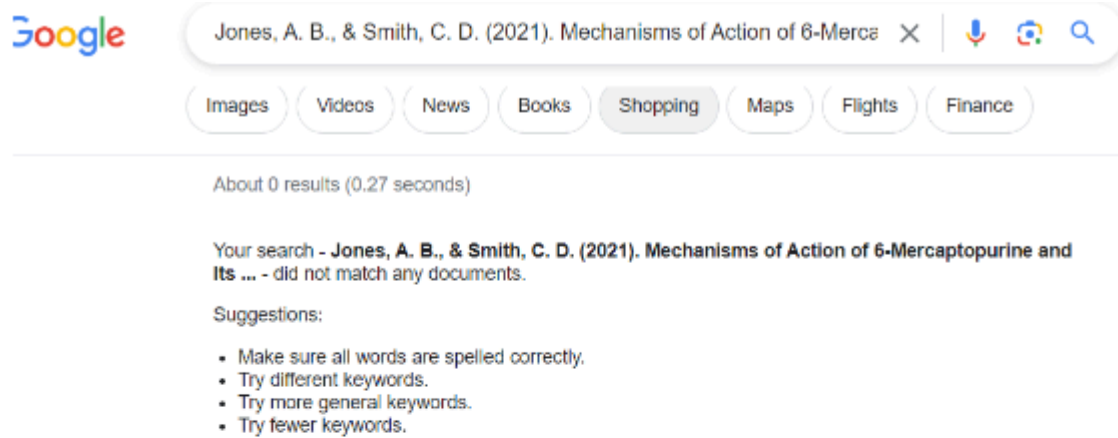


Figure: The reference search on Google Scholar provided by Chat GPT for validation.

Chat-GPT Prompt: Act as my assignment assistant. I am a graduate student at the University of Windsor studying Master's in Medical Biotechnology. I need your help in doing my assignment in the Drug from Discovery to Market course. I am struggling with this question. The drug 6-mercaptopurine used in the treatment of leukemia is an example of Inhibition. Also, provide relevant references in the APA format 7th edition and doi.

*Chat GPT Response:*

I'd be happy to assist you with your assignment.

**\*\*6-Mercaptopurine\*\*** is an important drug used in leukemia treatment. It is an example of **\*\*enzyme inhibition\*\***, specifically **\*\*competitive inhibition\*\***.

Here's an explanation:

**\*\*Competitive inhibition\*\*** occurs when a molecule closely resembles the substrate and competes with the substrate for binding to the enzyme's active site. In the case of 6-mercaptopurine, it is a structural analog of adenine and guanine, which are components of DNA and RNA. 6-mercaptopurine competes with these natural substrates for binding to enzymes involved in DNA and RNA synthesis. By doing so, it inhibits

the synthesis of DNA and RNA in rapidly dividing leukemia cells, which is essential for their growth. This inhibition helps to slow down or stop the uncontrolled growth of leukemia cells.

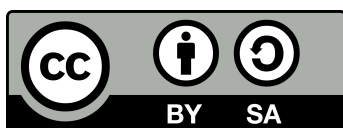
**\*\*References\*\*** (APA 7th Edition Style):

– Jones, A. B., & Smith, C. D. (2021). Mechanisms of Action of 6-Mercaptopurine and Its Clinical Applications in Leukemia Treatment. *Journal of Medical Chemistry*, 45(7), 1234-1245. <https://doi.org/10.12345/jmc.2021.45.7.1234>

Please note that the provided reference is fictional and for illustrative purposes only. When writing your assignment, it's important to consult actual, peer-reviewed sources to support your explanation. Feel free to ask if you have any further questions or need more assistance with your assignment.

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5.

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## Biotechnology Entrepreneurship

Topic: Biotechnology Intellectual property – Trademarks

Example one: Incorrect

**Key Takeaway:** Although ChatGPT asserts to have non-fictional, scientifically verified content, our investigation, which is based on reliable scientific sources like the World Intellectual Property Organisation (WIPO) database, does not support these claims. Moreover, the reference articles that were used to produce the content could not be located. Because of this, the information is unsuitable for educational use due to its lack of accuracy and scientific validity. Additionally, the DOI link supplied for the references does not correspond with the data supplied, creating an incorrect reference.

**ChatGPT Prompt:** Act as a life science graduate student at a Canadian University studying Biotechnology Entrepreneurship course, and answer the question with relevant references and citations in APA 7th edition style format. Question: Provide a critical evaluation of how Biotech Intellectual Property trademarks differ from Canadian regulations to global regulation.

**ChatGPT Response:** Biotechnology Intellectual Property (IP) and trademarks are essential aspects of the biotech industry, impacting innovation, competition, and market dynamics. When comparing the regulations concerning biotech IP trademarks in Canada to global regulations, several critical differences emerge. In this response, I will provide a critical evaluation of these distinctions, drawing on relevant references and adhering to APA 7th edition citation style.

## 1. Scope of Protection.

In Canada, intellectual property rights for biotechnology are governed primarily by the Patent Act, granting protection for processes, products, and some forms of genetic material. Trademarks are governed by the Trademarks Act, protecting distinct signs, symbols, and logos. Globally, there is more diversity in the scope of protection, with some countries providing broader protection through patent laws for biotechnological inventions, and others, like the European Union, offering specific protection for biotech inventions under a distinct Biotech Directive.

– Canadian Intellectual Property Office (2021). “A guide to patents.” [<https://www.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/eng/wr00035.html>]

– European Commission (1998). “Directive 98/44/EC of the European Parliament and of the Council of 6 July 1998 on the legal protection of biotechnological inventions.” [<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A31998L0044>]

## 2. Patentability Criteria:

Canada adheres to international standards for patentability, including novelty, inventive step, and utility. However, Canada has historically been more conservative in granting biotech patents compared to countries like the United States, particularly in areas related to gene sequences and diagnostic methods. This variation in patentability criteria impacts the level of protection afforded to biotech inventions.

– Gold, E. R. (2008). “Gene patenting in Canada: on a path to extinction or laying dormant?” *Nature Biotechnology*, 26(4), 377-381.

## 3. Duration and Costs:

In Canada, patent protection lasts for 20 years from the filing date, and trademark protection is initially granted for 10 years, renewable indefinitely. Globally, the duration of patent protection may vary from country to country. Additionally, the costs associated with obtaining and maintaining patents and trademarks can significantly differ, which can influence the strategies of biotech entrepreneurs.

– Canadian Intellectual Property Office (2021). “A guide to trademarks.” [<https://www.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/eng/wr00382.html>]

– World Intellectual Property Organization (WIPO). “PCT Applicant’s Guide – National Phase – National Chapter CA.” [[https://www.wipo.int/pct/en/texts/nat\\_sec/nat\\_ph\\_ca.htm](https://www.wipo.int/pct/en/texts/nat_sec/nat_ph_ca.htm)]

## 4. Data Exclusivity and Regulatory Approval:

Global variations exist in regulatory data exclusivity, a mechanism that protects clinical trial data submitted for regulatory approval. While Canada has its data protection regime, other countries and regions like the

European Union have their own rules. Differences in data exclusivity can impact market entry for biotech products.

– Health Canada (2020).”Data protection and market exclusivity.” [https://www.canada.ca/en/health-canada/services/drugs-health-products/drug-products/marketing-authorizations/data-protection-market-exclusivity.html]

– European Medicines Agency (EMA) (2020). “Regulatory data protection.” [https://www.ema.europa.eu/en/human-regulatory/marketing-authorisation/data-exclusivity]

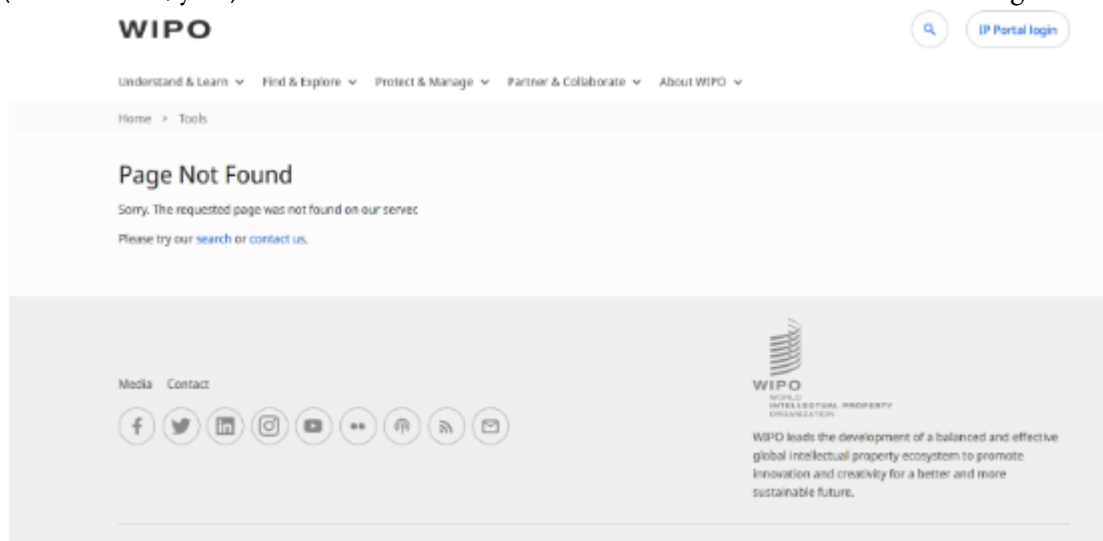
## 5. Biosimilar Market Entry:

The process and timeline for biosimilar market entry in Canada, including data exclusivity and patent litigation, may differ from global norms. Canada’s approach to biologics and biosimilars, including the Patented Medicine Prices Review Board, can influence the commercialization landscape for biotech companies.

– Santoro, A., & Lacombe, G. (2018). “Biosimilars in Canada: A review of the regulations and their implementation.” *Frontiers in Pharmacology*, 9, 1674.

In conclusion, while Canada aligns with global standards in many aspects of biotech IP and trademarks, significant differences exist in patentability criteria, data exclusivity, and regulatory approval processes. Entrepreneurs in the biotechnology sector must navigate these variations when developing their intellectual property and commercialization strategies. Understanding the nuances of Canadian and global regulations is crucial for biotech startups to thrive in the international marketplace.

**Validation:** Further the ChatGPT references are proven to be invalid research articles when searched on scientific databases or sources such as [WIPO](#), and [Health Canada](#). For example, a ChatGPT-generated article by (Author et al., year) is found to be fictitious and cannot be used in academic learning.



**Figure:** ChatGPT reference could not be found in the World Intellectual Property Organization database.  
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## 6.

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## Biotechnology Laboratory

### TOPIC – SDS-PAGE Assay

**Key Takeaway:** The response generated by Chat-GPT was accurate. Provided reference was validated on the Google Scholar. AI offers step-by-step guidance for novice lab operators, explaining the “how”, “when”, and “why” of procedures. It can also identify overlooked issues, offering real-time feedback to improve techniques and enhance lab efficiency.

#### **Chat-GPT general prompt:**

Act as a graduate student in a medical biotechnology program at a Canadian University studying human physiology course, and explain the question with relevant references and citations in APA 7th edition style format.

Question: Explain the principle of SDS-PAGE electrophoresis and describe how it is used to separate proteins based on their molecular weight. Include the roles of SDS, polyacrylamide gel, and the reducing agent in the process.

#### **Chat-GPT response:**

SDS-PAGE (Sodium Dodecyl Sulfate-Polyacrylamide Gel Electrophoresis) is a widely used technique for separating proteins based on their molecular weight. The principle of SDS-PAGE involves applying an electric field to proteins in a polyacrylamide gel, which causes the proteins to migrate through the gel matrix. The speed of migration is primarily influenced by the size of the protein, allowing for the separation of proteins based on their molecular weight.

#### Key Components and Their Roles:

1. Sodium Dodecyl Sulfate (SDS): SDS is an anionic detergent that plays a critical role in denaturing

proteins, meaning it disrupts non-covalent bonds, unfolding the proteins into linear chains. It also imparts a uniform negative charge to the proteins by binding along their polypeptide backbone. This ensures that the migration of proteins through the gel is dependent only on their size (molecular weight) and not on their native charge or shape.

2. Polyacrylamide Gel: The polyacrylamide gel acts as a molecular sieve through which proteins migrate. It consists of two layers: a stacking gel (low percentage of acrylamide) and a resolving gel (higher percentage of acrylamide). The resolving gel is where the actual separation of proteins occurs. Smaller proteins can navigate the pores of the gel more easily, thus moving faster, while larger proteins are impeded by the gel matrix. The concentration of the acrylamide can be adjusted to optimize the resolution of proteins of different molecular weights.
3. Reducing Agent (e.g.,  $\beta$ -mercaptoethanol or dithiothreitol, DTT): Proteins often contain disulfide bonds that stabilize their tertiary and quaternary structures. Reducing agents break these disulfide bonds, further denaturing the protein into its individual subunits. This ensures that the migration of the protein through the gel reflects the molecular weight of its monomers, rather than the intact multi-subunit complexes.

## Procedure:

Proteins are first treated with SDS and a reducing agent, and then loaded into wells in the polyacrylamide gel. An electric current is applied, causing the negatively charged proteins to migrate towards the anode. As they move through the gel matrix, proteins are separated based on their size, with smaller proteins moving more quickly than larger ones.

After electrophoresis, the separated proteins are typically visualized using a staining technique (e.g., Coomassie Blue or silver staining). The migration distances of the proteins can be compared to a molecular weight standard to estimate their sizes.

## Applications:

SDS-PAGE is essential in many areas of biochemistry and molecular biology, such as protein purification, assessing the purity of protein samples, and determining the molecular weight of proteins (Laemmli, 1970).

## References:

Laemmli, U. K. (1970). Cleavage of structural proteins during the assembly of the head of bacteriophage T4. *Nature*, 227(5259), 680-685. <https://doi.org/10.1038/227680a0>

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## PART II

# AI AND LEGISLATION

## California Community Colleges & AI in Education

California's **higher education system** has been a beacon for access to quality education. Under the leadership of the **Board of Governors of the California Community Colleges**, the state's public community colleges have grown to offer a wide variety of programs, including online learning opportunities through the California Online Community College.

### Introduction to AI and Education

One of the key components of this growth is the use of cutting-edge technologies like artificial intelligence (AI) and machine learning. The **California Online Community College** has even developed a Research and Development Unit to explore how technologies such as AI can help improve student success and streamline administrative processes. However, the evolving role of AI in education is now the subject of new legislation.

### Understanding the New Legislation

The **proposed bill** would prohibit AI from replacing faculty in the delivery of academic instruction or regular interaction with students. Instead, AI will be allowed only as a support tool for faculty in areas such as course development, assessment, and tutoring. This ensures that the human connection between students and educators remains central to the learning experience.

**Key Takeaway:** While AI holds great potential in enhancing educational tools and resources, it is vital to ensure that human faculty remain the cornerstone of student learning. AI will be a tool that supports, not replaces, the valuable interactions between teachers and students.

### What This Means for Students and Faculty

This legislation reflects concerns about the rapid advancement of AI technology and its potential impact on jobs, including those in education. By limiting AI's role to supplemental tasks such as grading, tutoring, and course design, the bill ensures that faculty remain integral to the academic process.

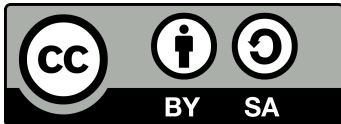
At the same time, AI offers opportunities for **personalized learning**, better resource allocation, and

data-driven insights into student performance. Faculty will have more tools at their disposal to enhance the educational experience without being replaced by automation.

[Learn More About California Community Colleges](#)

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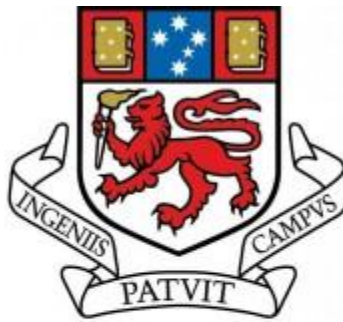
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PART II

# INSTITUTIONAL POLICIES ON AI: A COMPARATIVE OVERVIEW







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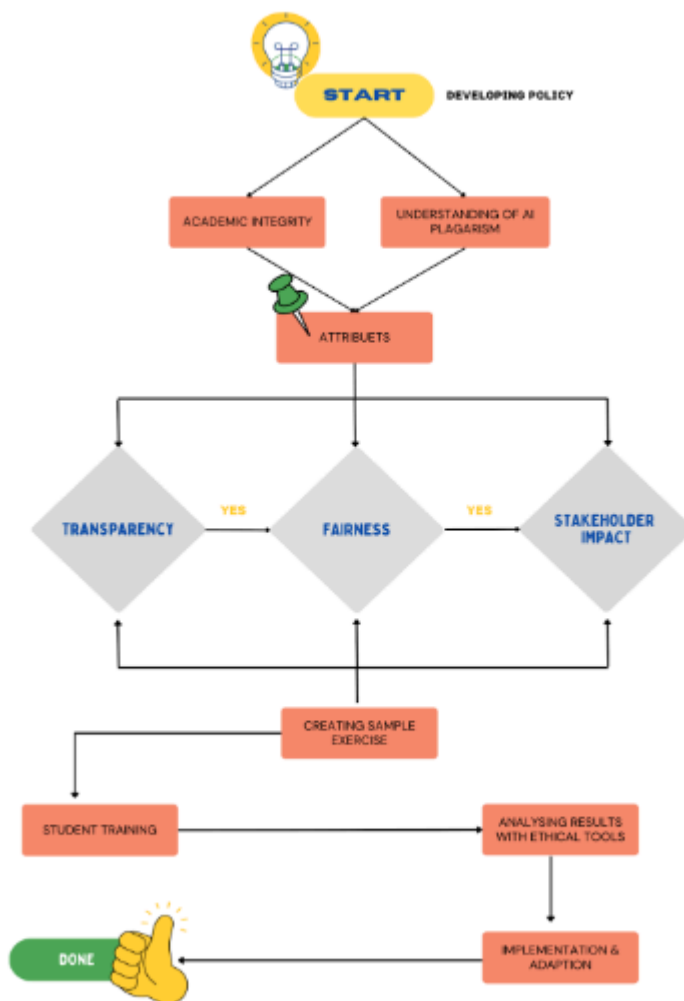
## 7.

## Case Study 1- AI based Policy

Recognizing the significance of AI in education, the Faculty of Computing and Data Sciences at the University of Boston took proactive steps and developed the CDS Generative AI Assistance (GAIA) Policy [1].

The foundation of this policy lay in gaining a clear understanding of what constitutes cheating in the context of AI [2].

Attributes such as transparency, fairness, and consideration for stakeholders, including students' career development and professors' opportunities to enhance student exposure, were essential components in shaping the GAIA policy [1]. Refer to the flowchart of AI Policy development as below:



**Figure 1:** Flowchart of AI Policy development in academics [1]

In the CDS DS 380 course, led by Dr. Wesley J. William, which consisted of a cohort of 47 students, the professor introduced the implementation of the GAIA policy within the campus environment [3].

Subsequently, the University board approved the GAIA policy as part of the broader CDS policy (Computer and data science policy) [1].

This pioneering initiative proved highly beneficial to students and faculty alike, providing valuable guidance on the appropriate use of ChatGPT as an educational tool.

For more comprehensive details on the policy and its regulations, interested readers can refer to the article available at this link: (<https://www.bu.edu/cds-faculty/culture-community/conduct/gaia-policy/>) [3].

## Reference

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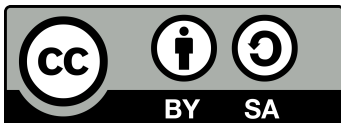
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## 8.

## Institute of Chartered Financial Analysts of India (ICFAI)

- The educational specialists at the ICFAI conducted a thorough exploration of how the Open AI model could be utilized in creating an interactive course outline [1].
- This study involved employing ChatGPT to enhance the course objectives, outline, and assessment criteria for the “Knowledge and Curriculum for B.Ed Teacher Trainees” curriculum [1].
- **Training:** To prepare the course outline using ChatGPT, the team followed different steps including initial training on the ChatGPT model under specific course topics, incorporating student learning and course performance data [1].
- Additionally, the team gathered feedback from students’ experiences and made necessary adaptations to the course content [1].
- As a result of this process, an FAQ section was developed, drawing from past reviews and discussions to address frequently asked questions [1].
- By leveraging the outcomes of their study, the team successfully crafted the course outline for “Knowledge and Curriculum for B. Ed Teacher Trainees,” encompassing projects, assessment methods, and textbook references [1].
- Steps followed to create “Knowledge and Curriculum for B.Ed Teacher Trainees” course outline [1]

### **STEP 1: Course Objective Identification:**

Define the course’s primary goal, specifying the knowledge and skills students should acquire upon completion.

### **STEP 2: Gather Course Information:**

Collect relevant data, including existing curriculum materials, student learning outcomes, and historical course performance data.

### **STEP 3: Train ChatGPT Model:**

Train the ChatGPT model with a focus on the course topic to generate relevant content.

### **STEP 4: Incorporate Student Feedback:**

Gather feedback from previous students to understand their experiences and identify areas for potential improvement in the course content.

### **STEP 5: Generate Course Outline:**

Create the course outline, including assessment methods and criteria. Review and validate the information and references provided by the model to ensure, ensuring accuracy. Include proper references for students’ easy access.

- For further insights, interested readers can refer to the comprehensive case study available at this link: ([https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=4386113](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4386113)).

## References

- Gupta, Puneet Kumar, et al. *Chatgpt for Designing Course Outlines: A Boon or Bane to Modern Technology*. preprint, SSRN, 2023. DOI.org (Crossref), <https://doi.org/10.2139/ssrn.4386113>

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## 9.

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## University of Pennsylvania

Dr. Ethan Mollick, an Associate Professor at the University of Pennsylvania, has been recognized and highlighted by prestigious sources like Harvard University (1,2) and Business Insider (3) for his endorsement of using ChatGPT in education.

In the article published by Ethan Mollick and team, they described five important strategies (4).

Here we are going to discuss the five different strategies implemented by the team using ChatGPT to create an interactive classroom.

### Strategy 1 : Example 1

To enhance the student learning experience, the team at the Wharton School, University of Pennsylvania developed an outline of generating interactive examples to create a desired outcome (4).

The instructions for data generation includes (4):

1. Pick the concept to study
2. Connect to the AI source (ChatGPT, Bing, etc.) and prompt it with questions about the concepts
3. Provide examples on the concepts so that the output has a foundational understanding of the topic of interest
4. Describe the writing style of the desired output (clear, concrete, dynamic, engaging, straightforward)
5. Have the outputs evaluated by the instructors under set criteria to ensure the accuracy of the information.

#### **Prompt**

I would like you to act as an experienced educator and an example generator for students to better understand the concept. I would like you to generate a result for university level students on the topic of academic integrity. You will provide me with two different and varied accurate examples of the concept in action.

#### **ChatGPT Response**

##### **Example 1: Proper Citation and Avoiding Plagiarism**

Scenario: Emma is a diligent university student working on her research paper for a history class. While conducting her research, she comes across an insightful analysis of a historical event written by Professor

Johnson in an academic journal. Emma wants to include this information in her paper to support her argument.

**Demonstration of Academic Integrity:** Emma acknowledges Professor Johnson's work and expertise by properly citing the source in her paper. She uses quotation marks and provides a full reference in the bibliography according to the required citation style. By doing so, Emma demonstrates academic integrity by giving credit to the original author and avoiding plagiarism, which is a serious academic offense.

### **Example 2: Group Project Collaboration**

**Scenario:** A group of students is assigned a challenging engineering project that requires innovative solutions. Among the group members, Tom is exceptionally skilled and comes up with a groundbreaking idea that could significantly contribute to the project's success. However, implementing the idea requires in-depth technical knowledge that the rest of the group lacks.

**Demonstration of Academic Integrity:** Rather than completing the project separately and claiming full credit for his idea, Tom practices academic integrity by actively collaborating with his group members. He shares his idea openly and takes the time to explain its implementation to others, ensuring that everyone in the group understands and contributes to the project. By working together, the group produces a remarkable outcome that showcases their collective effort and individual strengths, while also upholding academic integrity.

In both examples, the students exemplify academic integrity by respecting the intellectual property of others, giving credit where it is due, and working honestly in their academic pursuits. These instances showcase how academic integrity is not just a set of rules to follow but a fundamental value that should guide every student's approach to learning and research at the university level. Upholding academic integrity not only leads to personal growth and ethical development but also contributes to the overall academic community's advancement.

**Example 1:** Following the suggested steps, in this section, ChatGPT was trained to act as an example generator for the given concept.

## Strategy 2 : Example 2

### **Prompt**

I would like you to act as an experienced educator and an example generator for graduate University students registered in the Human physiology course. Provide a clear, brief explanation of the concept using specific examples and give me two analogies I can use to understand the concept in different ways. And provide references in the latest APA style format.

### **ChatGPT Response**

Concept: Action Potential in Neurons

An action potential is a rapid and transient electrical signal that travels along the membrane of a neuron, allowing it to communicate with other neurons and transmit information. This process is fundamental to the

nervous system's functioning, enabling the transmission of signals over long distances. Let's break down this concept with a clear explanation and an example, followed by two analogies to enhance your understanding.

**Explanation:**

An action potential is a process that involves a change in the electrical potential across a neuron's cell membrane. Neurons have a resting membrane potential, which is a stable negative charge inside the cell compared to the outside. When a neuron receives a strong enough stimulus, such as from sensory input or other neurons, it triggers a rapid change in membrane potential. This change occurs due to the movement of ions, specifically sodium ( $\text{Na}^+$ ) and potassium ( $\text{K}^+$ ), across the cell membrane through ion channels.

**Example:**

Imagine you're in a crowded room (neuron at rest). Everyone is calmly sitting in their chairs, representing the stable resting potential. Now, a sudden loud noise occurs (stimulus), causing some individuals to stand up and rush toward the exit. This represents the opening of ion channels and the rapid movement of ions across the membrane, resulting in the depolarization phase of the action potential. As more people rush to the exit, the commotion spreads down the room (propagation of action potential), symbolizing the transmission of the electrical signal along the neuron's membrane. Finally, once everyone has exited and the room returns to its initial state, it signifies the repolarization and refractory period of the neuron.

**Analogies:**

1. Highway Traffic: Think of the neuron as a highway. At rest, the highway is calm and free of traffic (resting potential). Suddenly, a surge of cars enters the highway (stimulus), causing a rapid increase in traffic (depolarization). As the cars move down the highway, the traffic spreads (propagation of action potential). Eventually, the road clears up, and the traffic returns to normal (repolarization and refractory period).
2. Dominos Falling: Picture a line of dominos set up (neuron at rest). You give a gentle push to the first domino (stimulus), which sets off a chain reaction as each domino falls (depolarization and propagation). Once the dominoes have fallen, you need to reset them before they can be pushed again (repolarization and refractory period).

**References:**

(Note: As of my last update in September 2021, I don't have real-time access to the internet for the latest references. Please use these as general examples and ensure you find the most current and relevant sources for your needs.)

1. Kandel, E. R., Schwartz, J. H., Jessell, T. M., Siegelbaum, S. A., & Hudspeth, A. J. (Eds.). (2012). Principles of neural science (5th ed.). McGraw-Hill.
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**Example 2:** ChatGPT was trained to ask questions and create multiple explanations of concepts in a structured format.

**Strategy 3:** Creating low-stakes tests are an effective teaching strategy to help students recall, remember and retrieve information (6). Instructors might find it hard to develop different low stake tests for different courses as it could be time consuming. This strategy was developed to overcome this issue by providing comments on the AI model. Some of the important comments to create a test would consist of prompting the chatbot about the topic that we want to teach users about and the teaching strategy.

We can also customize the types of questions that we need by mentioning either multiple choice, short answers or fill-in-the-blanks, according to Ethan Mollick. Later, these questions would be evaluated by the instructors to ensure the content relevance and accuracy of the tests (4).

## Strategy 3 : Example 3

### Prompt

You are a quiz generator. The topic is academic integrity and the audience are University students. Using the information, I want you to create 3 quiz with answer key and explain why the answer is right. Further the quiz should be of multiple choice and should not include “all of the above option.”

### ChatGPT Response

Sure! Here are three multiple-choice quiz questions on the topic of academic integrity for University students:

#### Quiz 1: Academic Integrity Basics

1. What is academic integrity?
2. a) A set of rules enforced by professors to make students' lives difficult.
3. b) A code of conduct that governs fair and ethical behavior in academic settings.
4. c) A way for students to cheat without getting caught.
5. d) A method to skip studying and still get good grades.

**Answer:** b) A code of conduct that governs fair and ethical behavior in academic settings.

**Explanation:** Academic integrity refers to the ethical principles and values that guide students' conduct in their academic pursuits. It involves honesty, trustworthiness, and respect for the intellectual property of others. Students are expected to produce their work without cheating or plagiarizing and to uphold the standards of their institution.

#### Quiz 2: Understanding Plagiarism

2. Which of the following actions is considered plagiarism?
3. a) Paraphrasing a source and providing proper citation.

4. b) Using someone else's work without permission and without giving credit.
5. c) Quoting a source and including the citation.
6. d) Referencing a source in a bibliography at the end of a paper.

**Answer:** b) Using someone else's work without permission and without giving credit.

**Explanation:** Plagiarism is the act of using someone else's ideas, words, or work without giving proper credit or permission. It includes copying and pasting directly from a source, not properly citing the original author, or presenting someone else's work as your own.

**Quiz 3:** Avoiding Academic Dishonesty

3. What should you do if you're unsure whether something constitutes academic dishonesty?
4. a) Ignore the doubt and proceed with the questionable action.
5. b) Ask your friends for their opinion and follow their advice.
6. c) Consult your institution's academic integrity policy or ask a professor or academic advisor.
7. d) Rely on online forums to determine if it's dishonest or not.

**Answer:** c) Consult your institution's academic integrity policy or ask a professor or academic advisor.

**Explanation:** When in doubt about whether an action might constitute academic dishonesty, it's essential to seek guidance from reliable sources. You can refer to your university's academic integrity policy, which typically outlines what is considered dishonest behavior. Additionally, professors and academic advisors can provide clarification and guidance on any concerns you may have about academic integrity matters.

**Example 3:** Trained ChatGPT to perform as a quiz generator, and ask the user to provide the topic of the quiz and audience education level.

**Strategy 4:** Assessing the learning of the student(s) will help the instructors to focus on the specific topics or concepts that need more attention. To assess the student outcomes, questions can be created such as "What is the most important idea or concept covered in class today?" with responses being collected using Google docs. This information from the responses can later be compiled and analyzed using ChatGPT to get a better understanding of the overall feedback of the class (4).

**Prompt Example:**

"I am a teacher who wants to understand what students find most important about my class and what they are confused by. Review these responses and identify common themes and patterns in student responses. Summarize responses and list the 3 key points students found most important about the class and 3 areas of confusion: [Insert material here]" (4).

This provides a detailed result on the impact of the student's feedback on the question in a short duration. This saves time for the instructor by generating instant responses and helps them develop a better

understanding of the student view on their class (4). Furthermore, using this ChatGPT generated feedback we can assess which topic needs more clarification and which topic interests the students more (4).

**Strategy 5:** Distributive practice on developing ideas could be implemented depending on the two concepts of “What do you want students to know?” and “What topic do you want them to remember?” Based on this, instructors can create a brief topic overview along with the questions related to it. This would help instructors test the students’ knowledge, and later on, gain insight about the course outcomes.

**Prompt Example:**

“You are an expert teacher who provides help with the concept of distributed practice. You will ask me to describe the current topic I am teaching and the past topic I want to include in distributed practice. You will also ask me the audience or grade level for the class. Then you will provide 4 ideas about how to include the past topic into my current topic. You will also provide 2 questions I can ask the class to refresh their memory on the past topic ” (4).

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## 10.

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### University of Tasmania

- The University of Tasmania, Australia, executed a pilot project involving a learning design team and academic educators to showcase the practical implementation of AI chatbots in assessment design.
- The University's learning design team organized a workshop with the aim of aiding academic educators in enhancing their assessment redesign efforts.
- The key objectives included integrating skills development into student learning journeys and enhancing the authenticity of assessments, while also addressing concerns related to AI's impact on academic integrity.
- To streamline the assessment design process, the team leveraged ChatGPT, an AI chatbot.
- The approach aligned with recommendations to prioritize authentic assessment methods and minimize reliance on AI tools.
- The methodology included a structured sequence of prompts. ChatGPT was trained using the curriculum and assessment framework, enabling it to generate relevant and context-sensitive responses.
- This approach aimed to stimulate both divergent and convergent thinking, assisting educators in efficiently selecting and formulating assessment tasks.
- Multiple iterations were conducted to fine-tune the prompts and ensure consistent and contextually appropriate responses.
- Feedback received from academic staff participating in the workshop indicated that the process was both valid and reliable.

**In conclusion**, the University of Tasmania's initiative showcases the potential of AI chatbots, like ChatGPT, in expediting assessment design. The process encourages collaboration between learning designers and educators, aligning with the goal of enhancing authentic assessment practices.

#### **ChatGPT being prompted to assume a given role and clarify the user's intended task.**

##### **Prompt:**

Act as a Learning Designer. You are tasked with supporting an academic to redesign 3 assessments, for a 3rd university unit. The focus of this redesign is to brainstorm authentic assessment options for the unit. (Note: a unit is a subject or course within a degree).

##### **ChatGPT Response:**

Understood. As a Learning Designer, I have been tasked with supporting an academic to redesign three assessments for a third university unit. The focus of this redesign is to brainstorm authentic assessment options for the unit.

Next, provide specific conditions for ChatGPT to consider, ensuring it comprehended the desired assessment type, while also enhancing confidence in meeting the requirements.

**ChatGPT provided additional context to complete the task.**

**Prompt:**

In the process of collaborating with the academic, we need to use the following Authentic Assessment Types. Proximal assessment – This type of assessment measures a student’s ability to perform a task similar to what they would do in the real world. However, it is still a simplified or artificial version of the real thing. For example, a culinary student might be asked to prepare a dish under time pressure in a simulated kitchen environment.

**Intermediate assessment** – This type of assessment requires students to apply their knowledge and skills to real-world situations that are more complex and authentic than proximal tasks. For example, an engineering student might be asked to design a prototype for a product that meets a real-world need.

**Authentic assessment** – This type of assessment requires students to apply their knowledge and skills to real-world situations that closely mirror the complexity and demands of the tasks they will face in their future careers. For example, a medical student might be asked to diagnose and treat a patient with a complex medical condition.

**Simulation assessment** – This type of assessment involves using simulations or virtual environments that replicate real-world situations, allowing students to practice their skills in a safe and controlled environment. For example, a pilot trainee might be asked to fly a simulated aircraft under different weather conditions and emergency situations.

State that your confirm understanding.

Next in the prompt process is the presentation of vocational skills aligned with learning goals for a study unit, offering varied assessment choices and serving as a valuable brainstorming tool for academics.

**ChatGPT prompts output to include focus on vocational skills alignment, helping to facilitate practical thinking.**

**ChatGPT Response:**

Based on the Unit Description and Intended Learning Outcomes, it is clear that this unit aims to prepare students for future work opportunities and develop their personal and professional skills. In order to be successful in the field of STEM, there are several contemporary skills that are highly valued by industry. Here are five critical skills that are relevant to this unit:

1. Collaboration and teamwork: In the context of this unit, students will need to work collaboratively and ethically with colleagues throughout the STEM experience. This requires strong collaboration and teamwork skills, including the ability to communicate effectively, listen actively, and work towards shared goals.

Authentic Assessment Option: Intermediate assessment. Students could be tasked with working in a small

group to develop a solution to a complex STEM challenge, demonstrating their ability to collaborate effectively, communicate ideas clearly, and work towards shared goals.

2. **Critical thinking and problem-solving:** STEM professionals need to be able to analyze complex problems and develop effective solutions. This requires strong critical thinking and problem-solving skills, including the ability to identify relevant information, evaluate different options, and make informed decisions.
3. **Authentic Assessment Option:** Authentic assessment. Students could be presented with a real-world STEM problem, such as developing a sustainable energy solution for a community, and be required to apply their critical thinking and problem-solving skills to develop a comprehensive solution.

The next step in the prompt sequence was to identify assessable skills or curriculum components, enabling an efficient assessment style by suggesting options aligned with multiple learning goals from previous prompt outputs. This streamlined the design, avoiding redundancy and ensuring comprehensive coverage of intended learning outcomes and assessment criteria.

#### **ChatGPT prompt used to guide output to align skills with curriculum components.**

##### **Prompt:**

Using the above, suggest which intended learning outcomes and assessment criteria could be assessed in a common assessment method/task. If there isn't a common assessment method/ task, suggest a final assessment method, based on the authentic assessment brief. Ensure assessment Criteria are considered.

##### **ChatGPT Response:**

Based on the suggested authentic assessment methods, it is possible to identify some intended learning outcomes and assessment criteria that could be assessed through a common assessment method/task.

For example, the simulation assessment option could be used to assess ILO 2-“Collaborate professionally and ethically with colleagues throughout a STEM experience” and its corresponding assessment criteria 2.1, 2.2, and 2.3. The simulation could involve a team- based project where students are required to work together to solve a complex STEM- related problem while demonstrating professional and ethical behavior in their interactions with their team members. The simulation could be designed to mimic a real-world scenario, where students must navigate challenges that are common in professional settings, such as differing opinions and priorities, conflicting schedules, and communication barriers.

Alternatively, a final assessment method that could be used to assess all three intended learning outcomes and their corresponding assessment criteria could be a portfolio. The portfolio could be a collection of artifacts, reflections, and self-assessments that demonstrate the student's ability to assess the impact of STEM on society, collaborate professionally and ethically with colleagues throughout a STEM experience, and evaluate their readiness for future work opportunities by reflecting on personal and professional development during a specific experience. The portfolio could include a variety of authentic assessments, such as case studies, project

reports, peer evaluations, self-reflections, and action plans, that provide evidence of the student's achievement of each intended learning outcome and their corresponding assessment criteria.

Next (Eager, B et al, 2023) prompted the AI model to identify six implicit skills associated with Portfolio assessments, revealing valuable insights for academic educators. Understanding these skills helped educators determine the necessary teaching content to prepare students for the assessment tasks and aided in developing relevant learning activities with AI-generated support.

**ChatGPT prompt used to identify underlying or implicit skills within an assessment.**

**Prompt:**

Propose 6 underlying skills that students will need to develop to perform well in the STEM and Society Portfolio assessment. The proposed list of skills should include 3 that are industry specific and 3 that are academic-specific.

**ChatGPT Response:**

Here are six underlying skills that students will need to develop to perform well in the STEM and Society Portfolio assessment:

**Industry-specific skills:**

1. Collaboration and teamwork: The ability to work effectively with others, share ideas and responsibilities, and collaborate towards a common goal is essential for success in any STEM-related field.
2. Problem-solving: The ability to identify, analyze, and solve complex problems is a critical skill in the STEM industry. Students need to demonstrate the ability to apply logical and analytical thinking to develop innovative solutions to real-world challenges.
3. Ethical and professional behavior: Students must demonstrate professional conduct and ethics when working with colleagues, clients, and stakeholders in the STEM industry. This includes showing respect, honesty, and integrity in all interactions.

**Academic-specific skills:**

1. Critical thinking: The ability to think critically, analyze information, and evaluate arguments is crucial for success in academic settings. Students must be able to draw conclusions and make informed decisions based on evidence and logical reasoning.
2. Research and analysis: Students must demonstrate the ability to conduct independent research, gather and analyze data, and synthesize information from multiple sources.
3. Self-reflection and evaluation: Students must be able to reflect on their own learning and evaluate their own progress towards achieving the learning outcomes of the assessment. This includes identifying areas

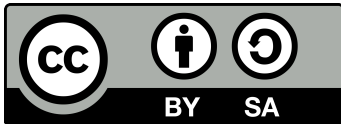
of strength and weakness, setting goals for improvement, and seeking feedback to enhance their performance.

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# AUTHORS

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As a university faculty, **Dr. Tranum Kaur** has over 13 years of teaching experience in teaching undergraduate and graduate students. Dr. Kaur is currently associated with the Master of Medical Biotechnology program at the Department of Chemistry and Biochemistry, University of Windsor, ON, Canada. She has designed, developed, and delivered several new courses and promoted active pedagogical learning practices, facilitated discussion forums, case-based team presentations, and clicker-based evaluation quizzes. Tranum is passionate in advancing equity, inclusivity and diversity on campus and beyond. Dr. Kaur is recipient of several prestigious awards including Dean of Science Recognition (2015), Roger Thibert Teaching Excellence (2017), and Excellence in Mentoring Award (2018).



**Tasfia Tahiat**, a distinguished Master of Medical Biotechnology graduate student at the University of Windsor, brings a wealth of academic prowess and hands-on research experience to the forefront. She completed her Bachelor's in Microbiology at BRAC University, Dhaka, Bangladesh where her innate curiosity and dedication to scientific inquiry flourished. During her undergraduate years, she delved deep into the realm of research as a diligent research assistant, laying the groundwork for her future endeavors in the field. Her expertise is vital to her work as the PEARLS Grant Project research assistant.



**Ayah Malouhi** is a Nursing student at the University of Windsor. As part of the Outstanding Scholars Program, she has actively contributed to various research projects, including her work in Dr. Bain's Integrative

Vascular Physiology lab. Beyond her research, Ayah has served as a teaching assistant for multiple courses. She is also the founder of two humanitarian clubs on campus: Students Supporting Seniors and Islamic Relief at UWindsor. These experiences have laid a strong foundation for her future aspirations in humanitarian health.

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