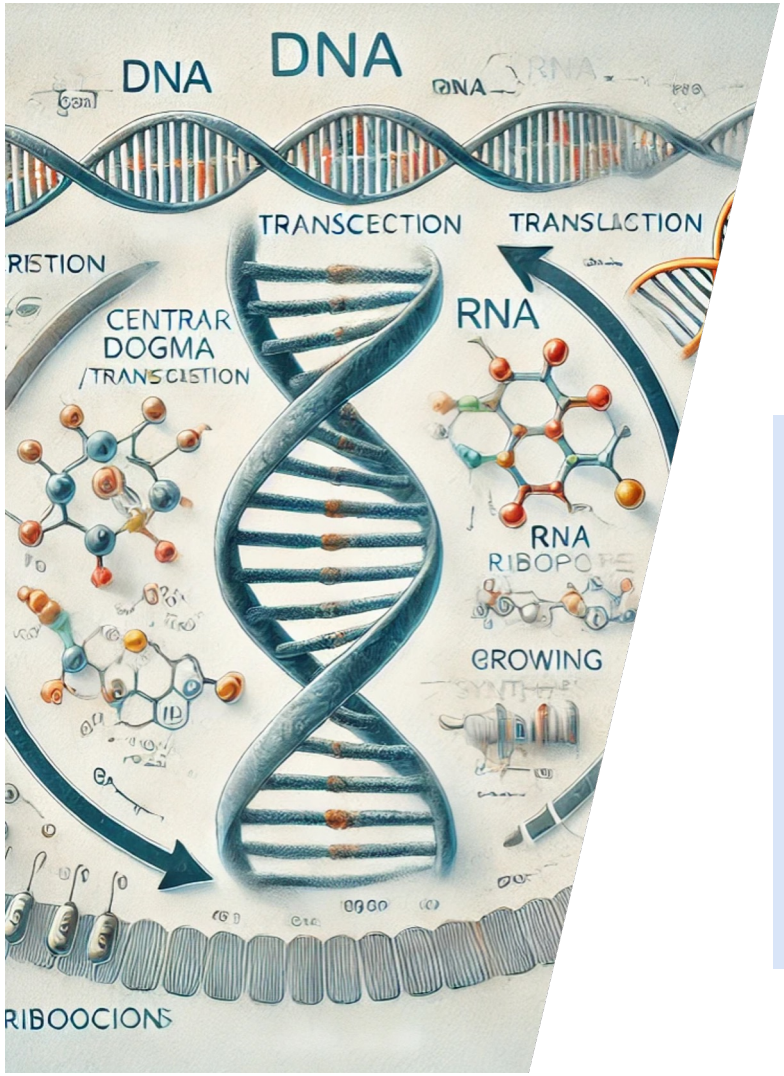
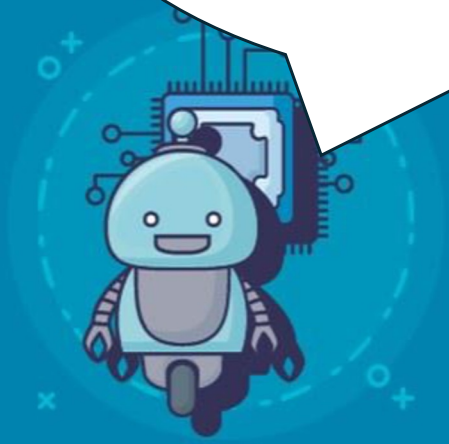


AI Literacy in Biology

Learning Objectives

- Explain the principles and mechanisms behind generative AI to a peer
- Identify ethical considerations associated with the development and use of AI technologies
- Differentiate between applications of AI that enhance learning and those that hinder the learning process, providing specific examples
- Develop specific, effective AI prompts tailored for studying and tutoring tasks to optimize learning outcomes.

Have you ever used generative AI (such as chat GPT)? What did you use it for?



Turn to your neighbor, take a few minutes…

- Share your AI experiences with a few people sitting around you.
- Discuss uses in school and other aspects of your life.
- If you've never used AI, think about what it could be used to do.

Ways that I've used AI – professionally and personally

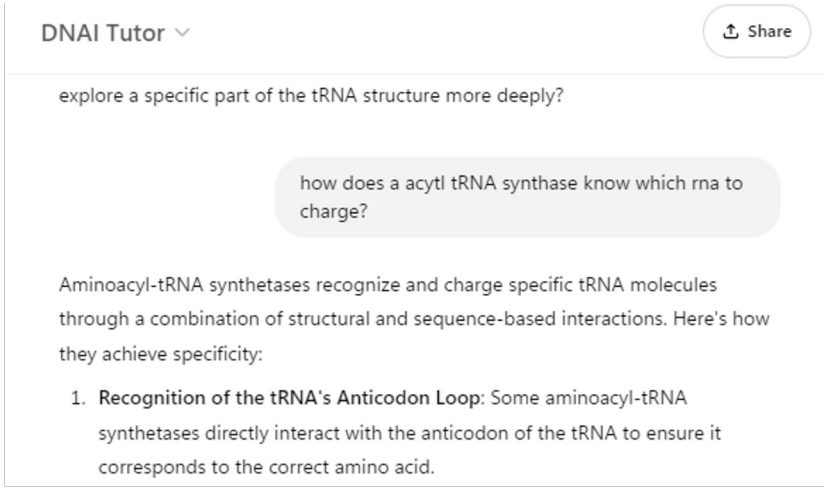
Professional summaries/job searching

- Summarize my CV for LinkedIn
- Identify skills from CV
- Help students align resume with job description

A cartoon blob eating a skyscraper, give the blob seven heads and a unicorn horn, make one of the blobs vomit a rainbow!

Creative Fun with my kids

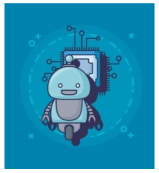
- Draw a picture of anything
- Write a story about anything



Biology Tutor

- Great at clarifying "muddy" topics
- You can ask it stupid questions

How does Generative AI Work?



Clicker Question

How do large language models determine the meaning of a word like "work"?

A) By translating it into a single value representing its definition
B) By analyzing its proximity to other words in large datasets
C) By scanning a dictionary to find its most common usage
D) By consulting a human user for clarification

Test your knowledge from the pre class reading.

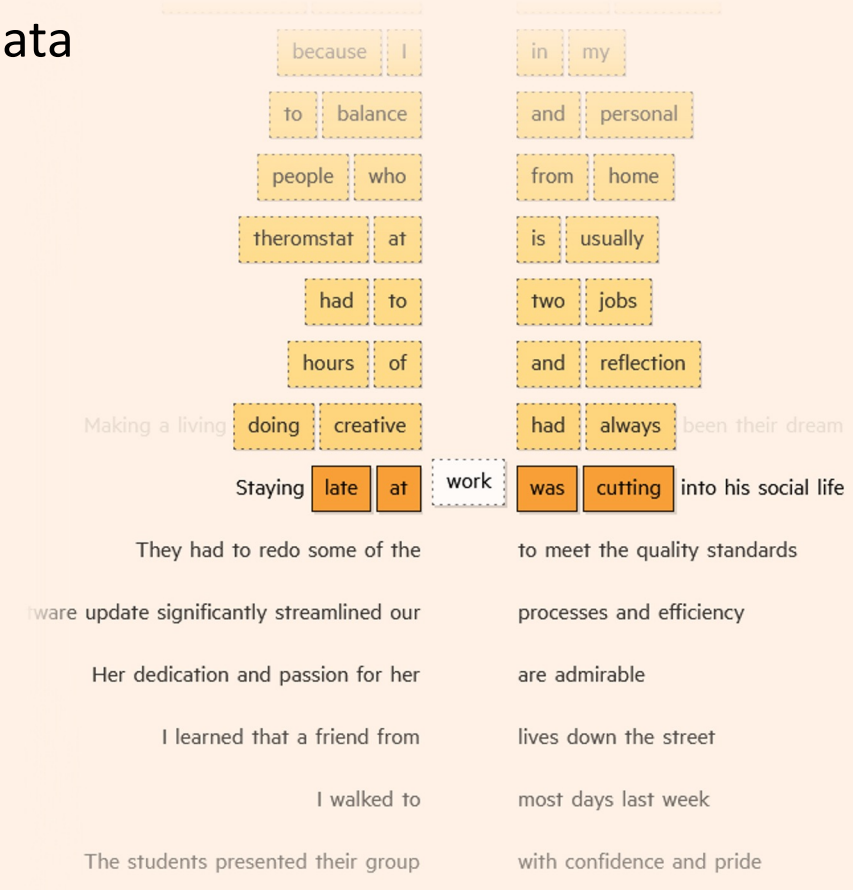
How does generative AI work?

First a block of words is broken into **tokens** — basic units that can be encoded. Tokens often represent fractions of words, but we'll turn each full word into a token.

Financial Times. *Generative AI: What Is It and How Does It Work?* Financial Times, https://ig.ft.com/generative-ai/.

Token are observed in context in large data sets

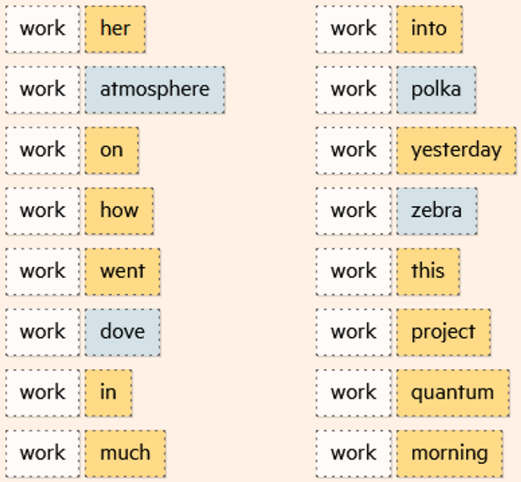
In order to grasp a word's meaning, **work** in our example, LLMs first observe it in context using enormous sets of training data, taking note of **nearby words**. These datasets are based on collating text published on the internet, with new LLMs trained using billions of words.



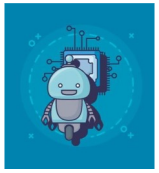
Financial Times. *Generative AI: What Is It and How Does It Work?* Financial Times, https://ig.ft.com/generative-ai/.

LLMs can process an entire phrase, sentence, paragraph or article at once.

Eventually, we end up with a huge set of the words found **alongside** **work** in the training data, as well as those that **weren't** found near it.



Financial Times. *Generative AI: What Is It and How Does It Work?* Financial Times, https://ig.ft.com/generative-ai/.



Clicker Question

What is a common challenge when using LLMs to generate text?

A. Slow processing speed when analyzing text
B. Their reliance on specialized datasets
C. The possibility of generating plausible but incorrect information
D. Inability to recognize patterns in text data

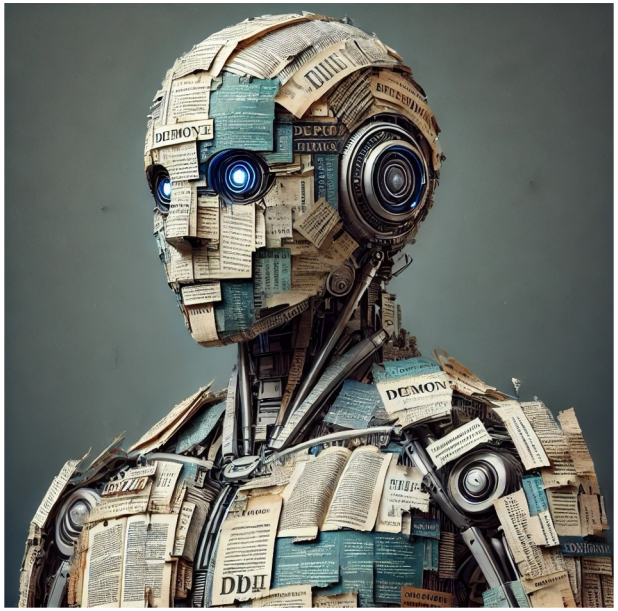
Test your knowledge from the pre class reading.

AI is *not* a search engine

AI is an online tool that learns from outside sources and predicts text possibilities.

AI is not information from a source, it is not all-knowing, and it is not 100% accurate.

Think of it as 'text paper mâché'.



ETHICAL CONSIDERATIONS ASSOCIATED WITH ARTIFICIAL INTELLIGENCE

Should AI do a Student's Homework?

§ **AI supports student learning during homework:**

- Acts as a tutor on tricky problems
- Delivers a non judgemental perspective
- Helps generate ideas and/or problem-solving strategies.

§ **AI hinders student learning:**

- Academic Integrity
- Cheating/Doing a student's homework
- Less active participation in the learning process.

Are AI Detectors Ethical?

- **Purpose of AI Detectors:**
  - § Designed to identify AI-generated content in academic and professional settings.
  - § Aim to uphold academic honesty and prevent misuse.
- **Concerns of AI Detectors**
  - § AI Detectors are not 100% accurate and can produce false positives.
  - § Misidentifying a students' work as AI can lead to unfair consequences.
- **Impact on Student-Professor Dynamic:**
  - § Flagging a student's work can cause a lack of trust.
  - § Has the potential of creating a power imbalance between the student and the professor.

Environmental Concerns

- **Computational Power Requirements:**
  - AI requires significant computational power, especially for training Large Language Models (LLMs).
- **Energy and Water Consumption:**
  - Training AI models requires more energy and water than prompt engineering.
- **AI's Share in Global Energy Demand:**
  - Data Centers account for **1-3%** of global energy demand.
  - AI is responsible for **15%** of data center energy consumption.
  - AI's total energy demand is estimated at **0.45%** of global energy usage.

- *Estimates are based on incomplete and sometimes contradictory sources (EPRI 2024, Goldman Sachs 2024)

- **Data Privacy Concerns**

- **AI and Personal Data Usage:**
  - AI systems rely on vast amounts of personal data to function effectively (behavioral, location, and communication data for example)
  - This raises significant security and privacy concerns.

- **Major Concerns:**
  - **Data misuse**: Companies may sell or share user data with third parties, leading to possible exploitation.
  - **User tracking**: AI systems can monitor and collect user activity without consent.
  - **Data breaches:** Unauthorized access to sensitive or personal information.
- **Potential Solutions:**
  - Increased user transparency.
  - Stricter data protection laws.
  - More effective AI security measures

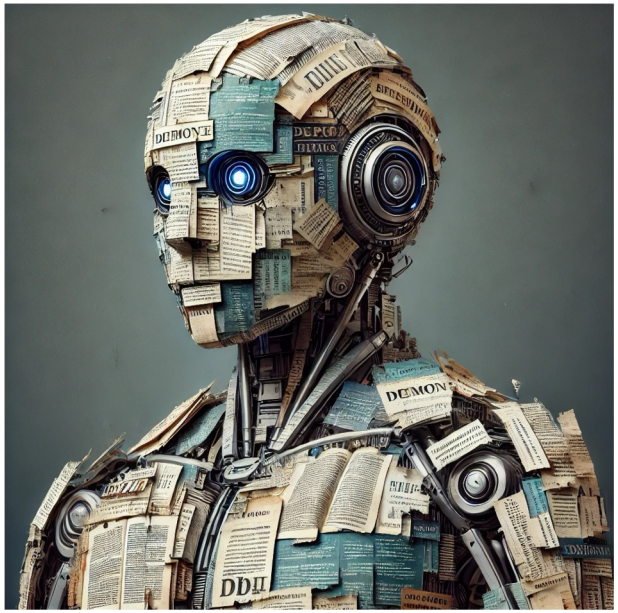
How to Cite AI when you use it – Ask your professor for specifics

AI-generated Text

MLA Format: “Prompt Text” prompt. *AI Tool Name*, Version Number/Name, Company Name, Date of Creation (formatted Day, Mon. Year), URL.

AI help with drafts or revisions

This paper was produced with drafting support from Microsoft Copilot.

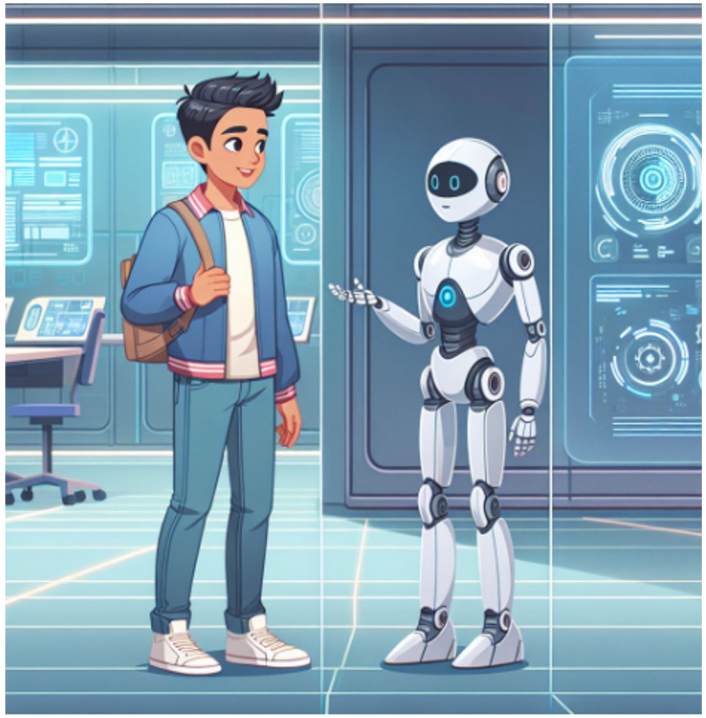


AI-generated Images

"can you generate an image to represent the idea that AI is "text paper mache", prompt, OpenAI, DALL-E 3.0, 2025

How to converse with AI

- **Prompt Engineering:**
  The process of crafting inputs into a chatbot to receive accurate, relevant and detailed responses.
- **Key Aspects:**
  Involves carefully phrasing requests to maximize AI's capabilities.
  Can include specifying information such as format, context, or desired AI behavior.
- **Purpose and Importance:**
  Helps guide the AI to generate responses that align with user needs.
  The phrasing of the request can significantly influence the quality and accuracy of the response.



“Good” AI Prompts

For a detailed explanation:

- “Can you explain the concept of string theory in physics, breaking it down simply for someone without a science background, and include an example to make it easier to understand?”

For creative writing:

- “Write a short story set in a dystopian future where technology has evolved to the point where humans can communicate telepathically, but emotions are banned.”

For generating advice:

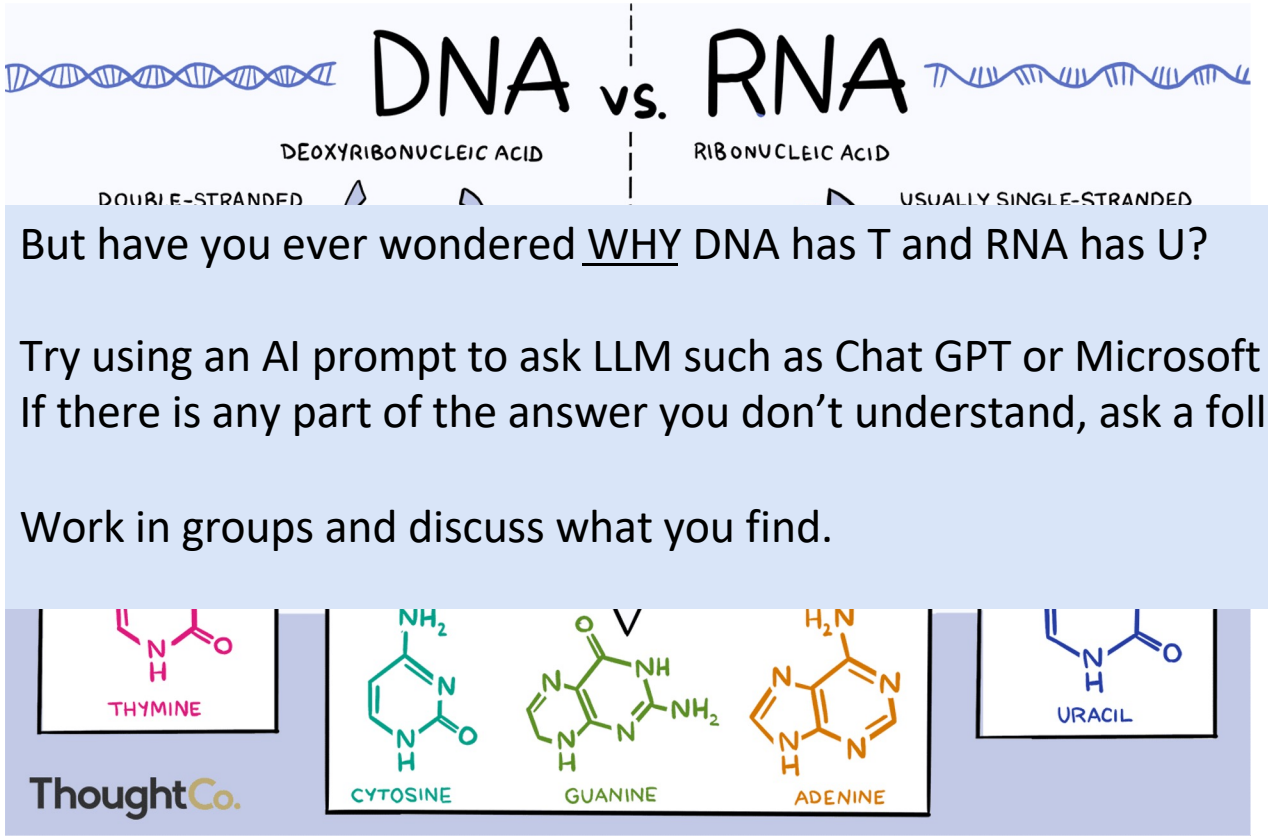
- “What are the top 5 strategies for maintaining productivity while working from home, and how can I implement them without getting overwhelmed?”

Let’s try it out.

Below is a homework question for an introductory biology class –

What would happen if RNA used the base T instead of U (like DNA does)?

Not sure? You could ask AI to answer the question for you, but before we do that, let’s imagine going back in time to yesterday’s biology lecture…



But have you ever wondered WHY DNA has T and RNA has U?

Try using an AI prompt to ask LLM such as Chat GPT or Microsoft Copilot.
If there is any part of the answer you don't understand, ask a follow up question.

Work in groups and discuss what you find.

Key Differences

bose
ribose

anded,
gle

e,
tive

4. DNA has T (thymine) base and RNA has U (uracil) base.

Why does DNA use T and RNA use U? What did you find out?

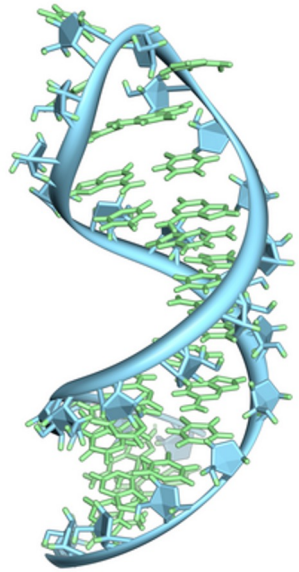
Now that we know why DNA has T and RNA has U, let's go back to the homework question.

What would happen if RNA used the base T instead of U (like DNA does)?
Which of the following answers is **FALSE**?

A) RNA synthesis would require more energy.
B) RNA structure and function could be affected.
C) DNA repair mechanisms might have trouble distinguishing RNA from damaged DNA.
D) RNA would be degraded too fast.

You can use AI to answer fundamental questions to help you understand a topic. With a better understanding of the topic, you can answer more challenging questions. Ask AI to propose a more challenging question!

Example AI Written Challenge Questions



- Why is uracil used in RNA instead of thymine, even though thymine is more stable?

- How does the presence of uracil in RNA help distinguish it from DNA in cellular processes?

- If a mutation caused DNA to use uracil instead of thymine, what problems might arise in DNA replication and repair?

Try having a discussion with AI about your answers to these questions or ask it to write a new set.