

SCIENTIFIC THINKING - SCI1020

Instructor Name: Maya Nicolas (maya.nicolas@aucegypt.edu)

Course Start Date: 09/08/2025

Current Meeting Time(s): Mon/Thu 11:30AM - 12:45PM

Course Location: SSE CP42

Office Hours: Mon/Thu 1:00PM – 2:00 PM or by appointment

Teaching Assistant: Hwaida Ali (hwaidaali@aucegypt.edu)

Catalog Course description

A survey of the pillars of science with a focus on the nature of science and the demarcation between science and pseudoscience. Types of logical reasoning, argument analysis and logical fallacies. The scientific process of investigation: Research methods, experimental design and research validity. Morals and ethics in science. Quantitative reasoning: Data analysis, graph presentation and interpretation.

Letter to students

What if every person questioned the world like a scientist? Would we be closer to the truth or just more confused?

This course invites you to explore the power and relevance of scientific thinking as a vital tool for navigating a complex world. We will grapple with some of humanity's biggest enduring questions: What is truth, and how we can truly know it? How do we distinguish between genuine knowledge and mere belief? How can we be truly skeptical without falling into cynicism? What are the limits of our understanding? How has life evolved, and what does it tell us about our place in the universe? How do myths and misinformation, even in areas like public health, shape our understanding and actions, and how can scientific thinking help us discern fact from fiction?

Through engaging discussions, hands-on activities, and real-world case studies, students will uncover how the scientific process rooted in skepticism, quantitative reasoning, and logical analysis, helps us make sound decisions, challenge assumptions, and solve meaningful problems. We will critically examine: What makes something truly scientific? How can we tell good science from bad, especially in an age of abundant information? Why does this distinction matter in our everyday lives, from making personal health choices to understanding global challenges?

You will dive into the fundamentals of research design, learn how to test the validity of scientific claims, and develop skills in interpreting and presenting data clearly and accurately. Along the way, you will confront big questions that transcend disciplines: How do we know what we know? What counts as evidence? How do biases shape the way we think and what we believe?

More than just a course in method, this is an invitation to think critically, reason clearly, and apply scientific thinking to the world around you. These skills will serve you across every field of study and throughout life, empowering you to navigate information, make informed decisions, and contribute to a more evidence-based understanding of the world.

Goals

In 3-5 years, I hope my students will:

- Understand the world through the eyes of a thoughtful skeptic, with an acute sense of criticality and contextual awareness, guided by the power of evidence.
- Build confidence in their intellectual courage and trust their ability to make decisions on how science and scientific inquiry work using the tools of science.
- Carry within them a lifelong habit of asking, “How do I know this is true?”. A question that will make them not only wiser scientists, but more thoughtful citizens, friends and human beings.

Objectives

By the end of the course, you will:

- 1) Understand what science is and is not capable of and be able to differentiate between science and pseudoscience and recognize misconceptions surrounding scientific discoveries that impact your lives and roles as global citizens.
- 2) Analyze logical arguments by identifying key components such as premises, assumptions, conclusions, and common logical fallacies.
- 3) Evaluate research validity and reliability within multidisciplinary contexts.
- 4) Interpret and analyze numerical and graphical data within multidisciplinary contexts.
- 5) Identify and use reliable resources including AI tools to enhance scientific research and inquiry.

Assessment Buckets

Midterm Exam

Frequency: 1

Value: 15%

Purpose: The midterm exam serves as a checkpoint to consolidate and apply what you've learned in the first half of the course. Particularly your ability to analyze logical and scientific arguments in addition to demonstrating an understanding of evidence-based inquiry by applying the scientific method. This exam also helps you strengthen your confidence in solving problems under time constraints and with limited guidance.

Task: You will be given 70 minutes to solve a set of problems related to argument analysis in addition to a short read that you will use to answer questions related to the scientific method.

Criteria: You will be evaluated on the accuracy and completeness of your answers.

Tips for Success: Review the materials covered in class in addition to the feedback given on quizzes and in-class activities. Use the practice links shared on Canvas.

Final exam

Frequency: 1

Value: 20%

Purpose: The final exam is intended to assess your ability to apply key critical thinking skills developed throughout the course. It will focus on your capacity to evaluate the validity and reliability of research and to interpret numerical and graphical data within a range of disciplinary contexts. This exam serves as a cumulative assessment of your understanding and application of the course's core analytical competencies.

Task: You will be working individually on a two-hour final exam.

Criteria: You will be evaluated based on the correctness and completeness of the answers.

Tips for Success: Review the materials covered in class in addition to the feedback given on quizzes and in-class activities. Use the practice links shared on Canvas.

Term Project

Frequency: 1

Value: 20%

Purpose: The purpose of this group term project is to provide you with the opportunity to demonstrate the critical thinking and scientific literacy skills developed throughout the course. By working collaboratively, you will apply these skills to explore complex issues, analyze information, and present evidence-based conclusions, reflecting your ability to engage with scientific concepts in a thoughtful and informed manner.

Task: You will work in a group to develop a scientific case study. The case study must include one section per member. Each member will provide a summary of a peer-reviewed research study, ask questions that assess its validity and provide answer key to the questions asked. This will be followed by data collected either from an experiment or a survey.

Criteria: You will be evaluated based on two rubrics that address individual and group work. Your teamwork will be evaluated based on a peer evaluation form.

Tips for Success: Start early! Assign tasks. Set timelines. Be cooperative, understanding and patient with your group members.

General Lectures

Frequency: 3

Value: 6%

Purpose: Throughout the semester, you will attend three General Lectures designed to inspire and deepen your understanding of the course learning outcomes. Each lecture will feature a guest speaker from a distinct professional background, offering unique perspectives, ideas, and experiences.

Task: Following each lecture, you will be given reflection questions asked by the speaker to respond to within three days.

Criteria: You will be evaluated on the accuracy, clarity and completeness of your answer in addition to proper citations.

Tips for Success: Pay attention and take notes during the lecture. Use your notes and online search to answer the questions in your own words. Cite your references properly.

Major assignments

Frequency: 3

Value: 15%

Purpose: Major assignments assess more than one learning objective. They are more complex than weekly homework and require more time to complete. Major assignments include:

Concept Map (5%)

Purpose: The purpose of this assignment is to develop your critical thinking and argumentation skills by constructing detailed argument maps related to one pseudoscientific claim. Through this exercise, you will learn to clearly articulate claims, support them with well-reasoned premises and co-premises, and engage with counterarguments through objections and rebuttals. By incorporating credible references, you will practice evidence-based reasoning and improve your ability to structure complex arguments.

Task: Using the MindMup software, you should produce detailed argument maps that include premises, co-premises, objections and rebuttals. Your premises must be supported using references and any other sources should be listed at the end of your assignment. Use of AI tools in this assignment is not permitted.

Criteria: You will be evaluated based on the truth of your premises, the strengths of the arguments and the citations of your work.

Tips for Success: Use credible sources to extract information. Cite the references properly. Build valid and sound arguments.

Post-debate reflection essay (5%)

Purpose: The purpose of this reflection essay is to encourage thoughtful evaluation of your experience using AI tools during debate preparation. By responding to guided questions, you will critically assess how AI contributed to or possibly limited your research and argumentation process. This reflection also aims to deepen your understanding of the role AI can play in academic inquiry, helping you consider its value, limitations, and trustworthiness as a co-debater or co-researcher in future learning contexts.

Task: Following a class debate, in an essay of 800 words, you will be answering the following questions: How did AI assist your preparation? Did AI help or hinder critical thinking? What limitations did you encounter? Would you trust AI as a co-debater or co-researcher in future?

Criteria: You will be evaluated on accuracy and clarity of answers.

Tips for Success: Be specific and honest about your experience. Reflect on thinking, not just output. Connect AI's help to a bigger picture. Use clear and organized writing.

Designing and Conducting an Experiment (5%)

Purpose: The purpose of this assignment is to develop your skills in scientific inquiry, collaboration, and communication of scientific results effectively.

Task: You will be given a hypothesis to test. You will work in a group of four to design and conduct an experiment and share your results in the form of a scientific research report and through a 10-minute oral presentation. You are also expected to answer questions from the audience.

Criteria: You will be evaluated based on your ability to: Design a well-controlled experiment with strong research validity, communicate your results confidently and work within a group. The latter parameter will be reflected through a peer-evaluation form that all group members must fill.

Tips for Success: Assign tasks to all group members. Set a timeline for task completion. Be cooperative and patient with all group members.

In-Class Activities

Value: 12%

Purpose: The in-class quizzes serve as a diagnostic tool to help both you and I gauge your understanding as the course progresses. They provide quick feedback on your knowledge of key concepts, helping identify areas that may need reinforcement. These quizzes and in-class activities are frequent and low-stakes designed to support your learning (not to penalize you) by encouraging consistent engagement with the material. They include:

Nearpod activities (3%)

Frequency: 3

Purpose: The purpose of this activities is to provide practice opportunities for students to apply and test their understanding of concepts (soundness and validity of arguments; research methods; experimental design) that were explained during class.

Task: Students will work in pairs and join an online session on Nearpod.com where they will try to answer a few MCQ questions in 10 minutes. Once the time is over, the instructor will discuss the answers in class and students will receive their grades.

Criteria: You will be assessed based on completion and accuracy of key concepts.

Tips for Success: You can access the slides and materials while doing the activity. You are expected to discuss the answers with your partner before you submit the answers.

Quizzes (7%)

Frequency: 2

Purpose: The purpose is to assess understanding, reinforce learning, and provide feedback, helping identify strengths and areas that need improvement. These quizzes are low-stakes and designed to support your learning (not to penalize you) by encouraging consistent engagement with the material.

Task: You will individually complete quizzes (30 min) during selected class sessions. These will typically include case studies and will cover topics such as: Arguments validity and soundness; Research methods; Quantitative reasoning.

Criteria: Excellence is demonstrated by a strong understanding of the material, accuracy in responses, and thoughtful engagement with each question. Students can self-evaluate by reviewing their answers for correctness, identifying patterns in mistakes, and seeking to understand the reasoning behind both correct and incorrect responses to guide future improvement.

Tips for Success: Use in-class activities as learning checkpoints. Review any incorrect answers to strengthen your understanding. Don't overthink or stress. Focus on participation and apply what you've learned. Arrive prepared by reviewing the lecture notes and your notes.

Class Debate (2%)

Frequency: 1

Purpose: The purpose is to engage students in constructive debates across a variety of topics, encouraging critical thinking skills while learning to responsibly and effectively use AI tools for research, analysis, and presentation of arguments.

Task: Following the pre-class debate preparation, students will follow the following format to debate their stance on the topic. 1) Description/Opening Statements 2) Present AI-supported arguments rebuttals 3) Address opposing arguments 4) Cross-Examination 5) Open Q&A between teams 6) Audience Q&A

Criteria: You will be evaluated based on: The validity and soundness of the arguments proposed. The clarity of the message. The professional and respectful tone. Practicing respectful time management and active listening by allowing others to express their views.

Tips for Success: Coordinate with your team to clearly divide roles and determine the specific angle or aspect each member will present. Ensure you are well-prepared by researching your arguments thoroughly and practicing your delivery in advance. Rehearsing as a group will help create a more cohesive and persuasive presentation.

Home Activities

Value: 12%

Purpose: The purpose of home activities is to help you prepare for higher order thinking class activities where a deeper discussion takes place. These activities are not expected to take longer than one hour to complete. Home activities include:

Science or Pseudoscience - Reflection (3%)

Purpose: The purpose of this activity is to develop your ability to critically evaluate pseudoscientific claims by identifying and using reliable sources to gather evidence. By investigating one claim from a provided list, you will practice distinguishing credible information from misinformation and build well-reasoned arguments. This process will culminate in a short reflection essay, where you will articulate your findings and reflect on the importance of evidence-based reasoning.

Task: You will be given a list of pseudoscientific claims where you will choose one to explore. You are expected to identify and use reliable sources to extract information that will be used to build your arguments. You will use your arguments to write a short reflection essay.

Criteria: You will be assessed on your ability to construct coherent and logically connected arguments, supported by relevant and specific examples. Proper citation of sources will also form an important part of the evaluation criteria.

Tips for Success: Explore all pseudoscientific claims before choosing one to write about. Choose examples from reliable sources such as peer-reviewed articles. Write using your own words.

MCQ (2%)

Frequency: 2

Purpose: The MCQ serves as a diagnostic tool to test students' readiness for in depth class discussions.

Task: Students will read short articles and/or watch short videos and take a 10-minute MCQ.

Criteria: You will be evaluated based on the accuracy and completeness of the answers.

Tips for Success: Prepare the materials before taking the test. Take notes. Make sure you have stable internet connection before starting the MCQ.

Case studies (4%)

Frequency: 3

Purpose: The purpose of the short case studies is to assess students' understanding and application of concepts that have been covered such as natural selection, sexual selection, Simpson's paradox.

Task: You will be given short case studies along with materials that you should prepare individually and submit before class.

Criteria: You will be evaluated based on the accuracy and completeness of the answers.

Tips for Success: Prepare the supplementary materials before you start solving the case studies. Do not wait till the last minute to work on the case studies.

Pre-class Debate preparation (3%)

Frequency: 1

Purpose: The purpose of this activity is to enhance your critical thinking, argumentation, and digital literacy skills by engaging in a structured debate on a controversial topic. By participating as part of either a Pro or Con team, you will learn to construct persuasive arguments, anticipate opposing views, and respond effectively. During the preparation phase, you will use at least one AI tool to conduct background research, explore counterarguments, clarify key concepts, and draft opening statements and rebuttals.

Task: You will be assigned a controversial topic and asked to join either Pro or Con team. Preparation Phase (Pre-class Homework): You must use at least one AI tool to: Generate background research; Explore counterarguments; Clarify concepts and definitions; Draft opening statements and rebuttals; You must submit a 1-page AI usage log explaining: What AI prompts you used; What outputs you found most useful; How you fact-checked the AI-generated content

Criteria: You will be evaluated on: The Use of AI in preparation (AI log + integration into argument); Quality of arguments and evidence; Responsiveness and critical thinking.

Tips for Success: Keep a clear and honest AI usage log. Focus on argument quality, not just quantity. Anticipate counterarguments. Practice with your group the delivery and responsiveness.

Course calendar

Date	Pre-class Preparation	In-class Work	Learning Objective
Lecture: Monday 08/09/2025 <i>Getting to know each other!</i>		Who am I as your instructor, and who are you as future scientific thinkers? How can our shared strengths and diverse backgrounds, help us build a supportive and engaging learning team?	
Lecture: Thursday 11/09/2025 <i>How do we know what we know?</i>	2 videos and 1 article about: Skepticism, Empiricism, Rationalism.	Lecture, activity and case study discussion about Skepticism, Empiricism, Rationalism	LO 1
Lecture: Monday 15/09/2025 <i>How do we differentiate between science and pseudoscience?</i>	2 videos and 1 article about: demarcation and falsifiability. - MCQ 1%	- Lecture, 2 class activities - Assign homework: Science and pseudoscience reflection 3% (due 18/09/2025)	LO 1, 2 & 5
Lecture: Thursday 18/09/2025 <i>The different types of logical reasoning</i>	2 videos and 1 article about: Induction, deduction, abduction	Lecture and In-class exercises	LO 2
Lecture: Monday 22/09/2025 <i>Validity and Soundness</i>	1 video and 1 article about: Valid and sound arguments	Lecture and In-class exercises	LO 2
Lecture: Thursday 25/09/2025	3 short readings about Inference and assumptions	Lecture and In-class exercises	LO 2

Date	Pre-class Preparation	In-class Work	Learning Objective
<i>Inference, assumptions and argument analysis</i>			
Lecture: Monday 29/09/2025 <i>Diagramming arguments</i>		Lecture and In-class exercises	LO 2
General Lecture I: Tuesday 30/09/2025 GL reflections 2% due Friday 03/10/2025			
Lecture: Thursday 02/10/2025 <i>Diagramming arguments</i>	Prepare argument mapping practice exercises	- Discuss the practice exercises - AI tools and argument mapping - Assign Major Assignment 1: Argument Map 5% (due 09/10/2025)	LO 1, 2 & 5
Lecture: Monday 06/10/2025 <i>Logical Fallacies</i>		- Quiz 1 3% (logical reasoning and argument mapping) - Logical Fallacies Discussion and in-class activities	LO 2
NO Lecture: Thursday 09/10/2025			
Lecture: Monday 13/10/2025 <i>Research hypothesis, question and methods</i>	2 readings and 3 videos - MCQ 1%	- Lecture - Case study: The great parking debate	LO 3
General Lecture II: Tuesday 14/10/2025 GL reflections 2% due Friday 17/10/2025			

Date	Pre-class Preparation	In-class Work	Learning Objective
Lecture: Thursday 16/10/2025 <i>Experimental design</i>	Case study 1.5%: The exaggerated traits of widowbirds	Case study discussion	LO 3
Lecture: Monday 20/10/2025 <i>Experimental design</i>	Case study: Mom likes you better	Case study discussion	LO 3
Midterm Exam 15%: Tuesday 21/10/2025 (11:30 AM – 1:00 PM) in Mary Cross Hall			
NO Lecture: Thursday 23/10/2025			
Lecture: Monday 27/10/2025		- Midterm Exam discussion - Term Project announcement	
Lecture: Thursday 30/10/2025 <i>Research validity</i>	4 readings	Lecture and in-class exercises	LO 3
Lecture: Monday 03/11/2025 <i>Research ethics</i>	Prepare research validity practice exercises	- Discuss research validity practice exercises - Lecture research ethics - Assign the debate (due Monday 10/11/2025)	LO 3
Lecture: Thursday 06/11/2025 <i>Simpson's paradox</i>	1 video	Case study: The case of two-faced data	LO 4
Makeup Lecture: Saturday 08/11/2025 <i>Central tendency statistics</i>	1 video	Lecture and in-class exercise about Median, Mean and Mode	LO 4

Date	Pre-class Preparation	In-class Work	Learning Objective
Lecture: Monday 10/11/2025 <i>Class debate</i>	Pre-class debate preparation 3%	- Class Debate 2% - Assign Major Assignment 2: Post-debate reflection 5% (due 17/11/2025)	LO 1, 2, 3 & 5
General Lecture III: Tuesday 11/11/2025		GL reflections 2% due Friday 14/11/2025	
Lecture: Thursday 13/11/2025 <i>Data distribution and p-value</i>	1 video - Case study 1%: En Garde! Animal structures and what they mean	- Lecture and in-class exercises about error bars and p-value - Discuss case study	LO 4
Lecture: Monday 17/11/2025 <i>Data representation and visualization</i>		- Lecture and in-class exercises about misleading graphs - Introduction to FlourishAI	LO 4 & 5
Lecture: Thursday 20/11/2025 <i>Data representation and visualization</i>	Case study 1.5%: I scream for ice cream	- Discuss case study - FlourishAI and data analytics - Assign Major Assignment 3: Designing and conducting an experiment 5% (due 01/12/2025)	LO 4 & 5
Makeup Lecture: Saturday 22/11/2025 <i>What is life? When & where it started?</i>		- Quiz 2 4% (Research validity and data interpretation) - Lecture: What is life? When and where it started?	LO 3, 4 & 1
Lecture: Monday 24/11/2025	2 videos	Lecture	LO 1& 4

Date	Pre-class Preparation	In-class Work	Learning Objective
<i>Natural and sexual selection</i> <i>Genetic flow and genetic drift</i>		- Case study: The Galapagos finches - Activity: Tuberculosis in a Russian prison	
NO Lecture: Thursday 27/11/2025			
Lecture: Monday 01/12/2025		Assignment 3 presentation	LO 3 & 4
Lecture: Thursday 04/12/2025 <i>Tree of life</i>		- Lecture: Explain how to read a cladogram - Activity: NOVA lab	LO 1 & 4
Lecture: Monday 08/12/2025			
NO Lecture: Thursday 11/12/2025 Term Project submission 20%			
Final Exam 20%: Saturday 20/12/2025 (5:30 PM – 7:30 PM) in TBA			

Course Information and Policies

Communication Procedures:

The instructor will respond to all questions via email within 24 hours. It is required that students use their official AUC email for communication. Students are expected to frequently check Canvas for announcements and assignments.

Course Materials:

This course has no textbook. Instead, you will be assigned weekly readings and/or videos that you are expected to prepare before every class. The course includes case studies and critical thinking exercises to enhance the learning process, hence attendance is extremely important. In class quizzes will be delivered to enhance continuous studying

and evaluate the students' understanding of the material. Some activities will be group-work activities to enrich teamwork skills and collaboration.

General Lecture

This course includes three general lectures that will be held on three Tuesdays at 11:30 AM at Bassily Hall. Attendance is mandatory! Doors close at 11:40 AM, and you won't be permitted inside the auditorium if you arrive late. Leaving the General Lecture once it has begun is not permitted – if a student must leave, they may not re-enter the lecture, nor receive credit for the lecture. Cell phone use is not permitted during the lecture. On regular weeks the class runs for 75 minutes, however on weeks when there is a general lecture the class time will be reduced by 25 minutes. Students missing the General Lecture, will not earn the 2% allocated for the General Lecture question.

Important Note about Grade

Final letter grades will be assigned based on a curve. This is designed to ensure fairness, while creating a challenging and stimulating learning environment. The class average is set to B. If you have questions about your grades during the course, please set up a meeting with me. If you are concerned about earning a “good grade” in class, do not wait until the end of the semester, or after final grades are posted to talk with me. At any point of the semester, I am more than happy to discuss and explain but NOT negotiate your grade.

Attendance Policy

- * Attendance will be taken at the beginning of every session. The policy at AUC allows a maximum of the equivalent of three weeks of absences. A student who misses more than the three-week equivalent of class sessions will fail the course.
- * Missing more than 15 minutes of a class counts as half of an absence and missing more than 30 minutes of a class counts as a full absence.
- * Students are responsible for the work done, and the announcements made in class during their absence.
- * There will be **no** makeup for missed in-class quizzes/activities, unless an email is sent from the Dean of Students.

* No makeup exams will be given except for serious medical conditions or immediate family hardship, and the professor should be notified before **(not after)** the exam. Failure to take a scheduled exam will result in a **zero** being recorded for that exam.

Late Work Policy

During class sessions, you will interact with me, your fellow students, and course content in a variety of ways. To make best use of our time together, it is important that you prepare for class and complete all assignments on time. Assignments are always due before class. Completing assignments on time is important since these will often set up the day's activities. To encourage you to keep up, I accept late assignments. However, there will be a **20%** grade deduction for each calendar day of delay. **No** work will be accepted after three days post the due date. Please note that I do **not** give assignments for extra credit. You shouldn't view this as a penalty, though. It is simply a reminder of the importance assignments play in your and your classmates' learning.

Honor and Academic Integrity Policy

An electronic copy of major assignments **must** be submitted on Turnitin.com before the assignment due date. You will be allowed to view your 'originality report', and it is your responsibility to check and make appropriate changes.

The use of artificial intelligence (AI) tools and applications is permitted for assignments in this course only ***if instructor permission is obtained in advance***. **Unless permission is granted, each student is expected to complete each assignment without the use of AI tools.** Relying on AI in this course to create and develop content is **prohibited**. When permission is granted, students are expected to properly acknowledge and cite their use. If you have any questions about how to properly document AI use, it is your responsibility to ask. Non-approved use of AI tools or failure to acknowledge/cite approved use are considered violations of AUC's Code of Academic Ethics and will be reported.

In accordance with the AUC's efforts to promote a culture of [academic integrity](#) on campus, the Core Curriculum and this course strictly enforces the academic integrity principles found in [AUC's Code of Academic Ethics](#). Violations of academic integrity can lead to serious consequences, including failing the course, all the way up to suspension or expulsion.

Scan the QR code to read further details about academic integrity:



Special Needs, Concerns, or Additional Support

We want all students to be treated in a fair and equitable manner, and to receive the necessary support for academic success. Students who have special needs or concerns about the class should talk to their instructors the first week of classes or as soon as possible. Students requesting accommodations from their instructors must first provide documentation from AUC's [Center for Student Well-being](#) (CSW). Reasonable accommodations for students are made starting from the date the instructor receives the official documentation (accommodations are not applied retroactively). AUC complies with the American Disabilities Act of 1990 and Section 504 of the Federal Rehabilitation Act of 1973.

Visit the link below or scan the QR code to read further details about special needs, concerns or additional support:



Enjoy the semester and good luck 😊