

University of Houston-Downtown

Course Prefix, Number, and Title: NS 1300: Emergence of Modern Science

Credits/Lecture/Lab Hours: 3/2/2

Foundational Component Area: Life and Physical Sciences

Prerequisites: Credit or enrollment in ENG 1301

Co-requisites: None

Course Description: An integrated lecture/laboratory course for non-science majors. This course will focus on the emergence and practice of the scientific method, major scientific discoveries and their role in the development of modern science and society. The course will illustrate how scientists observe, develop questions and interpret the natural world in an integrated manner across all disciplines of science. Students will also explore how science influences the worldview of culture, the role of politics, ethics and technology in the development of science. Various ethical issues such as nuclear energy, genetic engineering, land abuse and population pressures will also be discussed. Lab sessions will focus on making and interpreting the measurements of natural phenomena.

TCCNS Number: N/A

Demonstration of Core Objectives within the Course:

Assigned Core Objective	Learning Outcome Students will be able to:	Instructional strategy or content used to achieve the outcome	Method by which students' mastery of this outcome will be evaluated
Critical Thinking Empirical & Quantitative Reasoning	Utilize scientific processes to identify questions pertaining to natural phenomena.	Hypothesis Testing: M&M Statistics – students will form hypotheses questioning the Mars company's claims about color distribution. Climate Change Summit – students will examine evidence of global warming from multiple sources and develop an argument for action based on the data they collect. FDA Panel Discussion: Food Guide Pyramid - Students will design a meal plan based on guidelines from the FDA, follow their plan for one	Students will work in teams to complete a Chi square analysis of M&M color distribution to test their null hypothesis. Teams will complete a worksheet showing their calculations. (The worksheet is included in Appendix 3.) Students will write position papers from the perspective of different stakeholders and then defend their positions in a

		<p>week, and then report on their experience.</p> <p>CDC Panel Discussion: Bioethics - Students will each identify an issue in bioethics that can be studied using the scientific method or is the result of scientific misconduct.</p> <p>Caminalcules – students will use morphologic and behavioral clues to classify organisms into a taxonomic hierarchy. Students will then construct a phylogenetic tree from the fossil record and compare the outcomes of each process.</p> <p>Rube Goldberg Machines - Students will work in teams to construct Rube Goldberg Machines to accomplish an assigned task by applying physics principles.</p>	<p>town hall style forum. Students will use visual aids as appropriate for their presentations. Position papers will be assessed using a rubric. (The rubric is included in Appendix 3.)</p> <p>Students will make oral presentations with visual aids which will be assessed using a rubric. (The rubric is included in Appendix 3.)</p> <p>Students present their issue to the class and explain why the issue is important. The class will select one issue from those presented and discuss the issue on an online forum. The level of individual engagement in the discussion will be assessed and assigned a grade.</p> <p>Students will work in teams and use morphologic clues to categorize Caminalcules into taxonomic groups. Teams will then test these “hypotheses” by constructing a phylogenetic tree from the Caminalcule fossil record. Both results will be turned and graded.</p> <p>Teams will demonstrate their machines to the class and explain the principles</p>
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			that went into their design decisions. Presentations will be assessed using a rubric. (The rubric is included in Appendix 3.)
<p>Critical Thinking</p> <p>Empirical & Quantitative Reasoning</p>	Utilize scientific processes to develop hypotheses, collect and analyze data using quantitative and qualitative measures.	<p>Hypothesis Testing: M&M Statistics – students will form hypotheses and apply statistical methods to data collected in a group activity.</p> <p>Caminalcules – students will use morphologic and behavioral clues to classify organisms into a taxonomic hierarchy. Students will then construct a phylogenetic tree from the fossil record and compare the outcomes of each process.</p>	<p>Students will work in teams to complete a Chi square analysis of M&M color distribution to test the Mars Company's claims. Teams will complete a worksheet showing their calculations. (The worksheet is included in Appendix 3.)</p> <p>Students will work in teams and use morphologic clues to categorize Caminalcules into taxonomic groups. Teams will then test these "hypotheses" by constructing a phylogenetic tree from the Caminalcule fossil record.</p>
<p>Critical Thinking</p> <p>Empirical & Quantitative Reasoning</p> <p>Communication</p>	Utilize scientific processes to effectively communicate the analysis and results using written, oral and visual communication.	<p>Climate Change Summit – students will examine evidence of global warming from multiple sources and develop an argument for action based on the data they collect.</p> <p>FDA Panel Discussion: Food Guide Pyramid - Students will design a meal plan based on guidelines from the FDA, follow their plan for one week, and then report on their experience</p> <p>CDC Panel Discussion: Bioethics - Students will each identify an issue in bioethics that can be studied using the scientific method or is the result of scientific misconduct.</p>	<p>Students will write position papers from the perspective of different stakeholders and then defend their positions in a town hall style forum. Students will use visual aids as appropriate for their presentations. Position papers will be assessed using a rubric. (The rubric is included in Appendix 3.)</p> <p>Students will design a meal plan based on guidelines from the FDA, follow their plan for one</p>

			<p>week, and then report on their experience. Students will make oral presentations with visual aids which will be assessed using a rubric.</p> <p>Students will each identify an issue in bioethics and then present their issue to the class. The class will select one issue from those presented and discuss the issue on an online forum. The level of individual engagement in the discussion will be assessed and assigned a grade.</p>
Teamwork	Collaborate in the evaluation of the quality of scientific evidence from multiple perspectives toward the goal of reaching a shared objective.	<p>Climate Change Summit – students will examine evidence of global warming from multiple sources and develop an argument for action based on the data they collect.</p> <p>CDC Panel Discussion: Bioethics - Students will each identify an issue in bioethics that can be studied using the scientific method or is the result of scientific misconduct.</p> <p>Anthropic Cosmological Principal: The Nature of Reality – Students will watch a presentation about the nature of consciousness and discuss how well they know their own minds in groups. Groups will then find challenging problems, such as optical illusions, selective attention tests, magic tricks, and artistic devices that “trick” the mind.</p> <p>Physics of the Impossible - Students will identify one scientific</p>	<p>Students will write position papers from the perspective of different stakeholders and then defend their positions in a town hall style forum. Students will use visual aids as appropriate for their presentations. Position papers will be assessed using a rubric. (The rubric is included in Appendix 3.)</p> <p>Students will each identify an issue in bioethics and then present their issue to the class. The class will select one issue from those presented and discuss the issue on an online forum. The level of individual engagement in the discussion will be assessed and assigned a grade.</p>

		question which they believe is currently impossible to answer, research the issue to find out if it is indeed impossible, and then report their findings to the class.	<p>Groups will design their own puzzles and challenge their classmates to complete their puzzles. The puzzle will be graded based on originality and success in demonstrating an aspect of consciousness which can be studied scientifically.</p> <p>Students will make oral presentations with visual aids which will be assessed using a rubric.</p>
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Additional Course Outcomes:

Students will:

- utilize the scientific process to identify questions pertaining to natural phenomena;
- develop hypotheses;
- collect and analyze quantitative and qualitative data;
- collaborate in the evaluation of the quality of scientific evidence from multiple perspectives toward the goal of reaching a shared objective; and
- communicate analyses and results using written and oral communication.

After completing this course, students will:

- understand the scientific process and how problems are solved in science;
- understand how science provides explanation of cause and effect relationships in natural phenomena;
- be able to apply scientific reasoning to observations of natural phenomena;
- understand the history of important concepts in the natural sciences;
- understand how science is perceived by society, how the history of science and our modern world are intertwined, and how science continues to impact society today;
- be able to distinguish arguments that are based on scientific reasoning versus those that are not.

Course Topics:

Topics for the Week	Related Lab/Discussion Topic
<p><u>Explanation: It's Only a Theory</u></p> <p><u>Theories of explanation: Standing on the Shoulders of Giants</u></p> <p>Scientific method</p> <p>Theories and grand unifying theories</p>	<p>Hypothesis testing: M&M Statistics</p> <p>Lab Discussion Topic: Science in the news – where science, society, and politics meet</p>

<u>Why Study Science – The Philosophy of Science</u> Pure and applied science What is science (and what is not) Science Literacy	Discussion Board Topic: Questions No One Knows the Answers To
<u>Cosmology</u> The structure of the universe Our sun The origin of the earth <u>Plate Tectonics</u> Continental drift / biogeography Magnetic reversals / sea-floor spreading Orogeny	Hopscotch through Geologic Time: <u>Historical Geology</u> Lab Discussion Topic: Are we currently experiencing a mass extinction event? Discussion Board Topic: Is the Earth the Only Place Where Life has Evolved? (Sign Rock Walk Release Form)
<u>Natural Resources</u> Mineralogy Landscapes Oceans <u>The Rock Cycle</u> Igneous processes Volcanoes and Earthquakes Metamorphic Processes Sedimentary Processes	Rock Walk through Downtown Houston (Guide) Discussion Board Topic: To Boldly Go (Where Do You Want to Go?) (Assign Climate Summit Roles)
<u>Air and Water</u> Earth's fresh water Weather and climate <u>Nutrition</u> Industrial revolution From the green revolution to Food.inc	<u>Climate Change:</u> Climate Summit (Oral Presentations and Class Debate) Discussion Board Topic: Encyclopedia of Life (Assign FDA Challenge)
Exam #1 <u>The Biodiversity Crisis</u> Population ecology Ecosystems and biomes	FDA Panel on the Food Guide Pyramid: <u>Organic Chemistry</u> Student Presentations and Discussion Additional Lab Discussion Topic: What was wrong with the old food guide pyramid? Discussion Board Topic: How Much is Too Much? (The story of BPA)

<p><u>Darwin versus Aristotle and Plato</u> The Enlightenment Natural Selection The Fact and Theory of Evolution</p> <p><u>The New Synthesis</u> Molecular genetics and the Human genome project Human Evolution Emergence (complexity theory)</p>	<p>Caminalcules</p> <p>Lab Discussion Topic: What is a species, and how do new species evolve?</p> <p>Discussion Board Topic: The Evolution of Compassion</p> <p>(Assign Bioethics Challenge)</p>
<p><u>Classic & Molecular Genetics</u> Laws of Inheritance: Mendel to Dobzhansky: Peas to Flies Watson, Crick, Franklin and DNA Nature vs. Nurture</p> <p><u>Mismeasure of Man</u> The concept of race / the Bell curve Out of Africa hypothesis Guns, Germs, and Steel</p>	<p>CDC Panel Discussion: Bioethics (Oral Presentations and Class Debate)</p> <p>Lab Discussion Topic: Are We Ready for Neo-Evolution?</p> <p>Discussion Board Topic: Can Science Answer Moral Questions?</p>
<p><u>Consciousness</u> How the brain works TED.com: Jill Bolte Taylor – My stroke of insight</p> <p><u>Memory</u> How memory works The man who mistook his wife for a hat Can you improve your memory?</p>	<p>Game Theory: The Prisoner's Dilemma</p> <p>Lab Discussion Topic: Can we know our own minds?</p> <p>Discussion Board Topic: The Divided Brain</p>
<p><u>Medicine</u> Modern medicine The cell</p> <p><u>Longevity and Health / Biotechnology</u> Cloning, genetic engineering, GMOs, and cyborgs Do you want to live forever?</p>	<p>Consciousness Puzzles</p> <p>Lab Discussion Topic: The Nature of Reality - (Anthropic Cosmological Principle)</p> <p>Discussion Board Topic: Who Are We, Really?</p>
<p>Exam #2</p> <p><u>Classical Physics</u> Newton's laws and simple machines The importance of scale / perspective Reverse Engineering the Universe:</p>	<p>Rube Goldberg Machines</p> <p>Discussion Board Topic: How Simple Ideas Lead to Scientific Discoveries</p> <p>(Assign Brave New World)</p>
<p><u>Energy</u> Mechanical energy Heat, chemical, and electromagnetic energy</p>	<p>Lab Discussion Topic: Brave New World (Oral Presentations and Class Debate)</p>

<p>Energy transformations / thermodynamics</p> <p><u>General and Special Relativity</u> (wherefore art thou gravity?) Space-time Speed limit of the universe (light) Relativistic effects</p>	<p>Discussion Board Topic: Is the Universe Actually Made of Information?</p>
<p><u>E=mc²</u> Matter and energy Conservation of mass and energy <u>Particle Zoo</u> Standard model Field theory TED.com: Brian Cox – An inside tour of the world’s biggest supercollider</p>	<p>Kitchen Chemistry: Making Oobleck & Gak - <u>Materials Science</u></p> <p>Lab Discussion Topic: Is big science worth the cost?</p> <p>Discussion Board Topic: Shedding Light on Dark Energy</p>
<p><u>Quantum Mechanics</u> Double-slit experiment Heisenberg’s uncertainty principle / Schrodinger’s box Spooky action at a distance Is the Moon Really There If Nobody Is Looking? Quantum Computing and Quantum Interrogation</p> <p><u>The Search for the Unified Theory</u> The Ouroboros The first three minutes / seconds TED.com: Brian Greene – The universe on a string Sir Martin Rees – Is Earth in its Final Century?</p>	<p>Lab Discussion Topic: Is Time an Illusion? (Assign Future Shock Challenge)</p> <p>Discussion Board Topic: The coming Singularity</p>
<p>Future Shock Exponential rate of progress What problems have we solved? What problems lie ahead?</p> <p>Exam #3</p> <p>Final Exam</p>	<p>Lab Discussion Topic: Physics of the Impossible (Oral Presentations and Class Debate)</p> <p>Discussion Board Topic: Is This Earth’s Final Century?</p>

Grading/Course Content which Demonstrates Student Achievement of Core Objectives:

Course Grade **A: 90-100** **B: 80-89** **C: 70-79** **D: 60-69** **F: 0-59**

Summary of Course Exams, Quizzes, Activities, and Final	
Lecture Exams	300 pts
Quizzes	100 pts
Discussion Board	100 pts
Participation (oral and visual presentations)	100 pts
Lab Projects	200 pts
Final Exam	200 pts
Total	1000 pts