Science and pseudoscience: Why do so many people believe nonsense?
Arts and Sciences 1138
Autumn Semester 2021
Semester hours: 1

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Office hours: Thursdays, 1:00 – 3:00 p.m.

Course description

Most science education up through high school focuses on the results of science, meaning the facts we have uncovered about the physical universe. Often missing is a careful look at the process of science. How do we make reliable, repeatable observations? How do we learn about the way physical processes operate? How do we resolve scientific disputes, and how are new results accepted by the community?

In this seminar, we will explore these issues by focusing on three case studies of pseudoscience, broadly defined as topics which sound scientific but aren't. These case studies will come from the discipline of astronomy and will concentrate on three ideas with large communities of believers: the Flat Earth, astrology, and UFOs. While we will spend some time on the evidence that these belief-systems are factually incorrect, our focus will be to understand how people holding these beliefs think about evidence, and whether they follow thought processes that are similar (or not) to those employed in science.

Requirements

1. Attend each meeting and participate in class discussions.
2. Write a short (approximately 3 page) reflection paper on each of the three case studies.
3. Write a longer essay, approximately 10 pages, at the end of the semester. This will consist of a resource guide for future learning on a selected scientific or pseudoscientific topic.

All reading will consist of on-line resources.

The seminar targets first-year students in any STEM discipline.

Grading: S/U

Weekly plan

Week	Topics	Reading/reflection
1	Introduction to the seminar Expectations Overview of case studies	Why Trust Science (book review and interview). Reference [1] below.
The Flat Earth: believing in the impossible		
2	Flat-Earth 'theories' - History - Explosive growth in social media	Are Flat-Earthers Being Serious? [2]
3	Astronomical evidence - Centuries of indirect evidence - Direct proof from 1830 onward - Parsimonious theories and physical principles	How Does Foucault's Pendulum Prove the Earth Rotates? [3]
4	The nature of conspiracy theories - Belief that authorities manufacture or suppress evidence - Confirmation bias	The Conspiracy Theory Detector [4] Confirmation Bias [5]
5	How research works - Data and interpretation - The criterion of falsifiability - The word 'theory' in scientific and everyday speech	
Astrology: it could be true but isn't		
6	How astrology works - "As above, so below" - Eastern and Western astrology - "Real" astrology vs. newspaper horoscopes *First reflection paper due*	Astrology and Astronomy [6] A tour of astrological information on the Web Almanacs and astronomical calculators
7	The appeal of astrology - Establishing connectedness to the Universe - Safety, luck, and making good decisions - Reducing uncertainty about the future	Open investigation: celebrities who believe in astrology.
8	Why astrology fails as a science - No evidence for astrology's truth claims - No plausible physical mechanism that explains the evidence - No process for evaluating evidence and resolving disputes	Astrology: Is it Scientific [7]
9	Is astrology a form of prejudice? - Does knowing someone's sign mean you are pre-supposing something about them?	The Link Between Astrology and Prejudice [8]
UFOs and the Search for Extraterrestrial Intelligence (SETI)		
10	History of the UFO phenomenon - Cold-war scares	UFOs and the Cold War [9] Selected scenes from famous Sci-Fi films

	- What space aliens are supposed to be like *Second reflection paper due*	
11	How evolution works - Inevitable errors in copying and reproduction - Populations and the environment - Historical contingency	Understanding Evolution [10]
12	Expectations for the frequency of intelligent life - What we know about other planetary systems - The Drake equation as a thought-guide - The vastness of space and time	The Drake Equation [11] A tour of exoplanets.org
13	Current efforts in SETI - How one would recognize life / intelligence	SETI research [12]
Final essays		
14	Overview of topics to choose from How to gather good resources and summarize them *Third reflection paper due*	
15	How to write a good short essay - creating a story board - references and citations	

The final essay will be due one week after our last class meeting.

Readings

1. Why Trust Science (Book review and interview with Naomi Oreskes)
   https://news.harvard.edu/gazette/story/2019/10/in-why-trust-science-naomi-oreskes-explains-why-the-process-of-proof-is-worth-trusting/
2. Are Flat-Earthers Being Serious? (Live Science)
   https://www.livescience.com/24310-flat-earth-belief.html
3. How Does Foucault's Pendulum Prove the Earth Rotates? (Smithsonian Magazine)
   https://www.smithsonianmag.com/smithsonian-institution/how-does-foucaults-pendulum-prove-earth-rotates-180968024/
4. The Conspiracy Theory Detector (Scientific American)
   https://www.scientificamerican.com/article/the-conspiracy-theory-director/
5. Confirmation Bias (Encyclopedia Britannica)
   https://www.britannica.com/science/confirmation-bias
6. Astrology and Astronomy (Lumen Learning Courses)
   https://courses.lumenlearning.com/astronomy/chapter/astrology-and-astronomy/
7. Astrology: Is it scientific? (Understanding Science)
   https://undsci.berkeley.edu/article/astrology_checklist
8. The Link Between Astrology and Prejudice (Center for Inquiry)
   https://centerforinquiry.org/blog/the_link_between_astrology_and_prejudice/

9. UFOs and the Cold War (The History Press)
   https://www.thehistorypress.co.uk/articles/ufos-and-the-cold-war/
10. Understanding Evolution (UC Berkeley)
    Selected pages, for example Welcome to Evolution 101!
    https://evolution.berkeley.edu/evolibrary/article/evo_01
11. The Drake Equation (SETI institute)
    https://www.seti.org/drake-equation-index
12. SETI research (SETI institute)
    https://seti.org/seti-research

Biographical Statement

Professor Terndrup joined the Ohio State faculty in 1990. He is an observational astronomer focused on the characterization of stars and stellar systems, with an emphasis on their abundances and rotation rates. He is known for his work on the structure and stellar population of the Galactic bulge, the angular momentum of low-mass stars in the Pleiades and Hyades, the distances to open clusters, and the structure of spiral galaxies. In recent years, he has been investigating the outflows from quasars, which are massive black holes in the centers of large galaxies. From 2008 to 2012 he served as the Program Director for the Stellar Astronomy and Astrophysics Division at the National Science Foundation.

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It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct http://studentlife.osu.edu/csc/.

Students with Disabilities

Students with disabilities (including mental health, chronic or temporary medical conditions) that have been certified by the Office of Student Life Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office of Student Life Disability Services is located in 098 Baker Hall, 113 W. 12th Avenue; telephone 614-292- 3307, slds@osu.edu; slds.osu.edu.