PHYS 110

Science and Pseudoscience

Class: MWF 11:00-11:50

Instructor:	Michael Lerner
Office:	CST 213
E-mail address:	mglerner@gmail.com
Office hours:	TBD
	Also, whenever office door is open.
Website:	Moodle
Textbooks:	"Why People Believe Weird Things" Michael Shermer
	"what if?" Randall Munroe
	"A Mind of Its Own: How your Brain Distorts and Deceives" Cordeila Fine
	"How to Win Every Argument: The Use and Abuse of Logic" Madsen Pirie

Course Description:[1] What is pseudoscience, and how can we distinguish it from science? Why do people believe in mind reading? Alien abduction? Human-induced climate change? Perpetual motion machines? You will develop an understanding of what exactly it is that we call "science," and the critical thinking skills necessary to evaluate (and debunk!) outlandish claims on your own.

Note: This class is uses a "team-based learning" model, and several "flipped" components; the most important parts of learning happen in class, and missing class will hurt you.

Course Structure: This three-credit course will meet three times per week. The team-based structure is described in more detail below, but you'll find yourself doing a lot of reading outside of class, and a lot of practical work based on that reading in class. A common standard in academia is that students should devote 3 hours per week for each "hour" of credit. Consequently, you should expect to spend up to 9 hours per week (including class time) on this 3-credit course. This means 6+ hours per week of reading and homework!

Course Objectives: As an outcome of this course:

1. Students will be able to articulate a well-formed definition of science, explaining how science models the universe as well as its limitations.
2. Students will be able to articulate well-formed definitions of pseudoscience and superstition, clearly delineating between these and science.
3. Students will be able to explain why many discredited ideas survive, and why people continue to believe ideas that have been shown to be false.
4. Students will be able to identify standard types of "bad arguments," and to win debates against those arguments.
5. Starting from raw data, students will construct a scientific argument related to climate change.
6. Given a team setting, students will help build a constructive and creative team climate.

[1] Thanks to Alan Peel for content ranging from syllabus material to individual assignments. Thanks to Heather Lerner for TBL structure. Thanks to Brian R. Hall and Adam D. Light for this syllabus template.

Your final grade will depend on three factors: Individual Performance, Team Performance, and Peer Evaluation. Point assignments are listed below. Your Team Performance score will be modified by a Peer Evaluation Score, which is determined by an end-of-course peer evaluation that will be informed by your weekly team evaluations.

Grade Distribution:

Individual Performance	55%	Team Performance	45%
iRATs	15%	tRATs	5%
Homework	10%	Application Activities	25%
Papers	30%	Final Project/Presentation	15%

Letter Grade Expectations:

>= 93.00	A	73.00 - 76.99	C
90.00 - 92.99	A-	70.00 - 72.99	C-
87.00 - 89.99	B+	67.00 - 69.99	D+
83.00 - 86.99	B	63.00 - 66.99	D
80.00 - 82.99	B-	60.00 - 62.99	D-
77.00 - 79.99	C+	<= 59.99	F

Exceptional work throughout the semester can earn an A+ (both A and A+ read as 4.0).

Peer Evaluation Score: At the end of the semester, you will evaluate the contributions made by each of your teammates. You will distribute 100 points among your teammates. Team members who contributed more should receive more points than team members who contributed less. For example, in a team of 4 (Mary, Susan, Allen, Peter), Mary may receive the following scores: 30 from Susan, 34 from Allan, and 31 from Peter. Thus, Marys Peer Evaluation Score is 30 + 34 + 31 = 95. The Peer Evaluation Score is used to adjust the Team Performance Score. In the example above, Mary will receive 95% of her Teams Total Performance Score. The entire class will determine the minimum (min) and maximum (max) limits for the Peer Evaluation Score.

Homework, papers, projects: Here are some brief notes on the work we'll be doing:

- Homework will be a series of short answer questions to prime you for class discussions.
- With 16 weeks of class, we'll divide into roughly seven two-week units. For each of these, you'll write a short (1-2 page) reflection paper. The theme of the reflection paper will vary, with some focusing on general thoughts, and some on specific arguments/thoughts from the units.
- One of the units will involve a data-based climate change project. That will be a group project, and will count towards application activities.
- You will have group projects and 15-minute presentations on a pseudoscientific topic *not* covered in the class.

Climate Change: The Joseph Moore Museum is hosting a public event exploring climate change through art and science. You will get the chance to present your data-based projects to the public. By "chance" I mean "attendance is required" ... contact me well in advance if you have a prior commitment.

Late Work: For most assignments, no late work will be accepted without prior authorization. If you are going to be absent, make sure someone else can turn in your homework for you, or scan it and email it to me. If you can document a severe illness, we can make arrangements for you to complete your work. For the larger assignments (i.e. things more substantive than the reflection papers), we'll discuss the policy. The general guideline will be that you can turn it in on the official due date for up to 100% credit. You'll be given the option to turn it in two class days late for up to 80% credit, and up to a week late for up to 50% credit.

Communication: I think it's easiest to communicate face to face and by email. I will probably send a class email if anything comes up (i.e. there is a change or mistake in an assignment) so check your email every day. I will do the same and will generally respond within 24 hours. You will have a better chance of getting a quick response if you identify yourself, write complete sentences about your question or issue, and send your message during regular business hours.

Office hours are regularly scheduled times for you to come in and chat. If you need to meet with me outside of that time, the best way is to schedule an appointment by email. I'm often in my office during the week, so feel free to drop by. If I am in a web meeting or have an appointment with another student, I may have to ask you to come back later. Please don't take this personally!

Athletic or religious absences: I understand that those of you who are althetes have particularly large constraints on your time. If you must miss class for athletic competition, please notify me well in advance (more than two weeks) so we can make arrangements that allow you to learn what you may have missed in class.

Similarly, if you know that you will miss class because of a religious observance, please notify me well in advance (more than two weeks) so that we can make arrangements that allow you to learn what you may have missed in class.

Academic Integrity: My goal is to help you grow as people. I will provide tools that I think will help you, but learning is something to which you, yourself, must commit.

The College trusts students who enroll at Earlham to be honest seekers of truth and knowledge. This trust is extended to all students by other students and by teachers, and is manifested in a variety of forms. Exams are rarely proctored, and then usually after consultation with the class and the Academic Dean or Associate Academic Dean. Unlike many colleges and universities, Earlham does not ask students to sign an oath affirming that they did not cheat on an assignment, since this would imply that people are either inherently dishonest, or will be honest only when they explicitly swear to it.

Learning to think for yourself, assess information judiciously, and speak and write effectively in your own voice is at the heart of a liberal arts education and global citizenship. Treasure and cultivate these skills. In all honestly, it often takes less time to do the work (which is usually designed to help you as much as possible) than to try to get around doing the work.
Earlhams full policy on academic integrity can be found here: `http://www.earlham.edu/curriculum-guide/academic-integrity`

Disability Accommodations: Students with a documented disability (e.g., physical, learning, psychiatric, visual, hearing, etc.) who need to arrange reasonable classroom accommodations

must request accommodation memos from the Academic Enrichment Center and contact their instructors each semester. For greater success, students are strongly encouraged to visit the Academic Enrichment Center within the first two weeks of each semester to begin the process.

Earlhams full policy on disability accommodations can be found here: `https://www.earlham.edu/academic-enrichment-center/disability-services/`

Data for Research Disclosure: Any and all results of in-class and out-of-class assignments and examinations are data sources for educational research and may be used in published research. All such use will always be anonymous.

Earlham resources:

- **Writing Center:** The Earlham Writing Center is dedicated to providing Earlham students with advice and resources about writing. Students will meet one-on-one with trained consultants who will contribute feedback to writers at any stage of the writing process: brainstorming, drafting, researching, revising, and polishing. Consultants will begin with the writers needs and concerns. Please come prepared with questions and specific concerns associated with your writing have an idea of what you would like to focus on with writing that you bring in. We will use our knowledge and expertise to teach you how to recognize strengths and weakness so you may effectively improve your own work. You can enjoy free, walk-in service in the basement of Lilly Library (The Sandbox) from 8-11 pm Sunday through Thursday with additional hours on Sunday, 2-5 pm. You may also schedule an appointment 25 to 50 minutes in length up to 10 days in advance using the online scheduler: `http://www.earlham.edu/writing-center/`. If you have questions, please contact Becky Burke, The Writing Center Director at burkbe@earlham.edu.

- **Academic Enrichment Center:** Working on study habits and skills (personal organization, understanding instructions, listening, pronunciation) may be necessary to keep up with this course. The Academic Enrichment Center (AEC) is located in the basement of Lilly Library and provides free tutoring services. If you sense that a tutor would be helpful, fill out a form there.

- **The Math and Science Center:** The math and science center is staffed by trained peer tutors for assistance in math and science courses. For more information, visit `https://www.earlham.edu/math-and-science-center/`.

Course Outline:

The weekly coverage might shift as we slow down or speed up, but this is the general idea:

Week	Content
Week 1 (short) 8/26-8/29	• Introductions: course, instructor, and students. • Form teams. • Discuss content! • Reading: Shermer introduction and chapter 1.
Week 2 8/31-9/4	• Shermer Chapter 2 • Buisness about the class and our interests. • **Reflection paper 1: what is science?**
Week 3 9/7-9/11	• **First iRAT/tRAT** covering Fine Ch. 1, Shermer Ch. 3. • Continue through Shermer Ch. 5
Week 4 9/14-9/18	• Monday: Shermer Chapter 6 • Begin Unit 2: looking at our first examples! • **Second iRAT, tRAT on Wednesday**: Shermer 7-8 • discussion over Shermer 7-8, Fine 2
Week 5 9/21-9/25	• Monday: continue Shermer 7-8 discussion, Fine 2 discussion • **Second reflection paper Wednesday**, read Fine Ch. 4 for Wedneday. • Read 2 examples from Munroe by Friday
Week 6 9/28-10/2	• Begin Unit 3: Climate Change • Includes Fine Ch. 5. • **Third RAT Monday** • Wednesday and Friday will be supplemented with probability and statistics!
Week 7 10/5-10/9	• **Third reflection paper Monday** • We'll be reproducing the famous NYT figure, but for Richmond!
Week 8 (short) 10/12-10/16	• This unit takes some time, but is awesome!
Week 9 10/19-10/23	• Unit 4: Evolution and Creationism • **Fourth RAT Monday** • MGL gone Oct 23, guest lecture: Heather Lerner.
Week 10 10/26-10/30	• **Fourth reflection paper Friday**
Week 11 11/2-11/6	• Unit 5: Finish Fine/Class choice • **Fifth RAT Monday**
Week 12 11/9-11/13	• **Fifth reflection paper Friday** • MGL Gone Nov. 11, guest lecture on library resources. • this unit gets shortened if others (e.g. Climate Change) take longer.
Week 13 11/16-11/20	• Unit 6: final projects • MGL gone Nov. 20th.
Week 14 11/23-11/27	• FALL BREAK.
Week 15 11/30-12/4	• finishing projects
Week 16 12/7-12/11	• M-W: presentations. • F: **Sixth reflection paper**, final discussion.