ECOL250: HOW SCIENCE WORKS AND WHAT IT SAYS: A GUIDE FOR THE UNINITATED IN HOW TO MAKE SCIENCE WORK FOR YOU
SPRING 2021
General Education NATS Tier II course

Description of course
Have you ever wondered if science is relevant to your everyday life beyond technology development? Are you reading claims about scientific findings on social media or in the news and wondered how accurate they are? Then this course is for you. Science is not just a topic like biology or physics; instead it is a way of answering questions. Science allows us to see the true nature of the world beyond our biases and prejudices; this is based on a philosophical approach but also on the social practice of science today. In this class we will focus on your questions about science and how you can find rigorous and objective answers to your everyday problems, either in the scientific literature or by doing your own hypothesis-testing. We will touch on topics such as the scientific method, what predictions are good for, statistics and what it is good for, peer review and what distinguishes scientific articles from others. We will focus on specific topics that YOU want answers to, whether it is scientific information about pets, study strategies, video games, diet and exercise, getting better sleep, or other topics you select. A key topic will be to recognize uncertainty and how you can find out how much we do or do not know, and how confident you can be in different sources of information.

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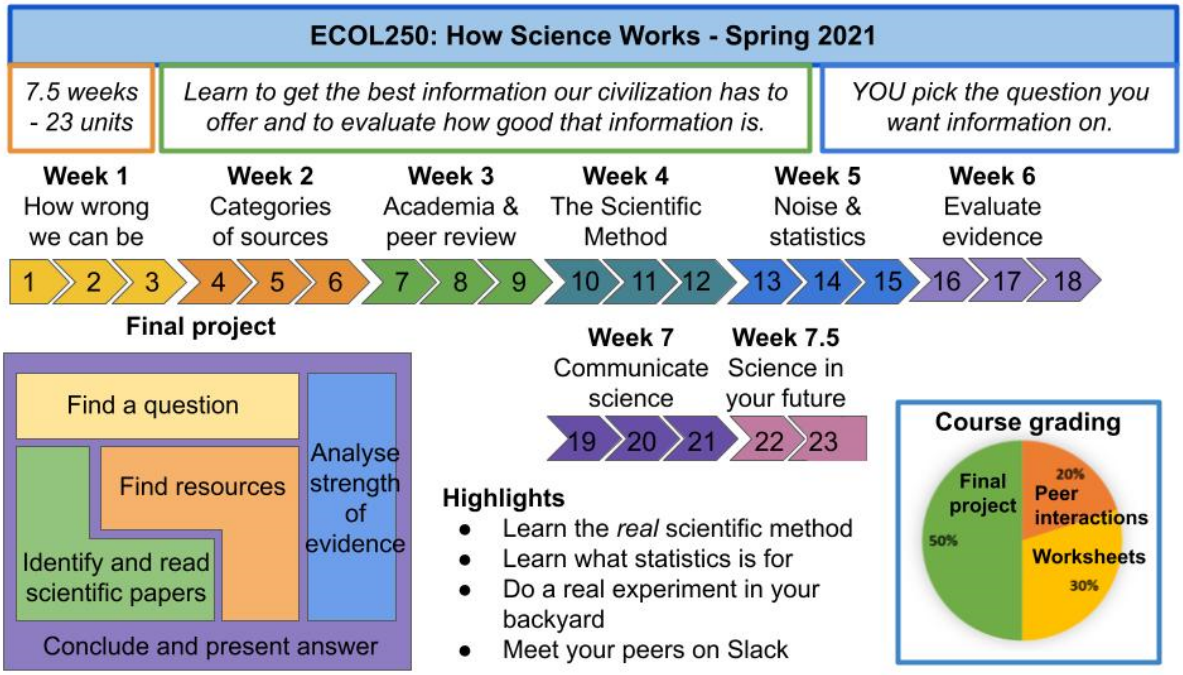
Learning objectives
The overarching learning goal for this class is to help you acquire scientific literacy. This means broadly, to be able to use our civilizations' scientific knowledge to find answers to questions you care about. We understand this to include being able to distinguish between original scientific information, second-hand reports about such information, and claims not based on science. The course thus particularly promotes and practices thinking critically, using information effectively, and communicating effectively.

Specific learning outcomes
At the conclusion of this course, students will be able to:

A. **Categorize information** based on whether or not it was peer reviewed, derived using the scientific method, what sample size it is based on, and how accepted it is in the scientific community, and based on this will be able to argue how certain or uncertain one should be about a particular claim;
B. **Find and interpret original scientific articles**, the building-blocks of our society's scientific knowledge, based on topics of interest and extract the overall conclusions from such articles;
C. **Evaluate the strength of evidence:** to this end, you should be able to describe the purpose of the scientific method and of statistics in the context of gaining objective information, and defend the fact that testing alternative hypotheses and deriving predictions before data are known are critical elements of generating objective results; then assess whether the scientific method and statistics were used to make a claim;
D. **Engage in societal discussions** about the nature of evidence, and conversations about what science is and should be, with a well-rounded perspective on how science works and can work.

These are ambitious learning goals; in fact, if you master C., you will have a deeper understanding of science than most people. However, all of the skills we are aiming for here are based on just a few basic principles, and we know that you can master them. We (the instructor, TA, and preceptors) are fully committed to helping you achieve all these goals. Please do not hesitate to talk about where you are stuck, or what is unclear, or what skills you do not feel you have the tools to master – you can state all these things either for the class in a channel on Slack (where it will help not just you but everyone understand the issue better), or, if you prefer, feel free to use 'direct messages' which will only go to a specific person (e.g. the instructor, Anna Dornhaus, the TA, Stefan Popp, or one of the preceptors. All of us are here to help you achieve these goals.



How this class works

This is an online, asynchronous class. What this means is two things: you can read/view the materials for the class, and complete the assignments for the class, on your computer at a time that fits with your schedule. BUT: it also means you have to be more deliberate and active about interacting with the instructor, TA, and preceptors as we cannot see you and won't know what issues you may be struggling with. For all informal interactions, questions, and to chat with your classmates (highly encouraged!) please use the Slack workspace for the class at http://ecol250spring-mye6239.slack.com. You will find an invitation link for the Slack workspace on D2L, as well as a tutorial on how to use it.

How you should start every week of the course is to review the schedule for the week (on D2L; check the description of the respective units, not just the D2L calendar). There are typically three 'units' per week, and each of them has a 'front page' on D2L explaining the resources and assessments associated with it. If there is a 'worksheet' for the week, download this before you do anything else, and read over the questions and activities. The worksheet may direct you to post thoughts or questions on Slack, or how to participate in other activities. Since this is a 7-week, 3 credit course, the workload is approximately 18 hours per week, or 6 hours per unit. If you are struggling, seek help immediately – by stating what you are struggling with on Slack, or directly asking the instructor, TA, or preceptors.

There are these types of activities (all have graded elements) in the class:

- Interaction with your peers, either with the entire class or in small groups, on ***Slack*** (invite link to the class workspace is on D2L). The 'interactive activities' category on D2L also includes Perusall (see below).
- ***Worksheets*** (download the .doc template from D2L, then fill in and resubmit to respective assignments folder on D2L); the worksheets serve as a kind of tutorial with stepwise instructions. You are welcome to submit worksheets before their respective deadline and seek feedback from the instructor or TA; you are also welcome to ask questions on Slack, including posting a draft answer in your group channel and seeking feedback and help from fellow students and preceptors. All resources are allowed; the only thing I don't want to see you do is copy someone else's answer word-for-word. Try to rephrase in your own words: this will help you understand the content better.
- ***Original empirical project*** done in your home or back yard: there will be a small research project that you can do yourself, where you will be making measurements and statistically analyzing them (more instructions in the materials on D2L). This project will take around a week and is intended to allow you to experience all the steps of making inferences from noisy data. (The grade for this project is part of a worksheet.)
- The '***final project***' which is the core aim of the class: you will choose a question about a topic of relevance to you (e.g. "Does the COVID vaccine work?", "Is online learning as effective as in-person learning?", etc. – further examples on D2L). All activities in class serve to help you find the best available answer to this question, by finding appropriate scientific and media resources and helping you to interpret them. The final project has several due dates for different stages, see below.
- We will use a ***variety of other tools*** to make the course more exciting and interactive for you, such as a unit on Checkology and social text annotation in Perusall. If you have any technical issues or questions about how to access these materials or activities, message the instructor or teaching team right away (ideally on Slack, or by email).

Grading

Your final grade will be determined from worksheets (30%), interactive activities like Slack and Perusall (20%), and the final project (50%). A detailed rubric for the final project is provided below. Note that the final project can be revised any number of times for a better grade, BUT: you must submit a first draft by the initial deadline (given on the schedule for each worksheet), and you must submit the final drafts of all assignments by May 3rd. You can check your current grade status at any time on D2L.

A: 90-100 %
B: 80-89.9 %
C: 70-79.9 %
D: 60-69.9 %
F (fail): 0-59.9 %

Written assignments lengths and timing

(1) The worksheets, which will be electronically available on D2L, will typically consist of short-answer questions relating to the current class material and/or activity performed in class. (total: approx.. 2000 words). You are welcome to seek feedback on your worksheet before submission.

(2) The final project for the class will be a review of scientific and media articles on a particular question of your interest. It will include your analysis of what the science concludes about the question, and how certain we can be about this answer, and why (based on the included literature, its type, reliability, sample size and variance in data,

etc.); it will also include an annotated reference list and a lay summary of the conclusion (the latter can be written or in graphical or any other format, e.g. video). There is no specific word limit but I expect your submission to be at least around 3-4 pages long (approx. 1000 words). You get points for each submission (see Table below) but you can revise each section for maximum content points any time until the final submission May 3rd.

The final project will go through at least one revision, i.e. you will receive comments from the instructor and revise the content accordingly before final submission. All Tier Two General Education Courses are writing intensive (http://gened.arizona.edu/content/writing-component).

The final project

Your main written product from this class will be to select a question of interest to you and to analyze what the scientific literature and media say about this question. Both the earlier drafts/ideas/reference lists and the final version of the 'Final Project' should use the form provided on D2L. For each deadline listed below, you should submit the entire file, which will have your first draft of the respective section listed below, as well as you're revised version of all the earlier sections. You can keep revising each section, but make sure you submit a first draft for the respective deadline. The final version is due to be submitted to the appropriate folder on D2L by May 3rd. Grade points add up to 50.

	Versions of your Final Project drafts	Due date for first draft	Expected content/quality	Grade points for on-time submission	Grade points for full version
Version 1	3 ideas with 1-2 references each.	March 17	Each idea needs to be phrased as a genuine question you may want to know the objective answer to. References can be any media but need to say things relevant to the question.	1	Idea list: 2
Version 2	Chosen idea with reference list.	March 23	All references are categorized by source type, and you have at least 5 original scientific articles, 1 review or meta-analysis, 4 public media articles, and 2 social media posts. Deviations from this need to be discussed with instructor.	1	
Version 3	References listed now have author information & summaries.	March 26	Each reference summary is 1-3 sentences and states what answer is given to the question, as well as broadly what the evidence for this answer is. For each author, name & expertise/role are given, e.g. 'journalist', 'scientific expert', 'scientist in other field', 'member of the public', 'with personal experience of issue', etc.	1	Reference list with information: 8
Version 4	Project is revised	Apr 14	In the 'Analysis' section, list & summarize each of the scientific	1	

	according to all feedback received so far; add sample sizes & alternative hypotheses to claims.		articles and longer media articles. For each give the argument for their answer given, what alternative hypotheses were considered, and the sample size used.		
Version 5	Evaluate each reference, summarize overall conclusion, find meta-analysis if possible.	Apr 20	In the 'Analysis' section, use the information you now have to evaluate the strength of the evidence presented in each reference. Derive your overall conclusion about what the answer to your question is (in 'Your conclusion').	1	Analysis section: 15
Version 6	Full draft of conclusion, discussion of certainty, annotated reference list.	Apr 23	This draft should include all sections from above, revised with any feedback you have received, and explicitly address how certain we can be about your conclusion and why.	1	Conclusion section: 8
Version 7 (final version)	Final full version with lay summary.	May 3	Final version should include the lay summary, written/created in a way that you can present it to your family, friends, or other contacts who may be interested in your question, but that still represents the strength of the evidence (or lack of it) for the conclusion you have.	1	Lay summary: 10

Honor's contract

Honors College students can take this course with an additional honors contract. Such a contract will include either (1) doing research in a lab concurrent with the class and giving a talk about it in the class, using the frameworks of scientific method, assessing uncertainty, and meeting your audience where they are; (2) doing a hands-on scientific experiment in a K-12 classroom in Tucson and reporting the outcomes on teacher and students in class; or (3) preparing a poster to be printed and hung in the BSW hallway on a common and relevant misconception among students, including graphs and references. Details of the project must be discussed ahead of time with the instructor. Honors contract information is available at http://www.honors.arizona.edu/future-students/honors-credit-across-campus.

Course website

Before the semester starts, or if you are not enrolled, you can get information such as this syllabus on the course website http://socialinsectlab.arizona.edu/ecol250.

The website you will be actively using during the course is located on D2L, at d2l.arizona.edu. You will be able to access it when the semester starts. You should check this site weekly to obtain readings and announcements for the class. You can also submit assignments and check your grades there. You can access the site from computers on campus if you don't have one at home. Note that student computer labs also offer printing services if you would like to print out

readings. To access your course on D2L you must have a UA NetID and be officially enrolled in the course for at least 24 hours.

Readings
All reading materials will be available online (on D2L). You can find which reading is due for each class in the 'schedule' on D2L under Content -> General information. Note that readings listed there are required, and it is your responsibility to check the website regularly for changes, and to read the reading when it is due. If you have questions about a reading, always ask them – ideally in Slack, or you are welcome to email the instructor, TA, or preceptors.

Class schedule
Note that the class schedule is subject to change during the semester; such changes will be announced on D2L and on Slack. The up-to-date version can always be found on the D2L website.

General issues
Professional Communication
If you have any questions for the instructors or the TA, feel free to email the instructor at dornhaus@email.arizona.edu. I will attempt to answer as soon as I can, however you should never assume an email will be answered in less than 3 days.
If you send any emails to the instructor or TA, make sure to mention the name of the class (ECOL250) in the subject line. Also, start your email by addressing the recipient, and end it with a greeting. A professional way to address persons with a PhD is, for example, "Dear Dr Dornhaus"; always end the email with your full name. Yes, that's also good form for replies in email chains. Yes, as far as I am concerned you are also welcome to say "Hi Anna" instead – just use a correct name, some form of greeting, and don't forget to mention your name and the class name. Re-read your email to check for spelling and grammar errors. Not adhering to these rules will mean that the addressee will get the impression that you are unused to professional communication, and this will probably result in them focusing on your communication style instead of your actual message; this is very detrimental in emails to future employers or mentors, so you should start practicing good habits now.

Classroom Behavior Policy
To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, be respectful, helpful, and friendly in Slack communications; always assume the best intent of others. This course supports elective gender pronoun use and self-identification; please include your preferred pronouns in your Slack profile (in the full name). We want to create an educational environment of inclusion and mutual respect. If you see any issues, please send a direct message on Slack or an email to the instructor pointing out your concerns or any suggestions for improvement.

Code of Academic Integrity
In real life, we almost never are required to solve problems without using the internet and other resources we are aware of. For the purpose of this course, you are welcome to use any resources at your disposal to answer worksheets and complete your final project, with the following qualifications:

- All the information you need for worksheets is provided in the course materials, i.e. on D2L and Slack, except where specified otherwise. If you feel this is not sufficient, I recommend you ask questions on Slack rather than 'googling' it. There is a lot of misinformation on the internet, and in particular, the 'scientific method' gets routinely misrepresented. Therefore, if you do want to use information from some source other than those listed, at least state this on Slack and seek comments from the class and instructors.

- You are absolutely welcome to discuss and even share answers you are giving on worksheets with other students in the class. Please do it on Slack – the reason for this is that this allows the instructors to add corrections or feedback before other students copy a misunderstanding from their peer.
- Write all answers in your own words. Do not copy definitions verbatim from others. The reason for this is to make sure you, in your own mind, have a conceptual grasp of what the answer means. Copying-and-pasting does not make your brain understand what you are writing. Since all worksheets can be revised, it really is a chance for you to work on figuring out the solution by using your own wording – if it is not quite capturing the correct answer, we will provide feedback an you can change it. This process of feedback and correction is *the* activity that will help you learn and master the learning goals of this course. Without making mistakes, and by copying too closely something someone else (or a source) says, you will deprive yourself of the opportunity to actually learn and understand the material.

Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity. The University Libraries have some excellent tips for avoiding plagiarism, available at http://www.library.arizona.edu/help/tutorials/plagiarism/index.html.
Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

Absence Policies
Since the class is asynchronous, we expect that you can complete the work for the class at times that do not conflict with time you are otherwise engaged. However, if you are sick or for other reasons unexpectedly unavailable, please contact the instructor if you are having trouble meeting a deadline. All deadlines except the final submission deadline can be flexible; however remember it is important to complete the work roughly according to schedule so you can best benefit from the Slack discussions, and so that you will be able to complete everything in the expected quality by the final deadline.
The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop.
Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete and http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal respectively.

UA Nondiscrimination and Anti-harassment Policy
The University is committed to creating and maintaining an environment free of discrimination; see http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy
Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

Accessibility and Accommodations
Our goal in this classroom is that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please let me know immediately so that we can discuss options. You are also welcome to contact the Disability Resource Center (520-621-3268) to establish reasonable accommodations. For additional information on the Disability Resource Center and reasonable accommodations, please visit http://drc.arizona.edu.

Threatening Behavior Policy
The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students.

Additional Resources for Students
UA Academic policies and procedures are available at http://catalog.arizona.edu/policies.
Student Assistance and Advocacy information is available at http://deanofstudents.arizona.edu/student-assistance/students/student-assistance.

Confidentiality of Student Records
http://www.registrar.arizona.edu/ferpa/default.htm

Subject to change
Please note that the information contained in the course syllabus, other than the grade and absence policies, may be subject to change with advance notice, as deemed appropriate by the instructor. This is particularly true of the details in the course schedule. The most up-to-date version of the class schedule (including assignment due dates) can always be found on D2L.