General Information, Course Requirements, and Syllabus

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Course Objectives

Science impacts our lives in countless ways. Our health depends on advances in basic biology and medicine. Wise environmental policies depend on understanding ecology and organismal biology. New scientific knowledge raises new ethical dilemmas. Yet too often nonscientists are content to leave science to the scientific "priesthood", thinking that science is too complex and requires too much training and technical skill for ordinary mortals to understand.

This course will fulfill a Group A natural science core requirement. Although students majoring in science are certainly welcome, it is designed for nonscience majors, and so may be one of only two or three science courses you take at UNR. The main objective of the course is *not* to make you into a scientist, but to help you develop your critical thinking skills by applying them to interesting questions in biology. This objective is really the same as that of all of your core courses, including core humanities. Just as you may have honed your critical thinking skills by analyzing the trial of Socrates in Core Humanities 201, you will hone them further by analyzing several case studies in biological research in this course. This should be helpful for any of you who may decide to major in a natural science as well as for those of you majoring in other fields, but Biology 125 does not substitute for the introductory majors courses in Biology (190-192) because it doesn't provide the broad background needed for upper-division Biology courses.

Learning to think critically about scientific questions will have several implications for you as individuals and as members of society. You will be able to evaluate news about developments in health and nutrition more effectively. If you are faced with a difficult medical decision in the future, this course may provide some of the tools to help you make the best decision. You will be able to vote more intelligently about the many issues that involve science, or about candidates for public office based on their positions on these issues. You will come to understand that science plays an important role in many personal, ethical, and social decisions, but is rarely the determining factor.

We will try to meet the main objective of this course by using concrete *case studies* to answer three general questions:

(1) How can we use observations, comparisons, experiments, models, and other methods to develop evidence about new ideas?

(2) How can we use quantitative methods to evaluate evidence and cope with uncertainty?

(3) How can writing sharpen critical thinking about ideas and evidence in science?

We will spend about two weeks on each case study, so we can explore them in quite a bit of depth. I will choose case studies that are interesting, timely, and diverse. Some may have important historical components; others may be brand new. Some will illustrate rigorous experiments; others will involve topics that can't be addressed

experimentally for pragmatic or ethical reasons. Most examples will include unanswered questions. Although the course isn't a survey course like Biology 100, you will learn about many of the fundamental areas within biology: evolution, ecology, genetics, behavior, growth and development, health and disease. You will also learn various "tools for thinking" about scientific questions, but won't learn as much about the technological tools used in modern science as you might in other courses.

Course Structure

There will be two, 50-minute lecture/discussion sessions per week and one, 75-minute lab/discussion session where we will meet for more intensive discussions, demonstrations, problem-solving, and lab exercises. The lecture/discussion sessions will meet from 11-11:50 am on Monday and Wednesday in FA 109. The lab/discussion sections will meet from 11-12:15 pm (section 001) or 1-2:15 pm (section 002) on Friday in FA 136 (for lab) or FA 144 (for discussion).We will spend about two weeks on each of seven case studies during the semester. During the lecture/discussion sessions, we will discuss the historical foundation for the topic, I will provide necessary background information, and we will discuss the broader implications of the topic. During the lab/discussion sessions, we will examine and discuss evidence bearing on the topic, with the goal of evaluating the strengths, limitations, and integration of various kinds of evidence. These sessions will include things such as brief oral presentations, debates, demonstrations, problem solving, and lab and computer exercises.

Each case study will culminate in a take-home assignment – either a short, analytical essay about a specific question arising from the case study or a quantitative problem-solving exercise.

Reading

Most of the reading will be from scientific research papers, review papers about specific topics, and news reports. I will provide links to these resources through WebCampus. In addition, you should purchase these three books, available in the ASUN Bookstore.

Booth, W. C., G. G. Colomb, and J. M. Williams. 2003. *The craft of research, 2nd edition*. University of Chicago Press.

Jenkins, S. H. 2004. *How science works: evaluating evidence in biology and medicine*. Oxford University Press.

Shubin, N. 2008. *Your inner fish: a journey into the 3.5-billion year history of the human body*. Pantheon Books.

We will not use these books as textbooks, so please don't think of them that way! *The craft of research* is a guidebook to asking interesting questions, making persuasive arguments, and writing effectively. This will be a valuable resource for many of your courses, including Biology 125. *How science works* is structured like this course, but uses different case studies than those we will discuss in class. Here you can find different examples to illustrate the same ideas about critical thinking that will motivate the class. *Your inner fish* is one of many books that I could have chosen to illustrate how science works by describing the day-to-day life of a scientist at work. Shubin is a paleontologist who has made important recent discoveries in evolutionary and developmental biology. He explains the significance of these discoveries in this engaging personal memoir.

WebCampus

We will use WebCampus for discussion forums about some of the case studies. In addition, I will post outlines of lectures and discussions, links to required and recommended readings, other useful links, and other resources. For example, *Critical thinking on the Web* is a directory of numerous electronic sources about critical thinking.

Requirements and Grading

There will ***two exams***, a midterm about a third of the way through the semester and a final exam at the end of the semester. Exams may include multiple-choice, matching, short-answer, and short-essay questions based on class discussions, lectures, and readings. Exams will be given during regular class periods and be closed book.

Each of the ***seven*** case studies will require a brief ***WebCampus posting*** in response to one or two specific questions about material that needs to be read before class discussion. These postings must be done before the discussion in class.

Five of the case studies will culminate in a take-home ***essay assignment*** of 3 to 4 double-spaced pages. I will ask you to address a specific topic in each of these essays and give you approximately one week to write each one. I encourage you to make appointments with me to discuss first drafts of your essays.

Two of the case studies will culminate in a take-home ***problem assignment*** in which I ask you to solve a quantitative problem arising from the case study and to interpret the results.

Participation in class discussion is expected and will contribute to your overall grade in the course.

These elements will contribute to your final grade as follows:

	Percentage of Overall Grade
Midterm (**2 March**)	11%
Final exam (**11 May, 9:45-11:45 am**)	22%
WebCampus postings (**check WebCampus regularly for due dates as the semester progresses**)	7%
Five short essays (first to last: 5%, 6%, 7%, 8%, 9%; **due 9 Feb for Case 1, 23 Feb for Case 2, 27 Mar for Case 4, 27 Apr for Case 6, 4 May for Case 7**)	35%
Two problem assignments (7%, 8%; **due 13 Mar for Case 3, 10 Apr for Case 5**)	15%
Class participation	10%
Total	100%

Final grades determined as follows: 90-100% A, 80-89% B, 65-79% C, 60-65% D, < 60% F.

Disability Statement

Any student with a disability needing academic adjustments or accommodations is requested to contact both the instructor and the Disability Resource Center (Thompson Building - 107), as soon as possible to arrange for appropriate accommodations.

Academic Dishonesty Statement

Academic dishonesty (e.g., cheating on exams or homework, plagiarism) is a serious offense. All work that you submit in this class must be your own. Each student is responsible for being familiar with UNR's policies on academic dishonesty. Any student engaging in academic dishonesty in this course will receive a 0 on the exam or assignment in question. In more severe cases, e.g., extensive plagiarism of work by other people, the case may be turned over to the proper University authorities for disciplinary action.

Plagiarism is defined as presenting someone else's work as your own. Plagiarism does not just mean copying whole papers or articles from another source. It includes any information, ideas, sentences, phrases, photographs, graphics, audio, video or other material copied from another source, whether that be a paper or assignment submitted by another current or past student at UNR or elsewhere, a published book or article, a Web site, or an unpublished document by another author. These must be properly acknowledged by providing citations in your text and a bibliography giving complete publication information for all sources used in your paper. Even if you paraphrase someone else's ideas and do not quote them directly, you still must acknowledge your source. Citations should also be given for little-known facts and statistics. **Ignorance is not an excuse for plagiarism. If you are not sure whether you need to provide a source for a piece of information or how to cite a source, ask me.** Dartmouth College has an excellent discussion of the ethics and practice of citing sources.

Tentative Syllabus (see p. 3 for exams and due dates of assignments)[1]

<table>
<tr><th>Week</th><th>Lecture/Discussion</th><th>Lab/Discussion</th></tr>
<tr><td>1 (21-23 Jan)</td><td>Introduction to the class</td><td>Introduction to reasoning in science</td></tr>
<tr><td>2 (26-30 Jan)</td><td rowspan="2">Case 1 – How does evolution work? Theodosius Dobzhansky wrote a famous essay entitled “Nothing in biology makes sense except in the light of evolution” (American Biology Teacher 35: 125-129 [1973]), so it makes sense to begin a beginning biology course with evolution. We will discuss evidence about mechanisms of evolution in populations and about the history of life on Earth.</td><td>You may have heard about Kettlewell’s experiments with peppered moths in high school biology. We will revisit this story because it is more complex than often thought.</td></tr>
<tr><td>3 (2-6 Feb)</td><td>Introduction to argument mapping using Rationale software.</td></tr>
<tr><td>4 (9-13 Feb)</td><td rowspan="2">Case 2 – “Do we really know what makes us healthy?” (G. Taubes, New York Times, 16 September 2007). We are bombarded daily with conflicting advice about heath and nutrition. Even advice based on scientific research may be inconsistent from one month to the next. We will discuss how to evaluate different kinds of evidence about health and nutrition.</td><td>Use Rationale to evaluate claims about health or nutrition; select a claim to work on.</td></tr>
<tr><td>5 (18-20 Feb)</td><td>Report on credibility of a claim about health or nutrition.</td></tr>
<tr><td>6 (23-27 Feb)</td><td rowspan="2">Case 3 – How do genes and the environment make the person? With advances in molecular biology, genetic determinism is in vogue. Whether reflected in optimism about benefits of genetic medicine or concern about genetic engineering, many assume simple causal pathways between genes and traits of people, In reality, complex interactions between genes and environments influence traits. We will discuss some classic nonhuman examples in which rigorous experiments can tease out roles of genes, environments, and gene-environment interactions, then apply these ideas to a few human examples where such experiments can’t be done.</td><td>Introduction to quantitative analysis of gene-environment interactions.</td></tr>
<tr><td>7 (2-6 Mar)</td><td>Gather and analyze data on quantitative genetics of a human trait.</td></tr>
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[1]There will be readings for each of these topics, mostly posted on WebCampus. I will provide reading assignments about a week before each topic, and you should read this material **before** class.

8 (9-13 Mar)	*Case 4 – What animals have personalities and why?* Dogs? Cats? How about fish? Spiders?	TBA
9 (23-27 Mar)	*Case 5 – How does HIV work in individuals and populations?* By this point in the semester, we will have spent quite a bit of time using some of the fundamental thinking tools for doing science – hypothesizing, predicting, observing, experimenting. Another important tool is modeling, which we will apply to understanding the biology of HIV (or another disease) from the molecular to the evolutionary level.	Introduction to mathematical models of disease.
10 (30 Mar - 3 Apr)		Using mathematical models of disease; "Epidemiology and the web of causation: has anyone seen the spider?" (N. Krieger, 1994, *Social science and medicine* 39:887-903).
11 (6-10 Apr)	*Case 6 – How and why do sea otters and killer whales interact?* Sea otters and killer whales are favorite marine species for many people. Long-term research in the Aleutian Islands suggests a complex and shifting interaction between these species, but much of the evidence is indirect and circumstantial, making this a good case study for those experienced at using the thinking tools of science, as you will be by this time!	Are sea otters a keystone species in nearshore environments?
12 (13-17 Apr)		Why did sea otter populations in the Aleutians decline dramatically in the 1990s?
13 (20-24 Apr)	*Case 7 – How will global climate change affect the diversity of life on Earth?* When historians of the future look back on the early 21st Century, I think the big story will be how we dealt with climate change, and the worldwide economic collapse of 2008-???? will be at most a footnote. We know more about the causes and consequences of global climate change than many people appreciate, but there is still much uncertainty about potential impacts of climate change on extinction of species. We will discuss evidence that may help us predict these impacts.	Dealing with uncertainty.
14 (27 Apr - 1 May)		Predicting the future.
15 (4 May)	*Where to from here?*	
16 (11 May)	**FINAL EXAM (9:45 - 11:45 am)**	