TOPICS IN THE PHILOSOPHY OF BIOLOGY

Class time: T, Th, 11am - 12.15pm
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A. GENERAL INTRODUCTION TO THE COURSE

This course will focus on philosophical issues in evolutionary biology but will also raise philosophical issues about biology more generally. Students with backgrounds in either philosophy or one of the biological sciences are especially welcome in the course. The "Thematic Overview" in **C**, and the "Tentative Schedule" in **F** below, provide detailed information about the course. The following types of questions should, however, give you a general idea of the content and orientation of the course, and allow you to decide whether you want to read further; I have indicated the sections in which each of these types of questions will arise most frequently.

Questions from the general philosophy of science: In what ways is evolutionary biology distinctive amongst the sciences? Are there laws in biology, as there are in physics? Is adaptationism a defensible paradigm in evolutionary investigations? Are species natural kinds? Are there limits to biological explanations and the domains to which they can be applied? (Sections I, II, V)

Questions about fundamental concepts in evolutionary biology: Can natural selection act at levels other than that of the organism (e.g., the gene 'below' or the group 'above')? What are genes and what is their role in evolution? What role do appeals to fitness and adaptation play in evolutionary biology? What problem does altruism pose for evolutionary theory? (Sections II, III, IV)

Questions with a methodological slant: What place is there for teleology within biology? What role does optimization play within evolutionary biology? Does the focus on genes in various areas of biology represent a distortion of biological reality? Is pluralism about species concepts the view that best reflects the reality of biological taxonomic practice? (Sections I, IV, V)

B. BACKGROUND FOR THE COURSE

The course has a pre-requisite of *two courses* in Philosophy; for students with two courses in Biology, the instructor will waive this pre-requisite. Although the course will not concentrate on technical matters, understanding a few of the issues that we discuss (e.g., Fisher's sex ratio argument) will presuppose a basic facility with high school algebra and (to a lesser extent) basic probability theory. Students interested in taking the course but concerned about their background preparation for the course should come and talk to me as early as possible; I may be able to recommend some additional, introductory readings that are of use. The week-by-week readings in **F** below include further readings for each topic we will cover, which should allow you to tailor the course to suit your own particular strengths and interests.

C. THEMATIC OVERVIEW

After the general introduction provided in the first week of the course, the topics we will cover are divided into four thematic sections. Here are the titles of each section, together with those for the weeks of the course that fall under them; this should provide you with a quick and dirty way to eyeball the course content as a whole. For more details, see **F**.

    I.   **Between Science and Philosophy**
          1. Why the Philosophy of Biology?

    II.   **Fitness, Adaptation, and Evolution**
          2. Fitness, Biology, Science
          3. Adaptation, Natural Selection, and Optimization
          4. The Adaptationist Paradigm

    III.   **Levels of Selection and the Problem of Altruism**
          5. The Units of Selection: Genes and Organisms
          6. The Units of Selection: Organisms and Groups
          7. The Problem of Altruism

    IV. **The Species Problem**
          8. Species Essentialism and Beyond
          9. The Nature of Species: Contemporary Views

    V. **Developmental Systems Theory**
          10-11. What is Developmental Systems Theory?
          11-12. Genetics and Development

D. COURSE MATERIALS

Required Books

Elliott Sober, *Philosophy of Biology*. Westview Press: Boulder, CO, 2nd edition, 2000. 236 pp.

This is a textbook, and we will read 6 of its 7 chapters in this course. The second edition is only minimally revised from the first, published in 1993, and so students who can find a used copy of the first edition will not be at a significant disadvantage relative to those who purchase the second edition. Both versions are available as reasonably-priced paperbacks.

Evelyn Fox Keller and Elisabeth A. Lloyd (eds), *Keywords in Evolutionary Biology*. Harvard, 1993, 414pp.

This book contains just over 50 keywords, each characterized in a short (2-6 page) article by one of the leading figures in the field. While I have drawn on only about one-quarter of these in the syllabus in **F** below, you will likely find many other articles here of use. For example, I have not listed the articles on group selection, character, and genotype and phenotype, but they (and many others) will likely be of interest to many of you. I encourage you to become familiar with the table of contents from this book early on so that you can make the best use of it throughout the course.

Course Packet

A course packet will contain all additional required and optional articles for the course. In general, these will be significant original papers or shorter overview articles that complement the textbook, and I will look to assign on average one of the papers from the course packet each week. Expect these papers to be **more difficult** than the textbook, and to have to read them, at least sometimes, more than once. The course packet will be available from the University Bookstore in SUB.

Further Readings

A list of books of further interest is provided in **G**. To further pique your interest in these books, note that there is a *minor assignment* based on your explorations here; see **E** and **G** below.

E. WORKLOAD AND COURSE REQUIREMENTS

The reading load for the course as assigned in **F** is moderate in quantity and moderate-difficult in level: it is about 40 pages of required reading per week, spread fairly evenly through the semester. The writing load for the course is moderate. Assessment for the course will vary for graduate and undergraduate students. Apart from the differences between the schemes listed below, graduate students will be assessed at more rigorous standards than will undergraduates.

For those taking the course as **undergraduates**, assessment will be determined as follows: **(a)** a short (1-2 page) report on your investigation of one or more of the books listed under "Other Books of Interest" in **G**, due at the end of Week 3 (10%); **(b)** a mid-term

examination based on material covered in weeks 1-7, to be held in Week 8 or so (40%); **(c)** a term paper of 2500-3000 words (40%); **(d)** general class preparedness and participation (10%).

For those taking the course as **graduate students**, assessment will be determined as follows: **(a)** a short (2-3 page) report on your investigation of one or more of the books listed under "Other Books of Interest" in **G**, due at the end of Week 3 (10%); **(b)** a mid-term examination based on material covered in weeks 1-7, to be held in Week 8 or so (20%); **(c)** your best 2 inquiry pages based on material covered in weeks 8-12 (20%) **(d)** a term paper of 3500-4000 words due shortly after the end of term (40%); **(e)** general class preparedness and participation (10%).

These assessment schemes are designed with two chief goals in mind: to encourage you to keep up with the work for the course on a week-by-week basis, and to minimize that end-of-term crunch that is so unpleasant for everyone. They should also provide you with early and fairly continuous feedback about how you are doing in the course, and help you to identify both strengths and weaknesses that you can work on as the course develops. Those who put in a steady effort through the semester should (i) accumulate an impressive % of their total grade well before the end of classes, (ii) be well-placed to write a strong term paper, (iii) learn a lot.

What I have in mind by an **inquiry page** is a page (or so) that raises and explains one question or makes one comment about the reading for that week. These can be fairly specific or quite general, and should reflect your preparation for a given topic; if you like, you can simply take up one of the questions I have provided with the readings for a given week. You may divide your page between question and comment as you see appropriate, provided that you limit yourself to one single-spaced, typed page (200-400 words). These are not intended to be summaries of the readings, though they may point to difficulties that you have with some of the materials, or identify broader issues that those readings raise; rather, they should be your early attempts to intellectually probe that material and reflect on it.

Your first inquiry page will be due in Week 8 or 9 (after the mid-term is out of the way), and you may submit up to 4 of these for the semester as a whole. Inquiry pages will need to be submitted either before or shortly after the classes in which the corresponding material is discussed; *handing them in at the end of classes is not an option*.

The term paper will be due shortly after the end of classes, and you should begin work on it well in advance of the end of classes. I will distribute a list of topics for it by Week 10, and earlier if possible. I would be happy to discuss a draft of the term paper in advance of its deadline. Late papers are not particularly welcome, and you should (i) talk to me in advance about a paper which will not be submitted by the due date, (ii) expect to be penalized for a late paper that does not have a written extension from me. In general, I penalize at a grade a day for late papers, and set a "received by" date after which the paper will receive a grade of *zero*. Please take this general policy seriously.

F. A TENTATIVE SCHEDULE

The following schedule will give you some idea of the week-by-week content of the course. The textbook chapters ("Sober" below) should provide you with a basic introduction to each topic that we cover (except the last). The regular course packet readings ("#" below) will supplement this basic reading, and will typically be discussed in class. They will introduce you to original ideas and thinkers, and may require several readings, as well as provide you with

some resources for further study. Optional readings (denoted by a "**+**") will allow you to pursue a topic in more detail than we will have time to cover in class**.** If you feel that the core readings only scratch the surface of a topic that you have further interest in exploring or have a solid background in, then go to these additional readings as a follow up. I should emphasize that I would expect you to use these readings selectively; only a crazed loon would try to do ALL of these optional readings.

The short articles from Keller and Lloyd can be used in two different ways. For the most part, they provide an accessible introduction to a topic that gives you a sense of some of the history or controversies that accompany a given concept. Thus, many of them may be best read before you delve into the corresponding chapter in Sober's textbook. But, alternatively, they might also profitable be read after you have a more systematic sense of a given topic, for they then may shed some light on particular problems and issues in a given area.

I am open to suggestions about what to leave out and what to add, or any other changes that you would like to see in the course. Minimally, you should cast your eye over **C** above and **F** below and think about what you want out of the course. I will give you further directions regarding and suggestions about the readings for a particular class in the preceding class. The brief comments for each section below should serve collectively to give you a more concrete idea of the contents of the course; individually, they provide minimal guidance to the reading(s) for each section and might help to orient you on a weekly basis.

+ = *further reading (optional)*

Section I.   Between Science and Philosophy

1. Why the Philosophy of Biology?

Sober	ch.1
Rob Wilson	Course Outline for Phil 415 [i.e., THIS document in full!]
+Sterelny and Griffiths	#1 "Theory Really Matters: Philosophy of Biology and Social Issues", ch.1 of their <u>Sex and Death: An Introduction to Philosophy of Biology</u>. Chicago, 1999.

Following Sober, we will take an approach that views evolutionary biology at the core of the philosophy of biology. One issue to start on is the question of what evolution *is*: how should we define evolution? Is it just a change in gene frequencies in a population? What problems are there with this view of evolution? We will use these questions to enter a general discussion of the role of definitions in science and the philosophy of science. Other issues that we will get out on the table here include the nature of Darwin's legacy to evolutionary biology, and the ways in which evolutionary biology contrasts with other sciences.

Section II.   Fitness, Adaptation, and Evolution

2. Fitness, Biology, Science

Beatty	"Fitness: Theoretical Contexts", in Keller and Lloyd.
Paul	"Fitness: Historical Perspectives", in Keller and Lloyd.
Sober	ch.3
+Keller	"Fitness: Reproductive Ambiguities", in Keller and Lloyd.

Fitness is a central concept within evolutionary theory, one that raises a host of issues about evolutionary biology. Natural selection requires some heritable variation in fitness within a population. After introducing a basic, mathematical representation of fitness, we will look at different interpretations of the concept of probability, which features in the idea of viable selection (and so fitness). Some other issues: it has sometimes been said that the claim that there is "survival of the fittest" is a tautology, and that this impugns the scientific status of evolutionary theory. Why is this? What truth is there to the claim? What is the significance of the claim that biology *supervenes* on physics? What place is there for appeals to fitness in causal and mathematical models of the biological world?

3. Adaptation, Natural Selection, and Optimization

Burian	"Adaptation: Historical Perspectives", in Keller and Lloyd.
West-Eberhard	"Adaptation: Current Usages", in Keller and Lloyd.
Sober	ch.5
+Orzack and Sober (eds)	*Adaptation and Optimality*. Cambridge, 2000.

To say that organisms are adapted to their current environments and that many traits they possess are present because they are adaptations may sound like saying the same thing twice. But the second introduces an idea not present in the first, a claim about the history of an organism's present traits. Loosely put, adaptationism is the idea that models of evolution that represent natural selection as the primary or sole force of evolutionary change can adequately explain the existence of most (all?) phenotypic traits. How adequate is Sober's own characterization of adaptationism? Does Sober make a good prima facie case for the plausibility of adaptationism? Why or why not?

4. The Adaptationist Paradigm

Gould and Lewontin,   #2 "The Spandrels of San Marco and the Panglossian
                             Paradigm: A Critique of the Adaptationist Paradigm", in E.
                             Sober (ed.), *Conceptual Issues in Evolutionary Biology*. MIT
                             Press, 1993 (2nd ed.), ch.4, pp.73-90.
Dennett   #3 "The Spandrel's Thumb", in his *Darwin's Dangerous Idea*.
                             Simon and Schuster, 1995, ch.10, section 2, pp.267-282.
+Dennett   #4 excerpts from "Intentional Systems in Cognitive Ethology: The
                             'Panglossian Paradigm' Defended", *Behavioral and Brain
                             Sciences* 6 (1983), reprinted in his *The Intentional Stance*.
                             MIT Press, 1987, pp.250-268, and pp.277-286.

As a research program, *adaptationism* has been attacked by Stephen Jay Gould and Richard
Lewontin as "Panglossian" in its character, and as representing a restrictive perspective on
evolutionary thought. Dennett argues, in response, that these views seriously misrepresent the
role that adaptationism plays in structuring evolutionary biology. What does the Gould and
Lewontin charge of Panglossianism amount to? Should adaptationism be rejected? Why or why
not?

Section III.   Levels of Selection and the Problem of Altruism

5. The Units of Selection: Genes and Organisms

Sober   ch.4
Sterelny and Kitcher   #5 "The Return of the Gene", Journal of Philosophy, 85/7 (1988),
                             pp.339-361.
+Sober and Lewontin   #6 "Artifact, Cause, and Genic Selection", Philosophy of Science,
                             49/2 (1982), pp.157-180.
+Lloyd"Units of Selection", in Keller and Lloyd.

A fairly typical view of evolution by natural selection is that the fitter traits of organisms are
selected for, and that this process of selection governs the direction of evolution. This view
appears to take the unit of selection to be the individual organism, since the benefits of having a
particular trait are conferred on organisms. But could there be other units of selection, such as
the group "above" or the gene "below"? Here we will examine some of the basic claims and
counter-claims in this debate. Along the way, we will encounter Simpson's paradox, the principle
of parsimony, and the ideas of inclusive fitness and kin selection. Is the gene's eye view more
parsimonious than other views of natural selection? Why worry about what "the" unit of
selection is? In what sense is the gene's-eye view a *reductionist* view?

6. The Units of Selection: Organisms and Groups

D.S. Wilson and Sober   #7 "Reintroducing Group Selection to the Human Behavioral Sciences", *Behavioral and Brain Sciences*, 17 (1994), pp.585-608.

+Sober and D.S. Wilson   *Unto Others: The Evolution and Psychology of Unselfish Behavior*. Harvard, 1998, esp. chh.1-4.

Individually and together, David Sloan Wilson and Elliott Sober have been the major forces behind the resurrection of *group selection*. They defend group selection as part of a "multilevel theory of selection", and have appealed to group selection in more recent work on altruism, group minds, and superorganisms. Here we will focus on their BBS paper; the first four chapters of their book on altruism are also strongly recommended, but note that this is about 150 pages of reading. Why is or isn't kin selection a form of natural selection? Is there something "unbiological" about the idea of group selection? Why or why not?

7. The Problem of Altruism

D.S. Wilson and Dugatkin   "Altruism: Contemporary Debates", in Keller and Lloyd.
Rosenberg   "Altruism: Theoretical Contexts", in Keller and Lloyd
D.S. Wilson   #8 "On the Relationship Between Evolutionary and Psychological Definitions of Altruism and Selfishness", *Biology and Philosophy*, 7 (1992), pp.61-68.
+Sober and Wilson   *Unto Others: The Evolution and Psychology of Unselfish Behavior*,   Part I, esp. chh.1-2.

The phenomenon of *altruism* is typically presented as a problem for standard, individual- or gene-centered views of evolution. After explaining why, we will examine some of the differences between evolutionary and psychological views of altruism, and address the issue of how both forms of altruism might evolve. Why is altruism a <u>prima facie</u> problem for some views of evolution? How could altruism evolve?

- **Mid-term exam coming up around here ... (20 or 40%, depending on your enrollment status)**

Section IV. The Species Problem

8. Species Essentialism and Beyond

Mayr   #9 "Typological Versus Population Thinking", reprinted in E.
                              Sober (ed.), *Conceptual Issues in Evolutionary Biology*. MIT
                              Press, 1993 (2nd ed.), ch.8, pp.157-160.
Sober   ch.6, 6.1 only
Sober   #10 "Evolution, Population Thinking, and Essentialism",
                              Philosophy of Science 47 (1980), pp.350-383.
+Stevens   "Species: Historical Perspectives", in Keller and Lloyd.

Systematics concerns the taxonomy of organisms into species, the relationships between species kinds, and the bases for phylogenetic inferences about these relationships. We will be focusing here on the first of these issues. As the title of a 1965 paper by David Hull--"The effect of essentialism on taxonomy--2000 years of stasis"--suggests, some philosophers and biologists have thought that a traditional way of thinking of species membership--as involving essential properties that all members in a species share--has been stifling. Mayr and Sober contrast essentialist styles of thought with what they call population thinking. What is *essentialism* in biology, and is it misleading in the ways claimed?

9. The Nature of Species: Contemporary Views

Dupré	"Species: Theoretical Contexts", in Keller and Lloyd.
Sober	ch.6, 6.2 only
R.A. Wilson	#11 "Introduction", in R.A. Wilson (ed.), *Species: New Interdisciplinary Essays*, MIT Press, Cambridge, MA, 1999, pp.ix-xvii.
R.A. Wilson	#12 "Realism, Essence, and Kind: Resuscitating Species Essentialism?", in R.A. Wilson (ed.), *Species: New Interdisciplinary Essays*, MIT Press, Cambridge, MA, 1999, pp.187-207.
+Williams	"Species: Current Usages", in Keller and Lloyd.
+Sober	ch.6, 6.3-6.5 only.

Here we will turn to Ghiselin's and Hull's view of species as historical entities, of species as individuals, and the implications that this view has for how we think of biological kinds. We will also investigate the various competing conceptions of species, and ask some general, philosophical questions about the significance of these diverse views. Are species natural kinds? Are there good reasons for thinking that some sort of pluralist view of species is plausible? Why or why not?

Section V.   Developmental Systems Theory

10-11. What is DST?

Oyama, Griffiths, and Gray	#13 "Introduction: What is Developmental Systems Theory?", in their *Cycles of Contingency*. MIT Press, 2001, ch.1, pp.1-11.
Griffiths and Gray	#14 "Darwinism and Developmental Systems", in *Cycles of Contingency*. MIT Press, 2001, ch.16, pp.195-218.

Developmental systems theory has challenged a number of dominant perspectives on evolution and biology over the last 10 years or so. In this section we will discuss the basic ideas of DST, and some of their implications. In this section of the course we will draw on a recent collection of new papers, edited by three of the major figures in DST, Susan Oyama, Paul Griffiths, and Russell Gray. Does DST require overthrowing any dogmas of the "Modern Synthesis"? Are there ways in which DST is anti-evolutionary? Why or why not?

11-12. Genetics and Development

Griffiths and Gray	#15 "Developmental Systems and Evolutionary Explanation", *Journal of Philosophy*, 91/6 (1994), pp.277-304. Reprinted in Hull and Ruse 1998, ch.7.
Keller	#16 "Beyond the Gene but Beneath the Skin", in *Cycles of Contingency*, ch.21, pp.299-312.
+Sterelny Extended	#17 "Niche Construction, Developmental Systems, and the Replicator", in *Cycles of Contingency*. MIT Press, 2001, ch.23, pp.333-349.

However we characterize evolution (see week 1), gene pools--their stability, isolation, and modification--are central to the processes leading to evolutionary changes. Genetics provides us with at least two understandings of heredity, classical genetics, which developed from Mendelian genetics through T.H. Morgan, and molecular genetics, a descendant of the more famous work of Francis Crick and James Watson. Although there are interesting questions about the relationship between classical and molecular genetics (e.g., can the former be reduced to the latter?), here we will examine assumptions common to both views and the challenge to those assumptions posed by recent developmental systems theory. In what sense do genes "code for" traits? Is there any sense in which genes form some privileged part of the overall developmental package that organisms offer?

- **Term paper due shortly after the end of classes (40%)**

G. THE DIRTY DOZEN and your FIRST ASSIGNMENT

Here is a briefly annotated, short list of other books that may be of interest to you, either as general background or further reading. Some of these books are fairly introductory and easy to read, others fairly sophisticated and more difficult. About half the authors are philosophers, one-third biologists (with a sprinkling of others thrown in for good measure).

Robert Brandon, *Concepts and Methods of Evolutionary Biology*. Cambridge, 1996. A collection of Brandon's essays covering a range of topics that we will discuss: adaptation, selection, and reductionism. Essays can be read as stand alone pieces, or in thematic chunks.

Gary Cziko, *Without Miracles: Universal Selection Theory and the Second Darwinian Revolution*. MIT, 1995. Provides a broad-sweeping argument to the effect that selectionist thinking has implications for many areas of intellectual inquiry, including immunology, social science, and education.

Richard Dawkins, *The Selfish Gene*, Oxford, 1989. The 2nd edition of Dawkins' 1976 popular classic that champions the idea that the gene is *the* unit of selection. Contains several interesting additional chapters (chh.12-13) to those in the 1st edition.

Richard Dawkins, *The Extended Phenotype*. Oxford, 1982. A sophisticated development of many of the ideas in *The Selfish Gene*, written primarily for his biological colleagues but still quite accessible.

David Depew and Bruce Weber, *Darwinism Evolving: Systems Dynamics and the Genealogy of Natural Selection*. MIT, 1995. A wide-ranging, historical overview of the Darwinian paradigm, with some guesses about its future.

Marc Ereshefsky, *The Poverty of the Linnaean Hierarchy*. Cambridge, 2001. A critique of the dominant taxonomic system that defends a pluralist view of biological taxonomy and proposes a system to replace the Linnaean hierarchy.

Ernst Mayr, *The Growth of Biological Knowledge*. Harvard, 1982. An accessible history of thinking in evolutionary biology by one of the major 20th-century figures in that history.

Oyama, S., Paul Griffiths, and Russell Gray (eds.), *Cycles of Contingency*. MIT Press, 2001. Mostly new essays on developmental systems theory and its implications both biological and philosophical.

Alexander Rosenberg, *Instrumental Biology or the Disunity of Science*. Chicago, 1994. Argues for the status of biology as a relatively instrumental science; good reading for those with some interest and background in general philosophy of science.

Elliott Sober and David Sloan Wilson, *Unto Others: The Evolution and Psychology of Unselfish Behavior*. Harvard, 1998. A much-discussed book that focuses on evolutionary altruism and its relationship to both group selection and psychological altruism.

Kim Sterelny, *The Evolution of Agency and Other Essays*. Cambridge, 2001. Related essays on agency, evolution, and the mind by one of the field's leaders.

Robert A. Wilson (ed.), *Species: New Interdisciplinary Essays*. MIT Press, 1999. A collection that focuses on pluralism and unity in the species debate, with contributions from philosophers, biologists, psychologists, and anthropologists.

To encourage you to stretch your curiosity about the course, here is your first assignment.

First Assignment:

Write a short report (i.e., 300-600 words for undergraduates; 600-900 words for graduate students) on your reading of a chapter or more of one of the books above. Choose a book that interests you in some way, and explain what your interest is and what you found on

that interest in the book you chose. Here I will not be looking for anything too deep, but evidence that you have taken the time to think about your own interests in the course and an ability to do some basic research.

10% of your final grade; due at noon on Tuesday, 18th September.

H. ABOUT THE INSTRUCTOR

Rob Wilson recently moved to the University of Alberta after gaining early release for good behaviour from his sentence at the University of Illinois, Urbana-Champaign. He took his doctorate in Philosophy at Cornell University from 1987 to 1992, where he also minored in Cognitive Studies, and has previously taught at Queen's University and the University of Illinois, Urbana-Champaign. His chief research interests are in the philosophy of mind and cognitive science, and the philosophy of biology. He was recently nominated to the Luxuriant Flowing Hair Club (http://www.improb.com/projects/hair/hair-club-top.html), and is the general editor (with Frank Keil, Psychology, Yale University), of *The MIT Encyclopedia of the Cognitive Sciences* (MIT Press, 1999).

R.A. Wilson   07/01