

PHIL 3370 Philosophy of Biology

Fall 2018 CTIHB 459

MWF 11:50am - 12:40pm

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Department of Philosophy

We are, depend on, and are surrounded by, living things. What, if anything, do we all have in common? To echo Schrödinger, what is life? Answers to this question are at once scientific and philosophical. This course will examine one kind of answer – the most ancient, but also implicated in our newest biotechnologies. This is the idea that life involves a particular arrangement of some special kind of part of living entities. It follows that the way to understand the nature of life is to look inward, toward the small and the interior, to find those elusive parts and how they fit together. We'll look at five important versions of this idea: cell theory, Mendelian factors, the DNA double helix, genomes and networks, and minimal synthetic organisms. We'll examine how these 'theories of life' relate to each other, to scientists' practices, and to broader social questions.

3 Credits No pre-requisites

Contact Information:

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Office Hours: Wednesday 1-2pm and by appointment

To set up an appointment, please stay after class or send an email. For most issues, it is more efficient to meet in person. Please use email only to set up an appointment or to ask very quick specific questions about the course. Note: please use your campus email account to send me messages.

Course Outcomes: At the end of the course, students will be able to:

- identify key concepts and premises of five important 'parts-oriented' theories of life
- articulate the strengths and limitations of each theory, and contrasts among them
- distinguish forms of reductionism, essentialism, and determinism
- raise questions and objections to the above philosophical positions
- connect scientific methods to philosophical commitments and broader social implications
- write clear and concise arguments incorporating the points above
- apply ideas in the course to biology and other science classes
- improve general skills in reading comprehension, reasoning, and argument

Teaching and Learning Methods: Lecture and discussion, with some small-group work. Students are expected to read assigned texts carefully before class, and come to class meetings prepared to discuss key issues and ideas. Course outcomes will be achieved by individual reflection, followed by discussion, and then articulation of ideas in writing. Assignments are structured so students build up to more difficult projects later in the semester.

Required Materials: Course materials can be found on the ‘Syllabus’ page on *Canvas*.

Grading and Evaluation:

The grading scale for this course is as follows:

≥100	A+	88-89	B+	78-79	C+	68-69	D+	0-59	F
93-99	A	83-87	B	73-77	C	63-67	D		
90-92	A-	80-82	B-	70-72	C-	60-62	D-		

Each requirement contributes a number of points toward the overall grade, corresponding to the percentage stated (max total=105). No curve.

Course Requirements:

1. *Participation* (10%)

Discussion is essential to philosophy. Thoughtful participation in class discussions is an important component of this course. Please come to each class meeting prepared to discuss the assigned readings. Participation in class (or lack thereof) will be noted at each class meeting.

2. *Think-pieces* (20%)

Four short writing assignments (1-2 pages, typewritten and double-spaced in a 12 point font) on basic and background issues for philosophy of science. Most will be assigned in the first weeks of the course, to practice philosophical writing and to get a feel for philosophical methods. Think-pieces are due at the beginning of class (see dates below); each counts for 5% of the overall course grade. Late think-pieces will not be accepted, except in cases of excused absence.

3. *Papers* (60%)

Three short papers (5-7 pages, typewritten and double-spaced in a 12 point font) on key issues from course readings and discussion. Topics will be assigned and the page limit strictly enforced. Papers are due at the beginning of class (see dates below); each counts for 20% of the overall course grade. Late papers will be penalized; for each day after the deadline, the grade declines by one half-letter (A to A-, B+ to B, etc.), except in cases of excused absence. Papers later than 1 week will not be accepted. One of the first two assigned papers may be rewritten for a regrade.

4. *Quizzes* (10%)

Five in-class quizzes will be given during the semester (see dates below). Each quiz will consist of questions about assigned reading and/or key issues previously raised in class, and will be worth 2% of the overall grade. No make-up quizzes will be given, except in cases of excused absence.

5. *Extra credit* (maximum 5%)

Throughout the semester, there will be talks at the U relevant to the course. I will announce upcoming talks in class; if you know of one that hasn't been announced, please let me know ASAP. You can receive extra credit for attending a talk and writing a short (1-2 page) report describing its relation to issues in the course.

University policies:

• *The Americans with Disabilities Act:* The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, (801) 581-5020. CDS will work with you and the instructor to make arrangements

for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.

- *Addressing Sexual Misconduct*: Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

- *Drop/Withdrawal deadlines*: The last day to drop classes is Fri., Aug 31; the last day to withdraw from this class is Fri., Oct 19. Please check the academic calendar for more information pertaining to dropping and withdrawing from a course. Withdrawing from a course and other matters of registration are the student's responsibility.

- *Standards of Academic Conduct*: In order to ensure that the highest standards of academic conduct are promoted and supported at the University, students must adhere to generally accepted standards of academic honesty, including but not limited to refraining from cheating, plagiarizing, research misconduct, misrepresenting one's work, and/or inappropriately collaborating. For more information, see: <http://regulations.utah.edu/academics/6-400.php>

- *Accommodation Policy* (Sections O and Q): <http://regulations.utah.edu/academics/6-100.php>

Course policies:

- *Advising*: see <<http://philosophy.utah.edu/undergraduate/contact-advisor.php>>

- *Attendance and punctuality*: Success in this course requires showing up. Regular attendance is expected of everyone enrolled (see <http://regulations.utah.edu/academics/6-100.php>, Section O). Participation in discussion obviously requires attendance, so absences reduce this portion of your grade. In addition, many ideas and arguments relevant to the written assignments will be discussed in class. So absence puts one at a serious disadvantage. If you miss more than two classes consecutively, please see me asap to catch up on material you've missed. If you are absent on a day that an assignment is due, you will need to show that the absence is excused (due to illness, emergency, or similarly unavoidable circumstance) before handing in that assignment. If you are aware of any scheduling conflicts with class meetings, please see me asap so accommodations can be made in advance. For details on accommodations other than scheduling, see Section Q of the Accommodations Policy (<http://regulations.utah.edu/academics/6-100.php>). Punctuality is also expected. Arriving late to class will result in a lower participation grade for that day.

- *Deadlines*: All written material is due in class, hard-copy, at the beginning of the class meeting. Exceptions can be made only for excused absence situations. Plan ahead, and start early!

- *Electronic etiquette*: Please turn off all electronic devices during class, except those required for note-taking and to access texts.

- *Food and drink*: Please do not bring food and drink to class.
- *Plagiarism*: “Plagiarism” means the intentional unacknowledged use or incorporation of any other person's work in, or as a basis for, one's own work offered for academic consideration or credit or for public presentation. Plagiarism includes, but is not limited to, representing as one's own, without attribution, any other individual's words, phrasing, ideas, sequence of ideas, information or any other mode or content of expression (see ‘Student Code’). Proper acknowledgment means using a citation to indicate where you make use of another person’s words or ideas. Citations may be in footnotes, or inserted in the main text; in either case, they should include the author surname and publication date. A bibliography with full citation information should appear at the end of your essay or paper (see course handouts for details and format). If you are unsure how to correctly cite a source or have questions about how the Student Code applies to written work, please consult me or an academic advisor.
- *Scheduling accommodations*: Absences due to participation in officially sanctioned University activities, government obligations, and religious obligations are excused, as a matter of university policy (see <http://regulations.utah.edu/academics/6-100.php>, Section O). If you have any scheduling conflicts with assignment due dates for these reasons, please let me know asap so accommodations can be made in advance.
- *Student code*: The Student Code (see: <http://regulations.utah.edu/academics/6-400.php>) applies throughout the course. If you have specific questions about its application in this course, consult me asap.
- *Wellness*: Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student’s ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at www.wellness.utah.edu or 801-581-7776.

Schedule of Topics and Readings: ¹

Introduction

M 8/20 Course introduction

Noble (2006) ‘Introduction’ (ix-xi)

W 8/22 Discussion: significance of DNA (I)

Think-piece 1 due (1 page)

Watson and Crick (1953) ‘Genetical implications of the structure of DNA’

Cells: units of life?

F 8/24 The cell theory

Schwann (1847) ‘Microscopical researches into the accordance in the structure and growth of animals and plants’ (excerpt)

¹ There may be minor changes to the assigned readings and/or assignment due-dates as the semester progresses. Any such changes will be announced at least one week in advance, in class and by email announcement.

M 8/27 The cell theory, cont. **Think-piece 2 due** (1-2 pages)
Schwann (1847) – review
Coleman (1977) Chapter 2 (excerpt) ‘Form: cell theory’

W 8/29 Interlude on method (I): microscopic observation
Hacking ‘Microscopes’ (186-209)
esp. 186-192, 200-202 (‘Truth in microscopy’), 208-209 (‘Scientific realism’)

F 8/31 Interlude on method (II): the logic of scientific method {*abbreviated class meeting*}
French (2007) ‘The inductive account’

M 9/3 Labor Day holiday, no class

W 9/5 Professor away, no class

F 9/7 Our cells, ourselves **Think-piece 3 due** (1-2 pages)
Landecker (2007) ‘HeLa’

Mendel’s factors

M 9/10 Mechanisms of heredity (I) **Quiz 1 (in-class)**
Mendel (1865) ‘Experiments in plant hybridization’ (esp. Sections 1, 3, 7)

W 9/12 Mechanisms of heredity (II)
Mendel (1865) ‘Experiments in plant hybridization’ (focus on Sections 9-11)
Sterelny and Griffiths (1999) ‘What is Mendelian genetics?’ (p.113 and Section 6.2)

F 9/14 Laws of heredity?
Olby (1979) ‘Mendel no Mendelian?’ (excerpt)
Chalmers (1999) ‘Why should the world obey laws?’

M 9/17 The concept of genotype **Quiz 2 (in-class)**
Johannsen (1911) ‘The genotype conception of heredity’ (pages 129-35, 143, 153-5, 159)

W 9/19 Mendel’s factors, conclusion **Paper 1 assigned**
Barrett (1995) ‘The behavior of hawkweeds’

DNA and genes

F 9/21 The structure of DNA
Watson and Crick (1953) ‘Molecular structure of nucleic acids’

M 9/24 Genes, mapping, and DNA
Watson and Crick (1953) ‘Genetical implications of the structure of DNA’
Noble (2006) ‘DNA mania’ (pages 3-10)

W 9/26 The Central Dogma **Paper 1 due** (in class, hard copy)
Crick (1970) 'Central Dogma of molecular biology' (focus on diagrams)

F 9/28 What is a gene? **Guest lecture: Steve Downes**
Griffiths and Stotz (2007) 'Gene' (pages 85-92)
recommended: Downes (2004) 'Alternative splicing, the gene concept, and evolution'

M 10/1 Professor away, no class

W 10/3 Classical and molecular genetics
Sterelny and Griffiths (1999) 'How theories relate' (Section 6.1)
Kitcher (1984) '1953 and all that' (excerpt)

F 10/5 Genes and reductionism **Quiz 3 (in-class)**
Sterelny and Griffiths (1999) 'Reduction: for and against'
Noble (2006) 'Downward causation' (pages 33-35, 42-54)

10/6-10/14 **Fall Break**

M 10/15 Professor away, no class

W 10/17 Genetic determinism **Guest lecture: James Tabery**
Aspinwall et al (2012) 'The double-edged sword'
Denno (2013) 'What real-world criminal cases tell us about genetics evidence'

Genomes and systems

F 10/19 Sequencing genomes **Paper 2 assigned**
National Academies (1988) 'Mapping and sequencing the human genome' (Ch1 only)
International Human Genome Sequencing Consortium (2001) 'Initial sequencing and analysis of the human genome' (*Introduction and Concluding thoughts* only)

M 10/22 Understanding genomes
Gannett, Lisa (2014) 'The Human Genome Project' (esp Sections 2.1.3-2.1.5)

W 10/24 Networks and landscapes
Baribási (2002) 'The map of life'
Fagan (2012) 'Waddington redux' (excerpt)

F 10/26 Transitions in biology
Brenner (1999) 'Theoretical biology in the third millennium'
Keller (2005) 'The century beyond the gene'

M 10/29 Professor away, no class

- W 10/31 Systems Biology (I) **Paper 2 due**
 Kitano (2002) ‘Systems biology: a brief overview’
 Fagan (2013) ‘Systems biology’ and ‘Mathematical models’
- F 11/2 Undergraduate research opportunities **Guest lecture: Stephanie Shiver**
- M 11/5 Systems Biology (II)
 Kitano (2017) ‘Biological complexity and the need for computational approaches’
- W 11/7 Systems Biology (III) **Think-piece 4 due** (1-2 pages)
 O’Malley & Dupré (2005) ‘Fundamental issues in systems biology’
- F 11/9 Principles of life
 Mesarović et al (2004) ‘Search for organizing principles’ (skim mathematics)
- M 11/12 Genetic regulatory networks: principled models?
 Davidson (2009) ‘Network design principles from the sea urchin embryo’
- W 11/14 Mechanistic explanation **Quiz 4 (in-class)**
 Machamer et al (2000) ‘Thinking about mechanisms’ (focus on Sections 1-2, 7-8)
- F 11/16 Mechanistic explanation, cont.
 Bechtel (2011) ‘Mechanism and biological explanation’ (Sections 1-2, 7-8)
recommended: Green et al (2018) ‘Network analyses in systems biology’
- Syntheses and simulations**
- M 11/19 Creating cells?
 Gibson et al (2010) ‘Creation of a bacterial cell’
- W 11/21 Synthetic biology **Quiz 5 (in-class)**
 Endy (2005) ‘Foundations for engineering biology’
 Roosth (2017) ‘Life by design’ (pages 26-36)
- F 11/23 Thanksgiving holiday, no class
- M 11/26 Synthetic biology, continued
 O’Malley (2009) ‘Making knowledge in synthetic biology’
- W 11/28 Engineering life
 Elowitz and Lim (2010) ‘Build life to understand it’
<http://www.elowitz.caltech.edu/movies.html>
 Elowitz and Leibler (2000) ‘A synthetic oscillatory network of transcriptional regulators’
- F 11/30 Broader impacts
 Specter (2009) ‘A life of its own’
 Roosth (2017) ‘We shall be as gods’ (pages 42-48)

M 12/3 Computational biology - The Game of Life

Gardner (1970) 'The fantastic combinations of John Conway's new solitaire game "life"'
see also: Hensel 'Conway's Game of Life' < <http://www.ibiblio.org/lifepatterns/> >

W 12/5 Knowledge from simulation **Paper 3 assigned**

Winsberg (2015) 'Computer simulations in science' (SEP entry, Sections 1, 3)

R 12/13 Knowledge from simulation, cont. {*Make-up class: scheduled final exam*}

Winsberg (2010) 'Methodology for a virtual world'

Paper 3 discussion

M 12/17 **Paper 3 due** (online, Canvas, by 5pm)