

Philosophy of Biology and the Life Sciences

Instructor: Stavros Ioannidis

Day/time: Thursday 15.15 - 18.00, Library

Office hours: Monday 18.00 - 19.00 (old building, ground floor, first office on your left)

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The aim of the course is to systematically study the central problems of the philosophy of biology. We will study conceptual issues that arise within the life sciences (the levels of selection, the concept of function, of biological species, of the gene, of genetic information etc), more general issues in the philosophy of science applied to the life sciences (e.g. explanation, reduction, causality), as well as philosophical questions that arise from the application of the evolutionary way of thinking to traditional philosophical problems (e.g. human nature, mind, ethics).

Structure of the course

The course consists of **5 thematic units**:

1 Philosophical issues in evolutionary biology

Weeks 2-5 (evolution, natural selection, adaptation, adaptationism, niche construction, teleology, units of selection)

2 The ontology of evolution

Weeks 6-7 (organisms, biological individuals, biological species, higher taxa)

3 Philosophical issues in genetic and molecular biology

Weeks 8-10 (reductionism, gene, genetic causation, genetic information)

4 Biology as a science

Week 11 (biological laws and mechanisms, complexity, evolutionary progress, life)

5 Evolution and human nature

Weeks 12-13 (sociobiology, evolutionary psychology, cultural evolution, human nature, evolutionary ethics)

Learning outcomes

The main aim of the course is to introduce students to the central concepts and problems of contemporary philosophy of biology and more generally to the philosophical questions raised by modern life sciences. Upon successful completion of the course, students will be able to:

- identify the main debates and controversies in contemporary philosophy of biology
- explain the central concepts to be studied in the course
- critically analyse the various philosophical views and arguments in philosophy of biology
- read, understand and critically analyse philosophical and scientific articles on issues in philosophy of biology
- form their own views and arguments

- present in class an analysis of a philosophical account of a main issue in philosophy of biology
- compose a philosophical essay

Course requirements

- Paper presentation
- Final paper (4,500-5000 words)

Final Paper due: 7 June

Main bibliography

- PB** Godfrey-Smith, P. (2016) *Philosophy of Biology*, Princeton University Press.
- G** Griffiths, P.E. & K. Stoltz (2013) *Genetics and Philosophy: an introduction*, New York: Cambridge University Press.
- HR** Hull, D. L. & Ruse, M. (2017) *The Cambridge Companion to the Philosophy of Biology*, Cambridge University Press.
- RM** Rosenberg, A. & McShea, D. (2008) *Philosophy of Biology: A Contemporary Introduction*, Routledge.
- CIEB** Sober, E. (ed.) (2006) *Conceptual Issues in Evolutionary Biology*, Cambridge, Massachusetts: MIT Press.
- DG** Sterelny, K. (2003) *Dawkins Vs Gould: Survival of the Fittest*, Icon Books.
- SaD** Sterelny, K & Griffiths, P. (1999) *Sex and death: an introduction to philosophy of biology*, University of Chicago Press.
- SEP** Stanford Encyclopedia of Philosophy: <http://plato.stanford.edu>

Darwin (1859) *On the Origin of Species* (first edition). (introduction, ch. 1-4, 6, 14)
<http://darwin-online.org.uk/content/frameset?itemID=F373&viewtype=text&pageseq=1>

Weekly schedule

1 Introduction

What is philosophy of biology? Philosophy of biology as a branch of general philosophy of science, and as the study of conceptual and theoretical issues in modern biology. Relationship between philosophy of biology and other branches of philosophy (metaphysics, philosophy of mind, epistemology). Brief overview of the history of biology with emphasis on the Darwinian revolution, the creation of Modern Synthesis, and the development of molecular biology. Introduction to major concepts of biology: evolution, natural selection, adaptation, gene, organism.

Recommended reading:

- PB ch. 1
- SaD ch. 1

2 Evolution and natural selection

The structure of Darwin's long argument in *Origin of Species*, the evidence for evolution, and the theory of natural selection in Darwin and neo-Darwinism: Lewontin's characterisation, the concept of fitness and the tautology problem. Origin explanations vs distribution explanations. The concept of the adaptive landscape. What exactly does it mean for a character to be an adaptation? Adaptive traits vs adaptations. Natural selection explanations vs creationist explanations of adaptations.

Recommended reading:

PB 28-42

SaD ch. 2

William Paley (1802) *Natural Theology*, κεφ. 1+2:

<http://darwin-online.org.uk/content/frameset?itemID=A142&viewtype=text&pageseq=1>

3 Adaptationism and niche construction

The 'Panglossian Paradigm', the notion of a spandrel and Gould & Lewontin's critique of adaptationism; kinds of adaptationism and kinds of non-adaptive explanations of evolution; the notion of constraints; niche construction theory as a new way of looking at the relationship between organisms and the environment. Can an adaptationist hypothesis/the adaptationist programme be falsified?

Recommended reading:

SaD ch. 10+11

PB 50-59

RM ch. 3

Amundson (1994) 'Two concepts of constraint: adaptationism and the challenge from developmental biology', *Philosophy of Science* 61: 556-578.

Godfrey-Smith (2001) 'Three Kinds of Adaptationism' in Orzack & Sober (eds) *Adaptationism and Optimality*, CUP.

Gould & Lewontin (1979) 'The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme' [CIEB]

Gould & Vrba (1982) 'Exaptation—a missing term in the science of form', *Paleobiology* 8: 4-15.

Lewontin (1978) 'Adaptation', *Scientific American* 239: 212– 228.

Lewontin (1983) 'The Organism as Subject and Object of Evolution', *Scientia* 188: 65–82.

Maynard Smith (1978) 'Optimization theory in evolution' [CIEB]

Odling-Smee et al (1996) 'Niche construction', *American Naturalist* 147: 641-648.

Orzack & Sober (1994) 'Optimality Models and the Test of Adaptationism', *American Naturalist* 143: 361-380.

Pigliucci & Kaplan (2000) 'The fall and rise of Dr Pangloss: adaptationism and the Spandrels paper 20 years later', *Tree* 15: 66-70.

West-Eberhard (2005) 'Developmental plasticity and the origin of species differences', *PNAS* 102: 6543-6549.

4 Teleological concepts in biology

The place of teleological notions in modern biology. Does the theory of evolution through natural selection show that these notions should be eliminated from biology? The distinction between accidents and function and recent theories of function and functional

explanation. Is reference to function always an indirect reference to evolutionary history? The distinction between adaptation and exaptation. The concept of agency.

Recommended reading:

PB 59-65
RM ch. 1

Amundson & Lauder (1994) 'Function Without Purpose', *Biology and Philosophy* 9: 443-469.

Bigelow & Pargetter (1987) 'Functions', *Journal of Philosophy* 84:181-196.

Cummins, R. (1975) 'Functional analysis', *Journal of Philosophy* 72: 741-765.

Godfrey-Smith (1993) 'Functions: consensus without unity', *Pacific Philosophical Quarterly* 74: 196-208

Hempel (1965) 'The Logic of Functional Analysis' in *Aspects of Scientific Explanation*, New York: Free Press.

Millikan (1989) 'In Defense of Proper Functions', *Philosophy of Science* 56: 288-302.

Wright (1973) 'Functions', *Philosophical Review* 82: 139-68.

5 The units of selection and the gene's-eye view of evolution

Does selection act only on individuals, or can it also act at lower levels (e.g. genes) as well as at higher ones (e.g. group, species)? Williams' critique of group selection and Dawkins' gene's-eye view of evolution. Kin selection, contemporary views on group selection, realist vs. anti-realist views on units of selection and Maynard Smith and Szathmáry's framework of the major transitions in evolution.

Recommended reading:

PB 42-49, 93-99

DG part 2

SaD ch. 3-5 + 8

RM ch. 6

Lloyd 'Units and Levels of Selection' [SEP]

Okasha (2001) 'Why Won't the Group Selection Controversy Go Away?', *British Journal for the Philosophy of Science* 52: 25-50.

Sterelny (1996) 'The Return of the Group', *Philosophy of Science* 63: 562-584.

6 Organisms and biological individuals

What conditions must be met for something to be a biological individual? We will start with traditional philosophical theories on individuality and then focus on recent theories of biological individuality. Questions to be examined: What is the relationship between organisms and Darwinian individuals? Can parts of organisms constitute Darwinian individuals? Are groups of organisms (e.g. assemblages of bacteria) biological individuals? The evolution of biological individuality.

Recommended reading:

PB 66-80

Wilson, R. (2007) 'The biological notion of individuality' [SEP]

O'Malley and Dupre (2007) 'Size doesn't matter: towards a more inclusive philosophy of biology', *Biology and Philosophy* 22: 155-191.

7 Biological species and higher taxa

The concept of biological species has been a contentious issue among biologists and philosophers since the time of Darwin (and even earlier). We will examine some central species concepts, as well as various philosophical issues raised by species concepts (realist vs. anti-realist views, pluralist vs. monist views). Central questions to be examined: What kind of entities are biological species, sets, natural kinds, individuals or something else? Do species have essences? What is the ontological status of the tree of life, and what is its relation to the species concept? What is population thinking? We will also examine philosophical issues raised concerning higher taxa.

Recommended reading:

PB 100-119

SaD ch. 9

Hey (2006) 'On the failure of modern species concepts', *Trends in Ecology & Evolution* 21:447-450.

Hull (1976) 'Are species really individuals?', *Systematic Zoology* 25: 174-191.

Kitcher (1984) 'Species', *Philosophy of Science* 51: 308-333.

Mayr 'Typological versus Population Thinking' [CIEB]

Okasha (2002) 'Darwinian Metaphysics: Species and the question of essentialism', *Synthese* 131: 191-213.

Padian & Horner (2002) 'Typology versus transformation in the origin of birds', *Trends in Ecology & Evolution* 17:120-124.

8 The concept of the gene

The concept of the gene has been the most important concept of biology during the past century. Central aspects of classical and molecular genetics will be discussed, as well as the plurality of gene concepts in modern biology and the historical sources of each concept. Issues to be examined: the relationship between genes and genetic causation; the concepts of the genetic code and the genetic program; theories of heredity before and after the early 20th century; the relationship between genes and development; recent views on genetic causation; the relationship between genes and epigenetics.

Recommended reading:

PB 81-93

G κεχφ. 1+2

Rheinberger 'Gene' [SEP]

Griffiths & Neumann-Held (1999) 'The many faces of the gene', *Bioscience* 49: 656-662.

9 Reductionism in biology

Nagelian reduction of and attempts to apply it to the case of the relationship between classical and molecular genetics. Contemporary views of ontological reductionism: are biological facts reducible to chemical or physical facts? The historical controversies between mechanists, vitalists and organicists. Is mechanistic explanation a form of reductionist explanation?

Recommended reading:

G ch. 3+4

SaD, ch. 6+7

RM ch. 4

Brigandt & Love (2007) 'Reductionism in Biology' [SEP]

Waters (2007) 'Molecular Genetics' [SEP]

Fodor, J. (1974) 'Special Sciences', *Synthese* 28: 77-115.

Kitcher, (1984) '1953 and All That: A Tale of Two Sciences' [CIEB]

Oppenheim & Putnam (1958) 'Unity of Science as a Working Hypothesis', *Minnesota Studies in the Philosophy of Science* 2: 3-36.

Rosenberg, A. (2007) 'Reductionism (and Antireductionism) in Biology' in Hull & Ruse (2007) *The Cambridge Companion to the Philosophy of Biology*, New York: Cambridge University Press.

Sober, E. (1999) 'The multiple realizability argument against reductionism' [CIEB]

Waters, C. K. (1990) 'Why the antireductionist consensus won't survive the case of classical genetics' [CIEB]

10 Genetic information

How should the concept of biological information be understood? Shannon's theory of information, teleosemantics and other views on biological information. The concept of the genetic programme; biological communication. Do such concepts point to a deeper distinction between the life sciences and sciences such as physics and chemistry?

Recommended reading:

PB 144-157

G ch. 5+6

Godfrey-Smith & Sterelny 'Biological Information' [SEP]

Maynard Smith (2000) 'The Concept of Information in Biology', *Philosophy of Science* 67: 177-194.

11 Biological laws and mechanisms

Are there biological laws, and if yes, are they of a different nature from those of physics? Is biology a different kind of science from sciences like physics and chemistry (perhaps because of its historical character)? Recent views on the existence of laws in biology; the nature of explanation and prediction in historical sciences such as evolutionary biology; the place of mechanisms in biology. What is the relationship between laws and mechanisms? Do mechanisms make laws redundant? Complexity and its relationship to mechanisms and biological laws; the concept of evolutionary progress; the concept of life.

Recommended reading:

PB 11-27

SaD ch. 15.2

DG part 3

RM ch. 2

Beatty, J. (1995) 'The Evolutionary Contingency Thesis' [CIEB]

Brandon (1997) 'Does biology have laws?', *Philosophy of Science* 64: Supplement.

Cleland (2011) 'Prediction and Explanation in Historical Natural Science', *British Journal of Philosophy of Science* 62: 551-582.

Machamer et al (2000) 'Thinking about mechanisms', *Philosophy of Science* 67: 1-25.

Sober, E. (1997) 'Two Outbreaks of Lawlessness in Recent Philosophy of Biology' [CIEB]
Waters (1998) 'Causal Regularities in the Biological World of Contingent Distributions',
Biology and Philosophy 13: 5–36.

12 Evolutionary explanations of social behaviour

How can altruism emerge from the interactions of selfishly behaving organisms? Sociobiology and evolutionary explanations of cooperative behaviour in humans and other organisms. Evolutionary game theory and theories of the evolution of cooperation in human societies.

Recommended reading:

PB 120-136

SaD ch. 13

Alexander, J. M. 'Evolutionary Game Theory' [SEP]

Axelrod & Hamilton (1981) 'The evolution of cooperation', *Science* 211: 1390-1396.

13 Cultural evolution and human nature

Can psychological and cultural phenomena be explained evolutionarily? Evolutionary psychology and its relationship with sociobiology; universal Darwinism; theories of cultural evolution. The relationship between evolution and ethics and the implications of evolutionary biology for the question of whether there is a 'human nature'. Should an evolutionary theory of human behavior adopt genetic determinism? Is the mind 'massively modular', as evolutionary psychologists claim? Should we expect that we have Stone Age minds today?

Recommended reading:

PB 45-49, 136-143

SaD ch. 13

RM ch. 7

Downes 'Evolutionary Psychology' [SEP]

Hull (1986) 'On human nature', *PSA 1986 Volume 2*: 3-13.

Kitcher (1993) 'Four ways of "biologizing" ethics' [CIEB]

Lewens (2006) 'Memes' in *Darwin*, Routledge.

Machery 'A plea for human nature', *Philosophical Psychology* 21: 321–329.

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1	Introduction	PB ch. 1	
2	Evolution and natural selection	PB 28-42	
3	Adaptationism and niche construction	PB 50-59	
4	Teleological concepts in biology	PB 59-65	
5	The units of selection and the gene's-eye view of evolution	PB 42-49 93-99	DG part 2
6	Organisms and biological individuals	PB 66-80	
7	Biological species and higher taxa	PB 100-119	
8	The concept of the gene	PB 81-93	
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