

Philosophy of Biology
PHIL*6740 (2017)
Monday 7-10 pm



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Hours: by appointment

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Hours: Mon. 4-5 or appointment

Course Theme: Individuality and Variation in Biological Systems

Most of us think of biological “individuals” as medium-sized organisms with integrated parts and discrete boundaries. On this view, lower-level entities such as genes and cells are classified as components, not as individuals unto themselves. Similarly, organisms are generally seen as “real” biological entities, whereas the definition and status of higher levels (species and higher-level taxonomic categories, communities, ecosystems, etc.) remains the subject of much debate. Thus, on this view, organisms appear to occupy a privileged place in biology and in nature.

But how accurate is this picture? Are organisms really so special? Or, might our focus on them just be a matter of convention since we, ourselves, are medium-sized organisms? Perhaps it is more informative to view the world as a nested hierarchy of individuals. Lineages of genes, cells, or even communities might then be viewed as having their own (level-specific) evolution and ecology. To address these questions we will investigate how individuals are identified and studied across various disciplines, ranging from genomics to ecology, and what features and processes are relevant at their respective levels.

General Description

The course is designed with two types of student in mind: philosophy students interested in how biology might inform their understanding of the world, and biology students interested in how a philosophical perspective sheds light on the foundational assumptions of their discipline. We have therefore tailored this course to be accessible to students even if they have little or no expertise in one or the other of these disciplines.

Format and Grading

The seminar usually contains a mix of both philosophy and biology students, with an emphasis on building bridges between these disciplines. To this end we assign discussion questions to be completed by small groups outside of class. They are then discussed in class as a group. In some weeks, particular groups will be responsible for leading the discussion. Taken as a whole, participation counts for 30% of the final grade

Students will write two papers. A short paper (worth 30%) will be due on approximately week six. Students will be supplied with a choice of topics and a set of writing guidelines. The final paper (40%) is due at the end of semester. Students are free to write on any theoretical topic, regardless of whether it was covered in class, provided that it has instructor approval.

Outline

Weeks 2 & 3 - Selfish Genes and Higher Levels

Selfish gene theorists like Dawkins and Trivers downplay the importance of organisms in favour of individual alleles. We will consider the arguments in favour of this perspective as well as some responses from multi-level selection theorists.

- Okasha, Samir (2006), "The levels of selection debate: philosophical issues. *Philosophy Compass* 1:74-85.
- Kerr, Benjamin & Godfrey-Smith, Peter (2002), "Individualists and multi-level perspectives on selection in structured populations. *Biol. & Philosophy* 17: 477-517.
- Sober, E & Wilson, D.s. (2002) "Perspectives and Parameterizations *Commentary on Benjamin Kerr and Peter Godfrey-Smith's 'Individualist and Multi-Level Perspectives on Selection in Structured Populations'*". *Biology and Philosophy*, 17:529-537.
- Okasha, Samir (2016), The Relation between Kin and Multilevel Selection: An Approach Using Causal Graphs. *British Journal for the Philosophy of Science*, 67: 435-470.

Weeks 4 & 5 - Genomics and Junk DNA

There is a popular tendency to classify genetic elements as either 'junk' or 'functional' according to whether they provide some benefit to the whole organism. We will review the history of this distinction and consider some alternatives such as multi-level selection and genome-level ecology.

- Pierre Capy, Giuliano Gasperi, Christian Biémont and Claude Bazin (2000), “Stress and transposable elements: co-evolution or useful parasites?” *Heredity*, 85:101-106.
- Agren, Arvid (2016), “Selfish genetic elements and the gene’s eye view of evolution.” *Current Zoology* 62: 659-665.
- Elliott, T.A., S. Linquist and T.R. Gregory (2014), “Conceptual and empirical challenges of assigning functions to transposable elements.” *American Naturalist*, 184: 14-24.
- Brunet, Tyler and Doolittle, Ford (2015) “Multilevel selection theory and the evolutionary functions of transposable elements.” *Genome Biology and Evolution*, 7: 2445-2457.

Weeks 6 & 7 – Microbiome and Cancer

Do recent views about the microbiome challenge our common sense picture of the biological individual as a cohesive unit? Should cell lineages sometimes be viewed as individuals with a distinct evolution and ecology, and does this have significance for practical issues such as understanding cancer?

- Scott F. Gilbert, Alfred I. Tauber (2016), “Rethinking individuality: the dialectics of the holobiont.” *Biology & Philosophy* 31(6): 839-853.
- W. Ford Doolittle, Austin Booth (2017), “It’s the song, not the singer: an exploration of holobiosis and evolutionary theory.” *Biology & Philosophy* > 2017(32): 5-24.
- Crespi, Bernard and Summers, Kyle (2007), “The evolutionary biology of cancer. *Trends in Ecology and Evolution*, 20: 545-552.
- Pierre Luc-Germain (2012), “Cancer cells and adaptive explanation.” *Biology and Philosophy*, 27(6): 785-810.
- Christopher Lean, Anya Plutynski (2016), “The evolution of failure: explaining cancer as an evolutionary process.” *Biology & Philosophy*, 31(1): 39-57

Week 8 - Unconventional Life Cycles

Colonial organisms and other species with unconventional life cycles are often cited in discussions about biological individuality. What do such examples show and are they a serious challenge to conventional views of individuality?

- Ereshefsky, Marc & Pedroso, Makmiller (2015), “Rethinking evolutionary individuality.” *Proceedings of the National Academy of Sciences*, 112:10126-10132.
- Ellen Clarke (2016), “Levels of selection in biofilms: multispecies biofilms are *not* evolutionary individuals.” *Biology & Philosophy* , 31: 191-212.
- Thomas Pradeu (2016), “Organisms or biological individuals? Combining physiological and evolutionary individuality.” *Biology & Philosophy*, 31: 797-817

Week 9 & 10 - Species and Major Transitions

To what extent can species be viewed as biological individuals and how does this change our understanding of their evolution? Do major transitions in the history of life involve the emergence of new levels of organization or new kinds of biological individual?

- Okasha, Samir (2005), "Multilevel Selection and the Major Transitions in Evolution." *Philosophy of Science* 72: 1013-1025
- Michod, Richard E. (2007), "Evolution of individuality during the transition from unicellular to multicellular life." *Proceedings of the National Academy of Science*, 104: 8613-8618.
- Rainey, Paul B. and Kerr, Benjamin (2010), "Cheats as first propagules: A new hypothesis for the evolution of individuality during the transition from single cells to multicellularity." *Bioessays*, 32:872-880.
- West, S.A. Fisher, R.M. Gardner, A. and Kiers, E.T. (2015), "Major evolutionary transitions in individuality." *Proceedings of the National Academy of Science*, 112: 10112-10119.
- O'Malley, M and Powell, R. (2016), "Major problems in evolutionary transitions: How a metabolic perspective can enrich our understanding of macroevolution." *Biology and Philosophy*, 31:159-189.

Weeks 11 & 12 – Ecological Communities and Gaia

In this section we consider some of the competing definitions of ecological communities and whether they qualify as individuals. We conclude by exploring a recent defense of the controversial idea that the entire Earth is best understood as a self-regulating individual

- Odenbaugh, Jay (2007), "Seeing the Forest *and* the Trees: Realism about Communities and Ecosystems." *Philosophy of Science* 74:628-641.
- Bouchard, Frederic (2014), "Ecosystem evolution is about variation and persistence, not populations and reproduction." *Biological Theory* 9:382-391.
- Doolittle, W.F. (2014) "Natural selection through survival alone, and the possibility of Gaia." *Biology and Philosophy* 29:415-423.
- Millstein, Roberta L. (forthcoming), "Is Aldo Leopold's 'Land Community' an Individual?" in O. Bueno, R. Chen, and M. B. Fagan (eds.), *Individuation across Experimental and Theoretical Sciences*, Oxford: Oxford University Press.
- Garcia, R.K. & J.A. Newman. 2016. "Is it possible to care for ecosystems? Policy paralysis and ecosystem management." *Ethics, Policy & Environment*, 19:170-182.

Please see the following link for College of Arts standard statements about expectations and requirements for students: <https://www.uoguelph.ca/arts/standard-statements-winter-2017>