**Division of Humanities**
**Course Syllabus**

**Course Code:** HUMA5902
**Course Title:** Philosophy of Biology
**Course Offered in:** Fall 2026
**Course Instructor:** Prof. Yafeng SHAN (Office: 3356; Office Hours: 1 – 2 pm on Mondays; Email: hmyfshan@ust.hk)

**Course Description:**
This module will provide students with the opportunity to become involved in contemporary issues in the philosophy of biology. The students will be provided with an overview of the history of the biological sciences (especially evolutionary biology and genetics). In addition, the module will cover some of the central issues in the philosophy of biology, including reductionism, scientific change, level of selection, design and creationism, and examine some important concepts in the life sciences such as 'gene', 'species', and 'causation'.

**Course Intended Learning Outcomes (ILOs):**

| On successful completion of the proposed course, students will be able to: | |
|---|---|
| 1. | Grasp an overview of the historical development of evolutionary biology and genetics and its cultural background |
| 2. | Demonstrate an advanced understanding of central theoretical debates in the biological sciences within their cultural context |
| 3. | Demonstrate an advanced understanding of key concepts in the biological sciences |
| 4. | Demonstrate intellectual originality in their writing |
| 5. | Consider the views of others, whether spoken or written, and develop a critique that furthers investigation |
| 6. | Demonstrate their capacity to conduct extensive research and original, independent study |
| 7. | Construct and evaluate methodologies and arguments as well as propose new hypotheses |

**Course Outline:**

| **Week** | |
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|---|---|
| **1** | Origins of Evolutionary Biology |
| **2** | Origins of Genetics |
| **3** | Reductionism (1): Biology and Chemistry |
| **4** | Reductionism (2): Classical Genetics and Molecular Genetics |
| **5** | Scientific Change in Biology (1): What is the Unit of Analysis? |
| **6** | Scientific Change in Biology (2): From the Modern Synthesis to the Extended Synthesis |
| **7** | Genes |
| **8** | Species |
| **9** | Proximate and Ultimate Causation |
| **10** | Conceptual Change in Biology |
| **11** | Units and Levels of Selection |
| **12** | Fitness and Adaptation |
| **13** | Design and Creationism |

**Assessment and Grading**

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

**Assessment Tasks:**

Summative essay: A 3,500-word essay 100 %

Participation in class and worksheets: Presentation (each student is required to do one presentation.) 0 %

*Late submissions of summative essay will be penalised. 10% deduction applies per delayed day. Missing submissions will lose all the grades.
**Using AI is not allowed at any stage of writing. Otherwise, 100% deduction applies.

**Final Grade Descriptors:**

| Grades | Short Description | Elaboration on subject grading description |
|---|---|---|
| A | Excellent Performance | Shows an excellent understanding of key concepts and arguments. Shows some original thinking. |
| B | Good Performance | Shows a very good or sophisticated understanding of key concepts and arguments. Shows some critical thinking. |
| C | Satisfactory Performance | Shows a good understanding of key concepts and arguments. |
| D | Marginal Pass | Shows a fair understanding of key concepts and arguments. |
| F | Fail | Shows an inadequate understanding of key concepts and arguments. Shows limited ability to think critically. |

**Course AI Policy**

Using AI is not allowed at any stage of writing. Otherwise, 100% deduction applies.

**Communication and Feedback**

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include comments on strengths and areas for improvement. Students who have further questions about the feedback including marks should consult the instructor within five working days after the feedback is received.

**Resubmission Policy**

No resubmissions will be allowed.

**Readings:**

**Week 1**

**Topic: Origins of Evolutionary Biology**

***Required Reading***

Radick, G. (2003). Is the theory of natural selection independent of its history? In G. Radick & J. Hodge (Eds.), *The Cambridge Companion to Darwin* (pp. 143–167). Cambridge University Press.

***Further Reading***

Borrello, M. E. (2021). The Historiography of Modern Evolutionary Biology. In M. R. Dietrich, M. E. Borrello, & O. Harman (Eds.), *Handbook of the Historiography of Biology* (pp. 33–58). Springer International Publishing.

Tanghe, K. B., Pauwels, L., de Tiège, A., & Braeckman, J. (2021). Interpreting the History of Evolutionary Biology through a Kuhnian Prism: Sense or Nonsense? *Perspectives on Science*, *29*(1), 1–35.

Mayr, E. (1982). *The Growth of Biological Thought*. Belknap Press. (pp.301-632)

**Week 2**

**Topic: Origins of Genetics**

***Required Reading***

Shan, Y. (2020). Mendel's Pisum Revisited. In *Doing integrated history and philosophy of science: A case study of the origin of genetics*. Springer.

***Further Reading***

Darden, L. (1991). *Theory Change in Science: Strategies from Mendelian Genetics*. Oxford University Press.

Gayon, J. (2016). From Mendel to epigenetics: History of genetics. *Comptes Rendus Biologies*, *339*(7), 225–230.

Sandler, I. (2000). Mendel's Legacy to Genetics. *Genetics*, *154*(1), 7–11.

Müller-Wille, S., & Richmond, M. L. (2016). Revisting the Origin of Genetics. In S. Müller-Wille & C. Brandt (Eds.), *Heredity Explored: Between Public Domain and*

*Experimental Science, 1850-1930* (pp. 367–394). MIT Press.

Shan, Y. (2020). De Vries' Mendelism Reassessed. In *Doing integrated history and philosophy of science: A case study of the origin of genetics*. Springer.

Shan, Y. (2021). Beyond Mendelism and Biometry. *Studies in History and Philosophy of Science*, *89*, 155–163.

**Week 3**

**Topic: Reductionism (1): Biology and Chemistry**

***Required Reading***

Keller, E. F. (2010). It is possible to reduce biological explanations to explanations in chemistry and/or physics. In F. J. Ayala & R. Arp (Eds.), *Contemporary Debates in Philosophy of Biology* (pp. 19–31). Wiley-Blackwell.

Dupré, J. (2010). It is not possible to reduce biological explanations to explanations in chemistry and/or physics. In F. J. Ayala & R. Arp (Eds.), *Contemporary Debates in Philosophy of Biology* (pp. 32–48). Wiley-Blackwell.

***Further Reading***

**Week 4**

**Topic: Reductionism (2): Classical Genetics and Molecular Genetics**

***Required Reading***

Kitcher, P. (1984). 1953 and All That: a Tale of Two Sciences. *The Philosophical Review*, *93*(3), 335–373.

***Further Reading***

Hull, D. L. (1979). Reduction in Genetics. *Philosophy of Science*, *46*(2), 316–320.

Goosens, W. K. (1978). Reduction by Molecular Genetics. *Philosophy of Science*, *45*(1), 73–95.

Vance, R. E. (1996). Heroic Antireductionism and Genetics: A Tale of One Science. *PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association, Volume. 1996*, S36–S45.

Waters, C. K. (1990). Why the Anti-Reductionist Consensus Won't Survive: The Case of Classical Mendelian Genetics. *PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association, Volume. 1990*, 125–139.

**Week 5**

**Topic: Scientific Change in Biology (1): What is the Unit of Analysis?**

***Required Reading***

Shan, Y. (2020). Exemplarising the Origin of Genetics. In *Doing integrated history and philosophy of science: A case study of the origin of genetics*. Springer.

***Further Reading***

Darden, L., & Maull, N. (1977). Interfield Theories. *Philosophy of Science*, *44*(1), 43–64.

Darden, L. (2005). Relations among fields: Mendelian, cytological and molecular mechanisms. *Studies in History and Philosophy of Science Part C :Studies in History and Philosophy of Biological and Biomedical Sciences*, *36*(2 SPEC. ISS.), 349–371.

Waters, C. K. (2004). What was classical genetics? *Studies in History and Philosophy of Science Part A*, *35*(4), 783–809. https://doi.org/10.1016/j.shpsa.2004.03.018

Waters, C. K. (2014). Shifting Attention from Theory to Practice in Philosophy of Biology. In M. C. Galavotti, D. Dieks, W. J. Gonzalez, S. Hartmann, T. Uebel, & M. Weber (Eds.), *New Directions in the Philosophy of Science* (pp. 121–139). Springer.

**Week 6**

**Topic: Scientific Change in Biology (2): From the Modern Synthesis to the Extended Synthesis**

***Required Reading***

Pigliucci, M. (2007). Do we need an extended evolutionary synthesis? *Evolution*, *61*(2), 2743–2749.

Shan, Y. (2024). The extended evolutionary synthesis: An integrated historical and philosophical examination. *Philosophy Compass*, *19*(6), e13002.

***Further Reading***

Futuyma, D. J. (2017). Evolutionary biology today and the call for an extended synthesis. *Interface Focus*, *7*, 20160145.

Gefaell, J., & Saborido, C. (2022). Incommensurability and the extended evolutionary synthesis: taking Kuhn seriously. *European Journal for Philosophy of Science*, *12*, 24.

Laland, K. N., Tobias, U., Feldman, M. W., Kim, S., Müller, G. B., Moczek, A., Jablonka, E., & Odling-Smee, J. (2015). The extended evolutionary synthesis: its structure, assumptions and predictions. *Proceedings of the Royal Society B*, *282*, 20151019.

Müller, G. B. (2017). Why an extended evolutionary synthesis is necessary. *Interface Focus*, *7*(5), 20170015.

Lewens, T. (2019). The Extended Evolutionary Synthesis: what is the debate about, and what might success for the extenders look like? *Biological Journal of the Linnean Society*, *127*(4), 707–721.

**Week 7**

**Topic: Genes**

***Required Reading***

Griffiths, P. E., & Stotz, K. (2007). Gene. In D. L. Hull & M. Ruse (Eds.), *The Cambridge Companion to the Philosophy of Biology* (pp. 85–102). Cambridge

University Press.

***Further Reading***

Falk, R. (1986). What is a Gene? *Studies in History and Philosophy of Science Part A*, *17*(2), 133–173.

Waters, C. K. (1994). Gene made molecular. *Philosophy of Science*, *61*(2), 163–185.

Waters, C. K. (2004). What Concept Analysis in Philosophy of Science Should Be (and Why Competing Philosophical Analyses of Gene Concepts Cannot Be Tested by Polling Scientists). *History and Philosophy of the Life Sciences*, *26*(1), 29–58.

**Week 8**

**Topic: Species**

***Required Reading***

Ereshefsky, M. (2010). Darwin's Solution to the Species Problem. *Synthese*, *175*(3), 405–425.

***Further Reading***

Barker, M. J. (2019). Eliminative Pluralism and Integrative Alternatives: The Case of SPECIES. *The British Journal for the Philosophy of Science*, *70*(3), 657–681.

Brigandt, I. (2003). Species Pluralism Does Not Imply Species Eliminativism. *Philosophy of Science*, *70*(5), 1305–1316.

Devitt, M. (2021). Defending Intrinsic Biological Essentialism. *Philosophy of Science*, *88*(1), 67–82. https://doi.org/DOI: 10.1086/710029

Ereshefsky, M. (1998). Species Pluralism and Anti-Realism. *Philosophy of Science*, *65*(1), 103–120.

**Week 9**

**Topic: Proximate and Ultimate Causation**

***Required Reading***

Laland, K. N., Sterelny, K., Odling-Smee, J., Hoppitt, W., & Uller, T. (2011). Cause and effect in biology revisited: is Mayr's proximate-ultimate dichotomy still useful? *Science*, *334*(6062), 1512–1516.

Shan, Y. (2025). The debate over proximate and ultimate causation in biology. *Synthese*, *205*(1), 37. https://doi.org/10.1007/s11229-024-04890-8

***Further Reading***

Ariew, A. (2003). Ernst Mayr's "ultimate/proximate" distinction reconsidered and reconstructed. *Biology & Philosophy*, *18*, 553–565.

Dickins, T. E., & Barton, R. A. (2013). Reciprocal causation and the proximate–ultimate distinction. *Biology & Philosophy*, *28*, 747–756.

Haig, D. (2013). Proximate and ultimte causes: how come? and what for? *Biology & Philosophy*, *28*, 781–786.

Scholl, R., & Pigliucci, M. (2015). The proximate–ultimate distinction and

evolutionary developmental biology: causal irrelevance versus explanatory abstraction. *Biology & Philosophy*, *30*, 653–670.

Uller, T., & Laland, K. N. (2019). Evolutionary causation. In T. Uller & K. N. Laland (Eds.), *Evolutionary causation* (pp. 1–12). MIT Press.

**Week 10**

**Topic: Conceptual Change in Biology**

***Required Reading***

Shan, Y. (2020). A New Mode of Conceptual Continuity. In *Doing integrated history and philosophy of science: A case study of the origin of genetics*. Springer.

***Further Reading***

Brigandt, I. (2010). The Epistemic Goal of a Concept: Accounting for the Rationality of Semantic Change and Variation. *Synthese*, *177*(1), 19–40.

**Week 11**

**Topic: Units and Levels of Selection**

***Required Reading***

Okasha, S. (2006). The Levels of Selection Debate: Philosophical Issues. *Philosophy Compass*, *1*(1), 74–85.

***Further Reading***

Sober, E., & Lewontin, R. C. (1982). Artifact, cause and genic selection. *Philosophy of Science*, *49*(2), 157–180.

Sterelny, K., & Kitcher, P. (1988). The Return of the Gene. *The Journal of Philosophy*, *85*(7), 339–361.

Waters, C. K. (2005). Why Genic and Multilevel Selection Theories Are Here to Stay. *Philosophy of Science*, *72*(2), 311–333.

**Week 12**

**Topic: Fitness and Adaptation**

***Required Reading***

Matthen, M., & Ariew, A. (2002). Two Ways of Thinking About Fitness and Natural Selection. *Journal of Philosophy*, *99*(2), 55–83.

***Further Reading***

Ariew, A., & Lewontin, R. C. (2004). The Confusions of Fitness. *The British Journal for the Philosophy of Science*, *55*(2), 347–363.

Pence, C. H., & Ramsey, G. (2013). A New Foundation for the Propensity Interpretation of Fitness. *The British Journal for the Philosophy of Science*, *64*(4), 851–881.

Sober, E. (2013). Trait fitness is not a propensity, but fitness variation is. *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of*

*Biological and Biomedical Sciences*, *44*(3), 336–341.

**Week 13**

**Topic: Design and Creationism**

***Required Reading***

Sober, E. (2007). What is wrong with intelligent design? *The Quarterly Review of Biology*, *82*(1), 3–8.

Ratzsch, D. (2010). There Is a Place for Intelligent Design in the Philosophy of Biology: Intelligent Design in (Philosophy of) Biology: Some Legitimate Roles. In F. J. Ayala & R. Arp (Eds.), *Contemporary Debates in Philosophy of Biology* (pp. 343–363). Wiley-Blackwell.

***Further Reading***

NAGEL, T. (2008). Public Education and Intelligent Design. *Philosophy & Public Affairs*, *36*(2), 187–205.