# HPSC0084 Causality, Mechanism and Evidence in Science

# Course Syllabus

2023-24 session | Prof Phyllis Illari| phyllis.illari@ucl.ac.uk

Much of science aims to find and use causes. Does penicillin cure bacterial infection? How big a dose and how often should we give it for it to be effective? Mechanisms are most obviously important in the biomedical sciences, but are relevant far beyond them. For example, we seek to explain how penicillin cures bacterial infection by describing the mechanism by which it kills bacteria in the body. So finding evidence of causes and mechanisms is a core problem of science. Further, our fundamental view of the world we live in has been profoundly affected by the kinds of causes and mechanisms we discover. This module explores the most important views of causality and mechanisms and how we seek evidence for them, and examines how they affect our view of the world around us.

## Course Information

### Basic course information

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|---|---|
| Course website: | |
| Moodle Web site: | https://moodle.ucl.ac.uk/course/view.php?id=38703 |
| Assessment: | Coursework (1 x 1,000 word essay plan, formative) (1 x 4,000 words, assessed, 100%) |
| Timetable: | www.ucl.ac.uk/sts/hpsc |
| Prerequisites: | No pre-requisites, course designed for masters level students |
| Required texts: | Phyllis Illari & Federica Russo: *Causality: Philosophical theory meets scientific practice*, OUP (October 2014); other readings on moodle |
| Course tutor(s): | Phyllis Illari |
| Contact: | phyllis.illari@ucl.ac.uk \| t: 020 7679 2486 |
| Web: | |
| Office location: | 22 Gordon Square, Room 1.2 |
| Office hours: | tbc |

## Schedule

| UCL Week | Topic | Date | Activity |
|---|---|---|---|
| 6 | How do we know what causes what? | | Reading before class |
| 7 | Is causality in the world? | | Reading before class |
| 8 | RCTs and evidence of causality in healthcare | | Reading before class |
| 9 | Is causality based on intervention? | | Reading before class think about essay |
| 10 | Writing philosophy essays | | Think about essay topic |
| 11 | **Reading Week** | **No Lecture** | Reading |
| 12 | Is causality about producing effects? | | Reading before class |
| 13 | Is causality mechanistic? | | Reading before class |
| 14 | Evidence: from formal debate to practice | | Reading before class |
| 15 | Evidential pluralism and causal claims in health | | Reading before class, formative essay due |
| 16 | Evidence, causality, mechanism, policy | | Reading before class, essay feedback |

## Assessments

**Summary**

| | Description | Deadline | Word limit |
|---|---|---|---|
| **Coursework** | 1 x essay plan (FORMATIVE) | 15th November 2023 | 2 pages? |
| **Coursework** | 1 x 4,000 word essay (ASSESSED) | 5.00 pm 2nd January 2024 | 4,000 |

**Assignments**

Essays must be submitted via Moodle. Essay topics to be decided by the student and approved by the course tutor.

**Criteria for assessment**

The departmental marking guidelines for individual items of assessment can be found in the STS Student Handbook. The full criteria will apply to the second, longer essay. The first, shorter essay is intended to be a practice run to develop ideas and gain feedback. We will go over this in class.

## Aims & objectives

**Aims**

The goals of the course are:

- To provide knowledge of the three key themes: Philosophy of Causality, Mechanism and Evidence in science.
- To apply these themes to understand cases from scientific practice, particularly medicine.
- More generally, students will learn how to analyse and assess theoretical concepts and arguments presented for and against them, particularly with respect to scientific problems.
- To develop students' skills in discussing difficult and contested issues concerning scientific methodology around causality and evidence.

**Objectives**

By the end of this course, students will be able to:

- Explain and criticise some of the key arguments and theories concerning causality, mechanism and evidence in contemporary philosophy of science.
- Explain and apply these theories and evaluate standard solutions to their problems in relation to at least one case study from scientific practice.
- Write an extended essay making an argument by applying theory to practice, although that can be either in a theory-led, case-led, or mixed style.

## Reading list

**1 How do we know what causes what?**

Essential Reading

- Illari and Russo, Chapter 6 (and Chapter 2 if required).
- Nancy Cartwright: Will this policy work for you? In Philosophy of Science, 9(5): 973-989.

Questions

1. How do we find out about causes?
2. What is an observational study and an experimental study? What are their advantages and disadvantages?
3. Why do we want to know about causes?
4. Do we always need to know the same things?

Extra Reading

- Cartwright, Nancy D. with Sophia Efstathiou. Hunting Causes and Using Them: Is There no Bridge from Here to There? In *International Studies in the Philosophy of Science*, September 2011 25(3), pp.223-241.
- Cartwright, Nancy (2007). *Hunting causes and using them*. Cambridge University Press, Ch 2, Ch 3.

**2 Is causality in the world?**

Essential Reading

- David Hume, (1975 (1777)). *An Enquiry Concerning Human Understanding* (Posthumous edition edn). Clarendon Press, Oxford. Part II, Section VII 'OF THE IDEA OF NECESSARY CONNEXION', particularly paragraphs 50-51, 58-61. Free online at Project Gutenberg http://www.gutenberg.org/ebooks/9662
- Illari and Russo Chapters 15 and 18.

Questions

1. What is Hume's view about causality?
2. What is the difference between projectivism and realism about causality?
3. What are the primary advantages and disadvantages of each view?
4. Which view do you prefer?

Extra Reading

- Cartwright, Nancy (1979). Causal laws and effective strategies. *Nous*, 13, 419–437
- Beebee, Helen (2007). Hume on causation: The projectivist interpretation. In Huw Price and Richard Corry (eds.) *Causation, physics, and the constitution of reality: Russell's Republic Revisited*, pp.224–49. Clarendon Press, Oxford.
- Psillos, Stathis (2009). Regularity Theories. In *Oxford Handbook of Causation* (ed. H. Beebee, P. Menzies, and C. Hitchcock), pp. 131–157. Oxford University Press.

**3 RCTs and evidence of causality in healthcare**

Essential Reading

- Sackett, D. L., Rosenberg, W. M. C., Gray, J. A. M., Haynes, R. B., and Richardson, W. S. (1996). Evidence based medicine: what it is and what it isn't. *British Medical Journal*, 312(7023):71–72.
- Papineau, D. (1994). The virtues of randomization. *British Journal for the Philosophy of Science*, 45:437–450.

Questions

1. What are the aims of the regulatory structure in healthcare?
2. What are the advantages of Randomised Controlled Trials for estimating the effectiveness of treatments?
3. What are the disadvantages?
4. Is the design of RCTs related to any particular view of causality?

Extra Reading

- Cartwright, N. and Munro, E. (2010). The limitations of randomized controlled trials in predicting effectiveness. *Journal of Evaluation in Clinical Practice*, 16:260–266.
- The Cochrane Handbook for Systematic Reviews of Interventions http://handbook.cochrane.org/ This is enormous, but an excellent resource, well worth browsing.
- Cartwright, Nancy D. A Philosophers View of the Long Road from RCTs to Effectiveness, *The Lancet* (Art of Medicine Section), Vol. 377, 2011, pp. 1400-1401.
- Stegenga, Jacob (2011). Is meta-analysis the platinum standard of evidence? *Studies in History and Philosophy of Biological and Biomedical Sciences*, 42, 497–507.
- Cartwright, N. (2010). What are randomised controlled trials good for? *Philosophical Studies*, 147:59–70.
- NICE (2006, April). *The guidelines manual*. National Institute for Health and Clinical Excellence, London. Available from: www.nice.org.uk.

- David Teira (2013) On the impartiality of early British clinical trials. In Studies in History and Philosophy of Biological and Biomedical Sciences, 44: 412–418.
- Cristian Larroulet Philippi (2022) There Is Cause to Randomize, *Philosophy of Science*, 89 (1). pp. 152-170.
- Illari and Russo Chapters 2 and 6.

**4 Is causality based on intervention?**

Essential Reading

- Woodward, James (2013) Causation and Manipulability. In *The Stanford Encyclopedia of Philosophy* Ed Zalta (ed.) http://plato.stanford.edu/archives/sum2013/entries/causation-mani/
- Cartwright, Nancy D. Causality, Invariance and Policy In *The Oxford Handbook of Philosophy of Economics*, Kincaid, H. and Ross, D. (eds.), New York: OUP, 2009, pp. 410-421.

Questions

1. What are the core claims of Woodward's theory?
2. What is an intervention?
3. Can we understand causality as based on 'in principle' interventions?
4. Why does Woodward's account make causality 'relative to a model'?
5. Does the view imply a form of anti-realism about causality?

Extra reading

- Illari and Russo Chapter 10.
- James Woodward (2003). *Making things happen: A theory of causal explanation*. OUP, Ch 2, Ch 3.
- Lewis, D. (2004). Void and Object, in J. Collins, N. Hall and L. Paul (eds.), *Causation and Counterfactuals*. Cambridge, Mass.: MIT Press, 277-90.

**5 Writing philosophy essays**

In preparation for your unassessed essay plan, we shall talk through the marking criteria, and I will give you guidance about what to put in your essay plan.

**6 Is causality about producing effects?**

Essential Reading

- Salmon, Wesley C. (1977, Jun). An "At-At" theory of causal influence. *Philosophy of Science*, 44, 215–224.
- Salmon, W. (1994). Causality Without Counterfactuals. *Philosophy of Science* 61: 297-312.

Questions

1. What is the main claim of the conserved quantity theory of causality?
2. What are its major problems? Do you think they can be overcome?
3. Is the Salmon-Dowe view realist? Does it matter?
4. Which do you prefer of the views to date?

Extra reading

- Illari and Russo Chapter 11
- Maria Carla Galavotti: Wesley Salmon. In *Stanford Encyclopaedia of Philosophy* https://plato.stanford.edu/entries/wesley-salmon/

- Psillos, S. (2004). A glimpse of the secret connexion: harmonising mechanisms with counterfactuals. *Perspectives on Science*, 12(3), 288–319.
- Schaffer, Jonathan (2000). Causation by disconnection. *Philosophy of Science*, 67(2), 285–300.

**7 Is causality mechanistic?**

Essential Reading

- Stuart Glennan (1996) Mechanisms and the Nature of Causation. In *Erkenntnis* 44: 49-71.
- Stuart Glennan (2009) Mechanisms. In Beebee, Hitchcock, and Menzies (eds) (2009): *The Oxford Handbook of Causation*, Oxford: Oxford University Press.
- Psillos, S. (2004). A glimpse of the secret connexion: harmonising mechanisms with counterfactuals. *Perspectives on Science*, 12(3), 288–319.

Questions

1. What does Glennan's theory say about causality? (Think about how it is related to the Salmon-Dowe view, and Woodward's view.)
2. What does Glennan's theory say about mechanism? (Think about how it is related to MDC's view, and Bechtel & Abrahamsen's view.)
3. Is causality mechanistic?
4. What does that mean, in the modern understanding of mechanism?
5. Why does it matter?

Extra Reading

- John Dupré and James Woodward (2013) Mechanism and Causation in Biology, *Proceedings of the Aristotelian Society Supplementary Volume* lxxxvii.
- Rao and Nanjundiah (2010) J. B. S. Haldane, Ernst Mayr and the Beanbag Genetics Dispute. In *Journal of the History of Biology*, 44: 233-281. DOI 10.1007/s10739-010-9229-5
- Eric Bapteste and John Dupre: Towards a processual microbial ontology, in *Biology and Philosophy* (2013) 28:379–404, DOI 10.1007/s10539-012-9350-2
- Illari, Phyllis McKay and Williamson, Jon (2012). What is a mechanism? Thinking about mechanisms across the sciences. *European Journal of the Philosophy of Science*, 2, 119–135.
- Kincaid, H. (2021). Mechanisms, good and bad. *Theoria*, 36(2), 173–189. https://doi.org/10.1387/theoria.21757

**8 Evidence: from formal debate to practice**

Essential Reading

- Susan Haack (2008): Warrant, Causation, and the Atomism of Evidence Law. In *Episteme* 5(3):253-266.
- Daniel Steel (2004) Social Mechanisms and Causal Inference. In *Philosophy of the Social Sciences,* 34; 55

Questions

1. What is evidence? What is evidence *for*?
2. Is evidence always one thing?

3. How should we put different items of evidence together?
4. What should we do with conflicting evidence?

Extra Reading

- Kelly, Thomas, "Evidence", The Stanford Encyclopedia of Philosophy (Winter 2016 Edition), Edward N. Zalta (ed.), URL = https://plato.stanford.edu/entries/evidence/ This is a good guide to more formal attempts to characterize evidence.
- Climenhaga, Nevin (2020) Evidence and Inductive Inference. The Routledge Handbook of the Philosophy of Evidence, edited by Maria Lasonen-Aarnio & Clayton Littlejohn. Preprint available here: http://philsci-archive.pitt.edu/17450/
- Currie, Adrian (2019) *Scientific Knowledge & the Deep Past: History Matters*. Preprint available: http://philsci-archive.pitt.edu/16081/
- Eder, Anna-Maria A. (2019) Evidential Probabilities and Credences. *The British Journal for the Philosophy of Science*. ISSN 1464-3537 Preprint available: http://philsci-archive.pitt.edu/16460/
- Samuel C. Fletcher (2021): How (not) to measure replication in *European Journal for Philosophy of Science* 11: 57 (2021)
- Fuller, Jonathan (2020) Epidemiologic Evidence: Use at Your Own Risk? [Preprint available http://philsci-archive.pitt.edu/17046/]

**9 Evidential pluralism and causal claims in health**

Essential Reading

- Russo, Federica and Williamson, Jon (2007). Interpreting causality in the health sciences. *International Studies in Philosophy of Science*, 21(2), 157–170.
- Brendan Clarke (2011): Causation and melanoma classification. In *Theor Med Bioeth* 32:19–32.

1. Why do we want to find out about causes of disease?
2. How can we address limitations of RCTs?
3. What are the flaws of alternative methods?
4. What are the drawbacks of some form of evidential pluralism?

Extra Reading

- Illari and Russo Chapter 23.
- Susan Haack (2008) Proving Causation: The Holism of Warrant and the Atomism of Daubert. In *Journal of Health & Biomedical Law*, IV: 253-289.
- Tulodziecki, D. (2013). Shattering the Myth of Semmelweis. *Philosophy of Science*, 80(5), 1065–1075. https://doi.org/10.1086/673935
- Veli-Pekka Parkkinen, Christian Wallmann, Michael Wilde, Brendan Clarke, Phyllis Illari, Michael P Kelly, Charles Norell, Federica Russo, Beth Shaw, Jon Williamson (2018): *Evaluating evidence of mechanisms in medicine: principles and procedures*, Springer
- Trisha Greenhalgh (2019): *How to Read a Paper: The Basics of Evidence-based Medicine and Healthcare*, 6th Edition, Wiley-Blackwell
- Sara Green, Mie S. Dam & Mette N. Svendsen (2021): Mouse avatars of human cancers: the temporality of translation in precision oncology, in *History and Philosophy of the Life Sciences* volume 43: 27 (2021)
- Pérez-González, Saúl and Iranzo, Valeriano (2021) Assessing the role of evidence of

mechanisms in causal extrapolation. *Theoria*, 36 (2). pp. 211-228.
- Pérez-González, Saúl and Rocca, Elena (2022) Evidence of biological mechanisms and health predictions: an insight into clinical reasoning. *Perspectives in Biology and Medicine*, 65 (1). pp. 89-105.

**10 Evidence, causality, mechanism, policy: Exposomics**

Essential Reading
- Illari and Russo Chapter 24
- Illari and Russo Information channels and biomarkers of disease. *Topoi*. (Online first)
- Russo, F. and Williamson, J. (2012). Envirogenomarkers. The interplay between difference-making and mechanisms. *Medicine Studies*. 3:249–262

Questions
1. What are all the different kinds of things we want to know?
2. What are the different kinds of methods we use to find out about them?
3. What are the particular challenges created by bringing all these problems together?

Extra Reading
- Susan Haack (2009) Irreconcilable differences? The troubled marriage of science and law. In *Law and contemporary problems*, 72(1): 1-23.
- David Teira and Julian Reiss (2012) Causality, Impartiality and Evidence-Based Policy. In in H-K Chao, S-T, Chen & R. Millstein (eds) *Mechanism and causality in biology and economics*, Springer.
- Canali, Stefano and Leonelli, Sabina (2022) Reframing the Environment in Data-Intensive Health Sciences. *Studies in History and Philosophy of Science*, 93. pp. 203-214. ISSN 00393681
- Kelly, Michael P. and Russo, Federica (2022) The 'lifeworld' of health and disease and the design of public health interventions. Preprint available http://philsci-archive.pitt.edu/20431/
- Lohse, Simon and Canali, Stefano (2021) Follow *the* science? On the marginal role of the social sciences in the COVID-19 pandemic. [Preprint available http://philsci-archive.pitt.edu/19577/]
- Illari and Russo Chapter 7.

**Extra reading: *Only* if you wish to follow up *some* ideas, perhaps for your essay**

**General books**

Helen Beebee, Christopher Hitchcock, and Peter Menzies (eds) (2009): *The Oxford Handbook of Causation*, Oxford: Oxford University Press.

David Hume (1975 (1777)). An *Enquiry Concerning Human Understanding* (Posthumous edition edn). Clarendon Press, Oxford.

Trisha Greenhalgh (2019): *How to Read a Paper: The Basics of Evidence-based Medicine and Healthcare*, 6th Edition, Wiley-Blackwell

Phyllis Illari, Federica Russo and Jon Williamson (eds.) (2011): *Causality in the Sciences*, Oxford: Oxford University Press.

Phyllis Illari and Federica Russo (2014): *Causality: Philosophical theory meets scientific practice*, OUP.

Samantha Kleinberg (2015): *Why: A Guide to Finding and Using Causes* O'Reilly Media, 2015
Lagnado, DA (2021) *Explaining the Evidence How the Mind Investigates the World*, Cambridge University Press
Veli-Pekka Parkkinen, Christian Wallmann, Michael Wilde, Brendan Clarke, Phyllis Illari, Michael P Kelly, Charles Norell, Federica Russo, Beth Shaw, Jon Williamson (2018): *Evaluating evidence of mechanisms in medicine: principles and procedures*, Springer

**Specialist books**

Bechtel, William and Richardson, Robert (2010). *Discovering complexity*. MIT Press.
Bechtel, William (2008). *Mental Mechanisms: Philosophical perspectives on cognitive neuroscience*. Routledge, Oxford.
Cartwright, Nancy (2007). *Hunting causes and using them*. Cambridge University Press.
Cartwright, Nancy (1989). *Nature's Capacities and their Measurement*. Clarendon Press.
Craver, Carl (2007). *Explaining the Brain*. Clarendon Press, Oxford.
Darden, Lindley (2006). *Reasoning in Biological Discoveries*. Cambridge University Press, Cambridge.
Eells, Ellery (1991). *Probabilistic causality*. Cambridge University Press, Cambridge.
Glennan, S. and Illari, P. (eds) (2017): *The Routledge Handbook of Mechanisms and the Mechanical Philosophy*, Routledge.
Kleinberg, Samantha (2012): *Causality, Probability, and Time*. Cambridge University Press, 2012
Lewis, David K. (1973). *Counterfactuals*. Blackwell.
Mackie, J. L. (1974). *The cement of the universe. A study on causation*. Oxford University Press.
Mill, John Stuart (1843). *A system of logic, ratiocinative and inductive: being a connected view of the principles of evidence and the methods of scientific investigation* (Seventh (1868) edn). Longmans, Green, Reader, and Dyer, London.
Huw Price and Richard Corry (eds.) (2007), *Causation, Physics, and the Constitution of Reality: Russell's Republic Revisited*, Oxford University Press
Psillos, S. (2002). *Causation and Explanation*. Acumen Publishing, Chesham.
Salmon, W.C. (1984). *Scientific Explanation and the Causal Structure of the World*. Princeton University Press, Princeton.
Spirtes, Peter, Glymour, Clark, and Scheines, Richard (1993). *Causation, Prediction, and Search* (Second (2000) edn). MIT Press, Cambridge MA.
Steel, Daniel. (2007). *Across the boundaries: Extrapolation in biology and social science*. New York, NY: Oxford University Press.
Williamson, Jon (2005). *Bayesian nets and causality: philosophical and computational foundations*. Oxford University Press, Oxford.
Woodward, James (2003). *Making things happen: A theory of causal explanation*. OUP.

**Causality**

Anderson, John (1938). The problem of causality. *Australasian Journal of Psychology and Philosophy*, xvi, 127–142.
Beebee, Helen (2007). Hume on causation: The projectivist interpretation. In Huw Price and Richard Corry (eds.) *Causation, physics, and the constitution of reality: Russell's Republic*

*Revisited*, pp.224–49. Clarendon Press, Oxford.

Bogen, James (2005). Regularities and Causality; Generalizations and Causal Explanations. *Studies in History and Philosophy of Biological and Biomedical Science*, 36: 397-420.

Cartwright, Nancy (1979). Causal laws and effective strategies. *Nous*, 13, 419–437.

Cartwright, Nancy (2002). Against modularity, the causal Markov condition, and anything between the two: Comments on Hausman and Woodward. *British Journal for the Philosophy of Science*, 53, 411–453.

Cartwright, Nancy (2004). Causation: one word, many things. *Philosophy of Science*, 71, 805–819.

Dowe, Phil (1992). Wesley Salmon's process theory of causality and the conserved quantity theory. *Philosophy of Science*, 59(2), 195–216.

Dowe, Phil (2000). Causality and explanation: review of Salmon. *British Journal for the Philosophy of Science*, 51, 165–174.

Dowe, Phil (2004). Causes are physically connected to their effects: why preventers and omissions are not causes. In *Contemporary debates in Philosophy of Science* (ed. C. Hitchcock). Blackwell.

Frisch, Mathias (2012): No place for causes? Causal skepticism in physics. In *European Journal for Philosophy of Science*, 2(3): 313-336

Frisch, Mathias (forthcoming) Physics and the human face of causation. In *Topoi*.

Gasking, Douglas (1955). Causation and recipes. *Mind*, 64(256), 479–87.

Gillies, Donald (2005a). An action-related theory of causality. *British Journal for the Philosophy of Science*, 56, 823–842.

Hall, Ned (2004). Two concepts of causation. In *Causation and Counterfactuals* (ed. L. Paul, E. Hall, and J. Collins), pp. 225–76. MIT Press.

Hitchcock, Christopher (2011). Probabilistic causation. In *The Stanford Encyclopedia of Philosophy* (Winter 2011 Edition edn) (ed. E. N. Zalta).

Illari, Phyllis McKay (2011). Why theories of causality need production: an information-transmission account. *Philosophy and Technology*, 20.

Lagnado, DA (2021) *Explaining the Evidence How the Mind Investigates the World*, Cambridge University Press

Lewis, David (2004). Void and object. In *Causation and Counterfactuals* (ed. E. H. LA Paul and J. Collins), pp. 227–90. MIT Press.

Menzies, Peter (2007). Causation in context. In *Russell's Republic* (ed. H. Price and R. Corry), pp. 191–223. Clarendon Press, Oxford.

Menzies, Peter and Price, Huw (1993). Causation as a secondary quality. *British Journal for the Philosophy of Science*, 187–203.

Norton, John D. (2003). Causation as folk science. *Philosophers' Imprint*, 3(4).

Price, Huw (2001). Causation in the special sciences: the case for pragmatism. In *Stochastic Causality* (ed. M. C. Galavotti, P. Suppes, and D. Costantini), pp. 103–121. CSLI Publications, Stanford, California.

Psillos, Stathis (2009). Causation and regularity. In *Oxford Handbook of Causation* (ed. H. Beebee, P. Menzies, and C. Hitchcock), pp. 131–157. Oxford University Press.

Reiss, Julian (2012). Causation in the sciences: An inferentialist account. *Studies in History and Philosophy of Biological and Biomedical Sciences*, 43, 769–777.

Rosen, Deborah (1978). In defence of a probabilistic theory of causality. *Philosophy of Science*, 45, 604–613.

Russell, Bertrand (1913). On the notion of cause. *Proceedings of the Aristotelian Society*, 13, 1–26.

Russo, Federica (2009). *Causality and causal modelling in the social sciences. Measuring variations*. Methodos Series. Springer, New York.

Salmon, W. (1994). Causality Without Counterfactuals. *Philosophy of Science* 61: 297-312.

Salmon, Wesley C. (1977, Jun). An "At-At" theory of causal influence. *Philosophy of Science*, 44, 215–224.

Schaffer, Jonathan (2000). Causation by disconnection. *Philosophy of Science*, 67(2), 285–300.

Schaffer, Jonathan (2004). Causes need not be physically connected to their effects: the case for negative causation. In *Contemporary debates in Philosophy of Science* (ed. C. Hitchcock). Blackwell.

**Mechanism**

Bechtel, W. (2007). Biological mechanisms: Organized to maintain autonomy. In F. Boogerd, et al., *Systems Biology; Philosophical Foundations*. New York: Elsevier

Bechtel, William (2010). The Downs and Ups of Mechanistic Research: Circadian Rhythm Research as an Exemplar *Erkenntnis*, 73, 313–328.

Bechtel, W. and Abrahamsen, A. (2005). Explanation: A Mechanistic Alternative. *Studies in History and Philosophy of the Biological and Biomedical Sciences*, 36, 421-441.

Bechtel, W. and Abrahamsen, A (2007). In search of mitochondrial mechanisms: Interfield excursions between cell biology and biochemistry. *Journal of the History of Biology*, 40, 1-33.

Bechtel, William and Abrahamsen, Adele (2009). Decomposing, recomposing, and situating circadian mechanisms: Three tasks in developing mechanistic explanations. In *Reduction and Elimination in Philosophy of Mind and Philosophy of Neuroscience* (ed. H. Leitgeb and A. Hieke), pp. 173–86. Ontos.

Craver, Carl F. (2003). The Making of a Memory Mechanism. *Journal of the History of Biology*. 36(1): 153-195.

Craver, Carl F. (2002).Interlevel Experiments and Multilevel Mechanisms in the Neuroscience of Memory, *Philosophy of Science (Supplement)* 69: S83-S97.

Craver, Carl F. (2005) Beyond Reduction: mechanisms, multifield integration and the unity of neuroscience *Studies in the History and Philosophy of Biological and Biomedical Sciences* 36: 373-395.

Craver, Carl F. and Darden, Lindley (2005). Introduction. *Studies in the History and Philosophy of Biological and Biomedical Sciences* 36: 233-244.

Darden, Lindley (2002). Strategies for Discovering Mechanisms: Schema Instantiation, Modular Subassembly, Forward/Backward Chaining. *Philosophy of Science (Supplement)* 69: S354-S365

Darden, Lindley (2005). Relations among fields: Mendelian, cytological and molecular mechanisms. *Studies in the History and Philosophy of the Biological and Biomedical Sciences*, 36, 349-371.

Darden, Lindley (2008, December). Thinking again about biological mechanisms. *Philosophy*

*of Science*, 75, 958–69.

Darden, L., and Craver, Carl F.(2002) Strategies in the Interfield Discovery of the Mechanism of Protein Synthesis, *Studies in the History and Philosophy of the Biological and Biomedical Sciences*, 33, 1-28.

Glennan, Stuart (1996). Mechanisms and the Nature of Causation. *Erkenntnis* 44: 49–71.

Glennan, Stuart S. (2005). Modeling Mechanisms. *Studies in History and Philosophy of Biological and Biomedical Sciences* 36: 443-464.

Glennan, Stuart (2009). Mechanisms. In *The Oxford Handbook of Causation* (Beebee and Hitchcock eds.), Oxford University Press.

Glennan, Stuart (2011). Singular and general causal relations: A mechanist perspective. In *Causality in the Sciences* (ed. P. M. Illari, F. Russo, and J. Williamson), pp. 789–817. OUP, Oxford.

Illari, Phyllis McKay and Williamson, Jon (2012). What is a mechanism? Thinking about mechanisms across the sciences. *European Journal of the Philosophy of Science*, 2, 119–135.

Machamer, Peter (2004). Activities and causation: The metaphysics and epistemology of mechanisms. *International Studies in the Philosophy of Science*, 18: 1, 27–39.

Machamer, Peter, Lindley Darden, and Carl Carver (2000), Thinking About Mechanisms. *Philosophy of Science* 67: 1-25.

Mouchart, Michel and Russo, Federica (2011). Causal explanation: recursive decompositions and mechanisms. In *Causality in the sciences* (ed. P. Illari, F. Russo, and J. Williamson), pp. 317–337. Oxford University Press.

Psillos, S. (2004). A glimpse of the secret connexion: harmonising mechanisms with counterfactuals. *Perspectives on Science*, 12(3), 288–319.

Skipper, Robert A. and Millstein, Roberta L. (2005). Thinking about evolutionary mechanisms: Natural Selection. *Studies in History and Philosophy of the Biological and Biomedical Sciences* , 36, 327-347.

Woodward, James (2002). What is a Mechanism? A Counterfactual Account. P*hilosophy of Science (Supplement)* 69: S366-S377.

Wright, Cory (2012). Mechanistic explanation without the ontic conception. *European Journal for Philosophy of Science*, 2:375–394.

**Healthcare**

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## Course expectations

This course will be taught as 10 lectures with 10 accompanying seminars. The lectures will not be entirely lecturer-led and students will participate in both the lectures and seminars. Group work will be used for argument analysis and problem-solving activities. Students should read the essential reading, and come to class having thought about it, using the suggested questions merely as a guide. Students will be expected to raise questions in class, and summarise claims from the essential reading. To complete the course, all students will write the two assessed essays.

## Important policy information

Details of college and departmental policies relating to modules and assessments can be found in the STS Student Handbook www.ucl.ac.uk/sts/handbook

All students taking modules in the STS department are expected to read these policies.