Leibniz Universität Hannover
Institute of Philosophy, Faculty of Humanities

Theories and Methods of Research (Philosophy of Science for Life Science and Engineering Students)

Mixed Format Online Course, Winter Semester 2017/2018

Instructor:	Prof. Dr. Thomas Reydon
Teaching Assistant:	Jonas Lipski
Session times:	Mon. 12:00-14:00 h (c.t.), start: Mon. 23 October 2018
Room:	B 313, Im Moore 21 (Bldg. 1146), rear entrance (inner courtyard), third floor

Course concept and aims

Among the central aims of research in the philosophy of science are to understand how science works, and how scientific research is able to produce reliable knowledge about the world that can be used for all kinds of practical and technological purposes. While one could think these questions are mainly of interest to people who study science from the outside (such as philosophers, historians, and sociologists), a basic understanding of these issues is also important for practicing scientists and engineers. After all, in order to assess whether they are doing their job well scientists and engineers should be able to reflect on the reasoning methods they use, on the adequacy of these methods in relation to the general aims of science and engineering, and on what these aims are (and could be) in the first place.

This course offers a practice-oriented introduction to the philosophy of science for science and engineering students. The course is designed for the M.Sc. programs *International Horticulture* and *Water Resources and Environmental Management*, as well as the M.A. program *Philosophy of Science*. Topics include the question whether there is a general reasoning method in science (deduction, induction, falsification), the question how scientific explanations work and the role of laws of nature in them, the aims of science (and the question how we determine these), and the basic elements of good scientific practice.

The general **aim** of the course is to provide students with tools from the philosophy of science that enable them to reflect on the reasoning methods they use, on how they do their work, and on their views of the general aims of science and engineering. As **learning objectives** upon completion of the course students should be able to

- explain in their own words the various topics, issues, ideas etc. that were discussed in the course;
- develop their own position regarding the question whether there is such a thing as *the* scientific method (and if there is, what it consists in);
- develop their own position regarding the usefulness of induction and falsification in science;
- develop their own position regarding the question what it means to scientifically explain a particular phenomenon;
- develop their own position regarding the question what the aims of science and engineering are – or rather, what these aims *should* be and how we can go about determining them;
- place their own research projects and research interests in the context of the various issues discussed in the course.

With respect to **general competences** after completion of the course students should be able to

- read and understand complicated argumentative texts;
- to identify the principal ideas, arguments, etc. in such texts and to separate them from side issues;
- to present their own work in writing in a clear and concise way.

Organizational and formal issues – instructions regarding course work

Work load and format: The course has a work load of 3 ECTS credit points, i.e., about 90 hours of work in total. As the semester encompasses 12 weeks, this means that you should have on average 7-8 hours per week available to work on this course. So, you should be prepared to spend about one full work day per week on this course, including class sessions, reading the assigned texts, preparing your written presentation, and studying for the final exam. As the sessions are 1 ½ hours per week, there should be about 5 ½ - 6 ½ hours per week available for your own independent work.

The course format is a mix of online teaching (by the principal instructor, Prof. Thomas Reydon) and in-class tutorials (by the Teaching Assistant, Jonas Lipski). The course will be supported by a website in the university's online learning environment, Stud.IP (https://studip.uni-hannover.de/index.php). On this website you will find all necessary information about the course, as well as all course readings as downloadable PDFs. All participants **must register** for the course on the course website. The course does not include lectures – instead you are expected to read the assigned texts independently and complete **seven assignments**, in part individually and in part as group work in class. You are expected to submit the written results of your assignments on a regular basis (see the workflow schedule below) by uploading them on the Stud.IP webpage of the course. When uploading the results of your individual or group work, please use the following format for file names: for individual work, use "AssignmentX-GroupY-YourName" and for group work use "AssignmentX-GroupY". Uploading will make all results available to all course participants. The principal instructor will comment on all uploaded assignment results and answer open questions, and comments and answers will be made available to all participants on the Stud.IP webpage of the course.

Independent work: The first core element of the course is **independent reading**. Rather than being presented with lectures that provide you with the main content, you will have to read the assigned texts for yourself and extract the main content from them. You will thus not be presented with input from lectures, but you will have to search the relevant input for yourself in the assigned readings. This will enable you to learn more actively and more efficiently, because you will have to think for yourself about what the main issues might be while you are reading the texts, instead of sitting passively in lectures and simply being presented with a list of items that you then have to memorize. This will also enable you to make your own connections with the course material, for example by identifying what is most relevant or interesting for you. The texts have been selected such that they often present the same topics and ideas in different ways, allowing you to access the topics of the course through the perspectives of multiple authors. For example, for the topic of falsificationism you will find much of the same things in both the text by James Ladyman and the text by Alan Chalmers. By reading both texts you will encounter the same points presented in different ways, which should bring the points across more clearly.

Note that philosophy is very different from the natural and engineering sciences. Philosophy not a subject in which standard problems and their solutions, standard techniques, or generally accepted answers to standardized problems play the main role. Rather, philosophy is about critical reflection on your own practices – in this case about what you are doing when carrying out scientific research or developing a more hands-on engineering project. The principal question of philosophy of science (and this course is a course in philosophy of science) is how science works. This is not a question that has a generally accepted answer, or even an answer on which mane philosophers would agree. Accordingly, the aim of this course is not to tell you how science works, but to make you think for yourself about this question, and to provide you with some tools to think about how science – and most importantly

your own research practice – might work better. Much of philosophy is about presenting your own view of a particular problem or situation, as well as exploring reasons why you would agree or disagree with views presented by others. Be prepared to think about what your views are and why you might find the views of others good or not so good.

The assigned texts, then, do not provide you with any final answers. Rather, they give you food for thought: they present various ways of thinking about how science works and how science could and should work, and you, as the reader of these texts, should let yourself be challenged by the views that are presented. You may agree with some of them and disagree with others, but the most important things when reading the texts is to ask yourself **why** you would agree or disagree with a view that is presented. If you agree with a view, you must have arguments that support your agreement – you should know why you think the author has a good point. Similarly, in cases in which you disagree you must have arguments too – you should know why your view is different from that of the author.

Group work: The second central element of the course is **group work**. You will be assigned to a group of three or four students, and you will work in the weekly class sessions in the context of this group. **As a group** you are expected to build a learning portfolio during the course. This portfolio should consist of the answers that you developed in response to the reading assignments on which the course is based. You will work on six such reading assignments, each of which focuses on a particular text or set of texts, as specified in the course plan. For each assignment (except the last one) you are expected to read the texts **individually** in the week before you will work on the corresponding reading assignment and make a list of questions that you have about the texts, in order to be prepared for the group work at the session.

If you have any questions: You can pose your questions about the course readings and organization (work procedures, expectations, etc.) either to the principal course instructor (Prof. Reydon) or to the Teaching Assistant (Mr. Lipski). You can pose questions to the Teaching Assistant in the class sessions. Questions to the principal instructor **must** be submitted online as posts in the Forum section of the course website on Stud.IP, such that both your question and the answer will be available to all participants. Questions will be answered promptly. Do **not** ask your questions via email, except in case of an emergence! Emails to either the Teaching Assistant or the principal instructor that do not pertain to a legitimate emergency will not be answered!

The course is an integral part of the M.Sc. programs *International Horticulture* and *Water Resources and Environmental Management*. In addition, the course is intended for students in the major or minor Philosophy in the dual-subject teacher training programs. Students can take the course as part of the following modules:

- M.Sc. *International Horticulture*: compulsory module A01 "Theories and Methods of Research";
- M.Sc. *Water Resources and Environmental Management*: elective soft skills module "Theories and Methods of Research";
- M.Ed. teacher training Master (*Masterstudiengang Lehramt an Gymnasien*), Philosophy: "Vertiefungsmodul zu einem systematischen Schwerpunkt" (VMs);
- Teacher training certificate program, third subject (*Zertifikatsprogramm Drittes Fach für das Lehramt an Gymnasien*), Philosophy: "Vertiefungsmodul zu einem systematischen Schwerpunkt" (VMs).

Participation is open **only** to students in the abovementioned programs. It is **not** open to guests and auditors. No specific prior knowledge in the areas of philosophy / philosophy of science is required to be able to participate in the course. In case of a shortage of places in the course, students from the M.Sc. programs *International Horticulture* and *Water Resources and Environmental Management* will enjoy priority admittance, followed by students from the teacher training programs listed above. Depending on the program within which the course is taken **3 to 5 ECTS credit points** can be obtained. Students who want to be examined in the context of finalizing a module in one of the philosophy programs ("Modulprüfung") should make separate arrangements with the instructor.

The principal **course readings** will be selections drawn from the following texts:

- James Ladyman (2002): *Understanding Philosophy of Science*, London & New York: Routledge.
- Alan Chalmers (1999): *What is This Thing Called Science? (Third Edition)*, Indianapolis: Hackett.
- Karl R. Popper (2002): *Conjectures and Refutations: The Growth of Scientific Knowledge (Fifth Edition)*, London & New York: Routledge.
- Peter Godfrey-Smith (2003): *Theory and Reality: An Introduction to the Philosophy of Science*, Chicago & London: University of Chicago Press.
- Jim Woodward (2002): 'Explanation', in Peter Machamer & Michael Silberstein (Eds): *The Blackwell Guide to the Philosophy of Science*, Malden, MA: Blackwell, pp. 37-54.
- Gillian Barker & Philip Kitcher (2014): *Philosophy of Science: A New Introduction*, New York: Oxford University Press.
- Philip Kitcher (2004): 'Responsible biology', *BioScience* 54: 331-336.
- ESF/ALLEA (2011): *The European Code of Conduct for Research Integrity*, Strasbourg: ESF & Amsterdam: ALLEA.

Contact details

Instructor:	Prof. Dr. Thomas Reydon, reydon@ww.uni-hannover.de (If you need to mail me course documents, need a signature, and so on, please contact the secretary of the Institute of Philosophy, Im Moore 21 (Bldg. 1146), rear entrance (inner courtyard), third floor, Room B 307.)
Teaching Assistant:	Jonas Lipski, jonas.lipski@stud.uni-hannover.de

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Course plan

– (16.10.17) *no class – intro week for new students*

1. (23.10.17) *Introductory session – What is philosophy of science?*
   Readings for this session:
   Alan Chalmers, *What is This Thing Called Science?*, Introduction & Chapter 1 (pp. xix-xxii & 1-18).
   James Ladyman, *Understanding Philosophy of Science*, Introduction (pp. 1-8).
   Work on **Assignment 1** in class.

2. (30.10.17) *Inductivism as the scientific method (1)*
   Readings for this and the next session:
   Alan Chalmers, *What is This Thing Called Science?*, Chapter 4 (pp. 41-58).
   James Ladyman, *Understanding Philosophy of Science*, Chapter 1 & Chapter 2 until the beginning of Section 2.2 (1) (pp. 11-41).
   Work on **Assignment 2** in class.

3. (06.11.17) *Inductivism as the scientific method (2)*
   Reading for this and the previous session:
   Alan Chalmers, *What is This Thing Called Science?*, Chapter 4 (pp. 41-58).
   James Ladyman, *Understanding Philosophy of Science*, Chapter 1 & Chapter 2 until the beginning of Section 2.2 (1) (pp. 11-41).
   Work on **Assignment 2** in class.

4. (13.11.17) *Falsificationism as the scientific method (1)*
Readings for this session:
Karl Popper, 'Science: conjectures and refutations', **only** Sections I-II, IV & VIII-IX (pp. 43-51, 55-61 & 69-72).
Alan Chalmers, *What is This Thing Called Science?*, Chapter 5 (pp. 59-73).
Work on **Assignment 3** in class.

5. (20.11.17) *Falsificationism as the scientific method (2)*
Readings for this session:
Alan Chalmers, *What is This Thing Called Science?*, Chapter 6 (pp. 74-86).
James Ladyman, *Understanding Philosophy of Science*, Chapter 3, Sections 3.1 & 3.3 (pp. 62-77).
Work on **Assignment 3** in class.

6. (27.11.17) *Falsificationism as the scientific method (3)*
Readings for this session:
Alan Chalmers, *What is This Thing Called Science?*, Chapter 7 (pp. 87-103).
James Ladyman, *Understanding Philosophy of Science*, Chapter 3, Sections 3.4 - 3.6 (pp. 77-92).
Work on **Assignment 4** in class.

7. (04.12.17) *Explanations and laws of nature (1)*
Reading for this and the next session:
James Ladyman, *Understanding Philosophy of Science*, Chapter 7, Section 7.1 (pp. 196-208).
Peter Godfrey-Smith, *Theory and Reality*, Chapter 13 (pp. 190-201).
Jim Woodward, 'Explanation'.
Work on **Assignment 5** in class.

8. (11.12.17) *Explanations and laws of nature (2)*
Readings for this and the previous session:
James Ladyman, *Understanding Philosophy of Science*, Chapter 7, Section 7.1 (pp. 196-208).
Peter Godfrey-Smith, *Theory and Reality*, Chapter 13 (pp. 190-201).
Jim Woodward, 'Explanation'.
Work on **Assignment 5** in class.

9. (18.12.17) *Values, aims and good science (1)*
Readings for this and the next session:
Gillian Barker & Philip Kitcher, *Philosophy of Science*, Chapter 6, first part (pp. 136-163).
Philip Kitcher, 'Responsible biology'.
ESF/ALLEA, *The European Code of Conduct for Research Integrity*, Chapter 1 & Chapter 2, Sections 2.1 - 2.3 (pp. 5-15).
Peter Godfrey-Smith, *Theory and Reality*, Chapter 11 (pp. 163-172).
Work on **Assignment 6** in class.

– (25.12.17) *no class – Christmas break*

– (01.01.17) *no class – Christmas break, New Year's Day*

10. (08.01.18) *Values, aims and good science (2)*
Readings for this and the previous session:
Gillian Barker & Philip Kitcher, *Philosophy of Science*, Chapter 6, first part (pp. 136-163).
Philip Kitcher, 'Responsible biology'.
ESF/ALLEA, *The European Code of Conduct for Research Integrity*, Chapter 1 & Chapter 2, Sections 2.1 - 2.3 (pp. 5-15).
Peter Godfrey-Smith, *Theory and Reality*, Chapter 11 (pp. 163-172).
Work on **Assignment 6** in class.

11. (15.01.18) *Presentation preparation (1)*
    No readings. You can work on **Assignment 7** in class.

12. (22.01.18) *Presentation preparation (2)*
    No readings. You can work on **Assignment 7** in class.

13. (29.01.18) *Written exam (Mo., 12:00-14:00h sharp, room B313)*
    All students **must** take this exam.

14. (05.03.18) *Written exam, second try (Mo., 12:00-14:00h sharp, room B313)*
    Please note: **The second try is only for students who failed the first written exam!** You **must** have taken (and failed) the first try to be allowed to take the second try. If you passed the first try, you **cannot** take the second try to improve your grade. Also, you cannot skip the first try and take the second try as if it was your first. Exceptions to this latter rule can be made if you had an emergency situation at the time of the first try **and** you are able to document the nature of the emergency.

Workflow schedule

The following schedule specifies for every week of the semester which tasks you are supposed to work on and when the results of the various tasks are due. You should use the schedule to organize and plan your work.

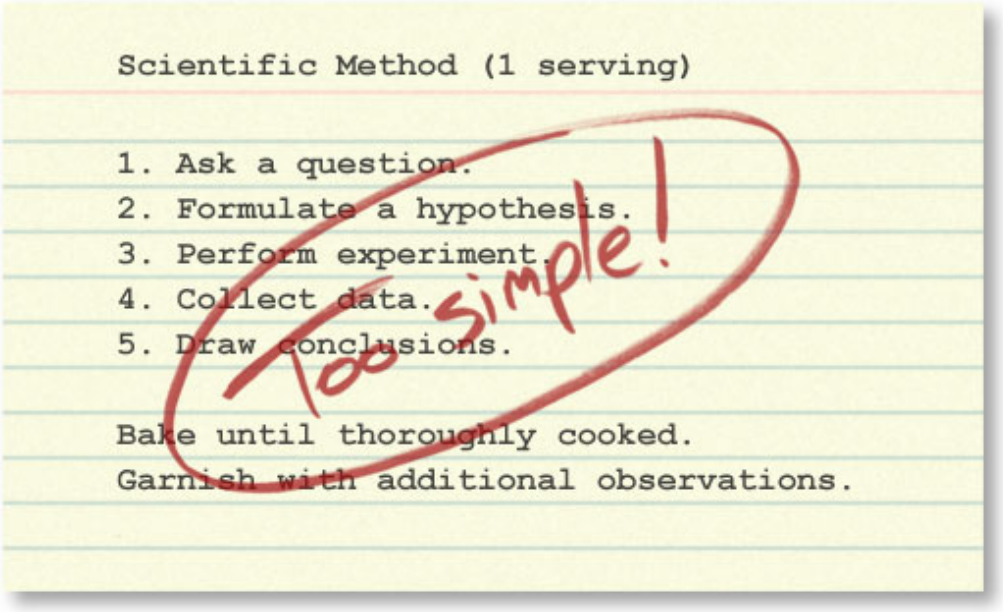
- Monday 16.10.17: No class (intro week for new students). Begin individual reading of course texts.
- Monday 23.10.17: Work on Assignment 1 in class; Assignment 1 Task I due.
- Thursday 26.10.17: Assignment 1 Task II due.
- Monday 30.10.17: Work on Assignment 2 in class.
- Thursday 02.11.17: Assignment 2 Task I due.
- Monday 06.11.17: Work on Assignment 2 in class.
- Thursday 09.11.17: Assignment 2 Tasks II & III due.
- Monday 13.11.17: Work on Assignment 3 in class.
- Thursday 16.11.17: Assignment 3 Task I due.
- Monday 20.11.17: Work on Assignment 3 in class.
- Thursday 23.11.17: Assignment 3 Tasks II & III due.
- Monday 27.11.17: Work on Assignment 4 in class. Assignment 4 Task I due (must be uploaded before the start of this session).
- Thursday 30.11.17: Assignment 4 Tasks II & III due.
- Monday 04.12.17: Work on Assignment 5 in class.
- Thursday 07.12.17: Assignment 5 Task I due.
- Monday 11.12.17: Work on Assignment 5 in class.
- Thursday 14.12.17: Assignment 5 Tasks II & III due.
- Monday 18.12.17: Work on Assignment 6 in class.

- Thursday 21.12.17: Assignment 6 Task I due.
- Monday 25.12.17: No class (Christmas & New Year's Break).
- Monday 01.01.18: No class (Christmas & New Year's Break).
- Monday 08.01.18: Work on Assignment 6 in class.
- Thursday 11.01.18: Assignment 6 Tasks II & III due.
- Monday 15.01.18: Work on Assignment 7 in class.
- Monday 22.01.18: Work on Assignment 7 in class.
- Thursday 25.01.18: Assignment 7 due.
- Monday 29.01.18: Written exam.
- Monday 05.03.18: Written exam (retry).

Suggested further reading (small selection)

Allhoff, F. (Ed.) (2010): *Philosophies of the Sciences: A Guide*, Chichester: Wiley-Blackwell.
Bird, A. (1998): *Philosophy of Science*: London: UCL Press.
Bortolotti, L. (2008): *An Introduction to the Philosophy of Science*, Malden (MA): Polity Press.
Chalmers, A.F. (1978): *What Is This Thing Called Science? (Third Edition)*, Maidenhead: Open University Press.
Curd, M., Cover, J.A. & Pincock, C. (Eds) (2012): *Philosophy of Science: The Central Issues*, New York: W.W. Norton & Company.
French, S. & Saatsi, J. (Eds) (2011): *The Continuum Companion to the Philosophy of Science*, London: Continuum.
Hacking, I. (1983): *Representing and Intervening Introductory Topics in the Philosophy of Natural Science*, Cambridge: Cambridge University Press.
Harré, R. (1972): *The Philosophies of Science*, Oxford: Oxford University Press.
Hempel, C.G. (1966): *Philosophy of Natural Science*, Englewood Cliffs: Prentice-Hall.
Losee, J. (2001): *A Historical Introduction to the Philosophy of Science (Fourth Edition)*, Oxford: Oxford University Press.
Machamer, P. & Silberstein, M. (Eds) (2002): *The Blackwell Guide to the Philosophy of Science*, Oxford: Blackwell.
O'Hear, A. (1989): *An Introduction to the Philosophy of Science*, Oxford: Clarendon Press.
Okasha, S. (2002): *Philosophy of Science: A Very Short Introduction*, Oxford: Oxford University Press.
Psillos, S. & Curd, M. (2008): *The Routledge Companion to Philosophy of Science*, London & New York: Routledge.
Rosenberg, A. (2012): *Philosophy of Science: A Contemporary Introduction (Third Edition)*, London & New York: Routledge.
Staley, K.W. (2014): *An Introduction to the Philosophy of Science*, Cambridge: Cambridge University Press.

Useful internet resources:
Internet Encyclopedia of Philosophy (http://www.iep.utm.edu/).
Stanford Encyclopedia of Philosophy (http://plato.stanford.edu/).



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