30.05 Exploring Scientific Issues: Methodology, Theory, and Ethics in the Sciences
3 hours; 3 credits

A critical examination of three fundamental sorts of scientific issues, methodological, theoretical, and moral. Exploration of the nature of scientific inquiry, scientific knowledge, pseudoscience. Examination of controversial theories, and of ethical issues relating to scientific research.

Prerequisite: Junior standing and satisfaction of all lower-tier requirements in Scientific Inquiry

Common Goals Addressed by Core course:
1. To understand what knowledge is and how it is acquired by the use of differing methods in different disciplines (2, 7, 17).
2. To develop the ability to think critically and creatively, to reason logically, to reason quantitatively, and to express one’s thoughts orally and in writing with clarity and precision (9, 10, 11, 12, 13, 15, 16, 21).
3. To develop the ability to make sound moral judgments (1, 26).
4. To acquire the tools that are required to understand and respect the natural universe (5, 18, 27).
5. To be capable of integrating knowledge from diverse sources (28).

Objectives of Core Course:
1. Students will acquire an understanding of scientific knowledge, and the nature of scientific inquiry. (2)
2. Students will acquire an understanding of research methodology used in the sciences. (17)
3. Students will develop skills of conceptual analysis and argumentation, relating especially to skills of thinking critically about scientific issues, methodological, theoretical, and ethical. (9)
4. Students will be able to explain, explore, and critically examine scientific views and issues clearly in writing. (11)
5. Students will be able to communicate thought relating to scientific views and scientific issues orally. (12)
6. Students will be able to develop a basis for interpreting and evaluating scientific texts. (13)
7. Students will acquire an ability to critically examine ethical issues in science. (1)
8. Students will be able to explain and critically examine the methodological foundations, and some theories, and theoretical and moral issues of modern science, and to apply this understanding to particular cases. (5)
9. Students acquire an understanding of scientific inquiry, and, using this foundation, students acquire an ability to evaluate scientific theories and scientific issues. (5)
10. Students will be able to differentiate between facts, hypotheses and theories, to describe how hypotheses are modified with further testing, to predict outcomes and formulate tests for hypotheses, to recognize that hypothesis formation and testing is part of their everyday lives. (18)
11. Students will be able to show that issues may be regarded from multiple viewpoints, and to provide and critically examine arguments for various different viewpoints. (28)
Outcomes for Core Course:
1 Students can explain the nature and role of methods used in the sciences and how this differs from pseudoscience and other methods of inquiry. (2)
2 Students can identify scientific methodology, can explain the role of evidence in science, and can analyze and critically examine arguments supporting scientific conclusions. (17)
3 Students can analyze, critically examine and engage with scientific issues relating to scientific methodology, scientific theories, and ethics and science. (9)
4 Students can effectively use writing to reflect on, to explain, and to critically examine scientific concepts, theories, and issues. (11)
5 Students can orally explain, and critically examine scientific concepts, theories, and issues (12)
6 Students can analyze and interpret scientific writings and philosophical writings that examine scientific issues. (13)
7 Student can recognize, explain, evaluate, and respond to ethical issues in science. (1)
8 Students can explain, critically examine, and evaluate the methodological foundations, and some theories, and theoretical and moral issues of modern science. (5)
9 Students can distinguish facts, hypotheses and theories, can explain the formulation and modification of hypotheses and the prediction of outcomes. (18)
10 Students can identify and explain different responses to scientific issues and can critically examine and evaluate arguments for different viewpoints. (28)

Course Outline:

Weeks 1 -4: Methodological Issues


Weeks 5 - 10: Theoretical Issues:

Week 8 - 10: Evolution. Readings selected from such works as the following: Charles Darwin, Origin of the Species; Ernst Mayr, What Evolution is, 2001; Daniel Dennett, Darwin's Dangerous Idea, 1995; Philip Kitcher, Abusing Science, The Case Against Creationism; 1993.
Weeks 11 - 14: Ethical issues:


Methods of Evaluation: Midterm (20%), Final (45%), Research Paper (20%), Writing Assignments (10%), Class Participation (5%).

Methods of Assessment:
1 Students are asked to explain the scientific method and how this differs from pseudoscience and other methods of inquiry. (2)
2 Students are asked to explain scientific reasoning and to provide support for or opposition to arguments for scientific conclusions. (17)
3 Students are asked to explain a controversial scientific issue, to present a response to this issues, and an argument supporting or opposing this response.. (11)
4 Students are asked to write an explanation of a controversial scientific concept, and alternative analyses of the concept by different thinkers. (12)
5 Students are asked to present orally an explanation of a scientific issues and alternative responses to this issue. (13)
6 Students are asked to analyze important passages from scientific writings or from philosophical writings that examine scientific issues. (13)
7 Student are asked to explain a controversial ethical issue of science, to present a response to this issue, and to provide an argument in support of this response.. (1)
8 Students are asked to identify and discuss an issue relevant to scientific method, or to a scientific theory, and or to a moral issue in science.(5)
9 Students are asked to distinguish and to explain facts, hypotheses and theories. (18)
10 Students are asked to identify and explain different responses to particular scientific issues and to critically examine and evaluate arguments for different viewpoints on these scientific issues. (28)
Assessment Tools: Diagnostic and end-of-term writing assignments. Research paper and class presentation. Homework and in-class essay questions that require explanation and critical examination of claims and arguments relevant to the sciences, to scientific method, scientific concepts, scientific theories, and ethical issues.

Bibliography


