Science may very well be the most important culture-shaping factor in the modern world but science courses present a problem not encountered to a similar degree in other areas. Here is the dilemma: in most areas of intellectual activity, the history of the subject is an integral part of the subject itself. Understanding what the subject is about requires an understanding of the way it came to be. Think, for example, of philosophy. While there are philosophers that claim that the history of philosophy is not philosophy, doing philosophy, inevitably, means engaging what philosophers have said in the past. A. N. Whitehead famously said that western philosophy is just footnotes on Plato. Science, on the other hand, we are told, is not like that at all. Scientists are trained in a way that ignores the past. The history of science is not part of the training of scientists. Occasionally, one finds someone who claims that the history of science should matter to scientists, but no one argues that in order to be a good scientist, one must know the history of science. Becoming a scientist is essentially a process of learning the subject and becoming proficient on the practice of the discipline. What, then, should one do with a course like Milestones? Clearly, this is not a traditional science course because you are not being trained to be a scientist. This is not, strictly speaking, a history of science course either because there is no way to do a history of modern science in one semester. What, then, is this course about? There is no unique answer. Different professors approach the course in different ways. Here is the way I have thought about it. This is a course in the MLS program and, as a result, it should aim to give you a sense of where science fits in the context of intellectual history. It should do so without ignoring the bits of science that make the story intelligible. Given that the emphasis is on modern science, will look in more detail at the milestones of modern scientific endeavor. The scientific revolution, the developments in cosmology, the theory of evolution, the molecular revolution in biology and, in physics, relativity and quantum mechanics are the milestones of modern science. The emphasis is in physics and biology but not exclusively so. There will be a bit of chemistry and, some geology. Will also look in some detail at some scientific giants, such as Newton, Galileo, and Darwin. In order to understand their contributions will have to look at the science content but will do so only to the extent that is necessary to make sense of what is happening. Will balance this with an approach that also addresses the cultural impact of science by looking at certain themes such as “Science and Technology” and the “Organization of Science”. The
course, then, is rather ambitious. It wants to look at the history of science, but it also wants to understand enough science to make sense of the questions posed, the answers given, and how they are related to the questions we presently have. In addition, will look at the cultural impact of science and a bit at science itself as an intellectual endeavor. It is my view, that in order to do this properly, one needs to go back to antiquity and that is where we begin.

**Evaluation:**

- Attendance and Participation ……….. 10%
- Weekly Questions……………………10%
- Response Papers……………………..10%
- Short Essays (2)……………………10%
- Research Paper……………………..20%
- Presentation…………………………10%
- Mid-Term Exam……………………15%
- Final Exam…………………………15%

**Weekly Questions:**

Every week, think about one question that you would like us to consider in class. The question must be posted on blackboard by Tuesday at midnight. Occasionally, I’ll bring questions that you should address in writing and bring to class for purposes of discussion. Your answers must be typed and should not exceed one page.

**Response Papers:**

These will be short papers related to the weekly readings. Four students will write them every week and they must be posted on blackboard by Tuesday at midnight. The papers will be used for class discussion. Response papers should not exceed four (1.5-spaced) pages.

**Short Essay Questions:**

There will be two take-home short essay questions throughout the semester.

**Research Paper:**

This is a longer paper (10-12 pages) also dealing with a topic of your choice related to any of the topics in the course. Details on the selection process will be provided later. The research paper is due on 5/02/13.
**Group Presentation:**

These are oral presentations about a scientist and/or a scientific topic. Pairs and small groups that will be put together as the class develops will do the presentations. Each formal presentation should last 15-20 minutes.

**Mid-Term and Final Exam**

There will be a Mid-Term and a final Exam that will consist of definitions, short essay questions and identification of major works.

**Late Assignment Policy:**

For the first three days, there is a 10% penalty for everyday that an assignment is late. On the fourth day the assignment automatically turns into a zero. Response papers cannot be late as they are to be used in a particular class.

**The Academic Honor Code**

Membership in the student body of Rollins College carries with it an obligation, and requires a commitment, to act with honor in all things. Because academic integrity is fundamental to the pursuit of knowledge and truth and is the heart of the academic life of Rollins College, it is the responsibility of all members of the College community to practice it and to report apparent violations.

The following pledge is a binding commitment by the students of Rollins College:

> The development of the virtues of Honor and Integrity are integral to a Rollins College education and to membership in the Rollins College community. Therefore, I, a student of Rollins College, pledge to show my commitment to these virtues by abstaining from any lying, cheating, or plagiarism in my academic endeavors and by behaving responsibly, respectfully, and honorably in my social life and in my relationships with others.

This pledge is reinforced every time a student submits work for academic credit as his/her own. Students shall add to all assignments (papers, etc.) the following abbreviated pledge followed by their signature:

> “On my honor, I have not given, nor received, nor witnessed any unauthorized assistance on this work.”

Material submitted electronically should contain the pledge; submission implies signing the pledge.
Textbooks:

- Natural Science in Western History (NSWH)
- The Making of Modern Science; Peter Bowler and Iwan Rhys Morus (MMS)
- The Intelligibility of Nature; Peter Dear (TIN)
- A Short History of Scientific Thought; John Henry (SHST)
- Galileo Goes to Jail and Other Myths about Science and Religion; Ronald Numbers (ed); Harvard University Press, 2010.

Websites:

TSBS: The Story behind the Science is a series of modules that have been developed for the purpose of introducing scientific topics in a historically and biographical context. Will use them occasionally.

When Science was called Natural Philosophy: “Science” before Science.

A. The Background: Chapters refer to NSWH. Chapters in *Italics* are from SHST.

1/17/13 (Week 1)

Introduction: What is this course about?
Discussion of the “Characteristics of Science” From (TSBS)

Chapter 1. The Ancient Western Heritage:

1. Nature in Ancient Civilizations
2. The Cosmos of Plato and Aristotle
3. The Greek Heritage in Natural Philosophy After Aristotle
4. The Nature of Science: The Problem with Ptolemy's Equant

Chapter 1: Setting the Scene: Natural Philosophy in Ancient Greece (SHST)
Chapter 2: Plato and Aristotle (SHST)

- MMS: Introduction: Science, Society, and History (pp. 1-20)

1/24/13 (Week 2)

Chapter 2. Learning in the Middle Ages:

1. Transmission of Greek Learning to the Near East
2. Revitalization of Intellectual Pursuits in the West
3. The Assimilation of Ancient Knowledge of Nature
4. The Nature of Science: Delimiting Faith and Reason
5. Late Medieval Natural Philosophy

Chapter 3: From the Roman Empire to the Empire of Islam (SHST)
Chapter 4: The Western Middle Ages (SHST)

- Discussion of the “Characteristics of Science” continued.
- Myth 1

1/31/13 (Week 3)

Chapter 3. Early Modern Innovations:

1. Recasting the Medieval Intellectual Heritage
2. The Nature of Science: Magic and Science
3. The Impact of Printing
4. Expanding Geographical Horizons

Chapter 5: The Renaissance (SHST)

- Myth 2 and 4

2/7/13 (Week 4)

Chapter 4. The Renaissance of Natural Knowledge

1. The World of Copernicus
2. The Nature of Science: Osiander and the Motion of the Earth

Chapter 5. Heliocentrism Considered:

1. The Immediate Reception of Copernican Heliocentrism
2. Tycho Brahe and the Copernican Theory
3. Johannes Kepler's Heliocentrism
4. The Nature of Science: Science and Mysticism
5. The Status of Heliocentrism

Chapter 6: Nicholas Copernicus and a New World (SHST)
Chapter 7: New Methods of Science (SHST)

- Myth 6

The Scientific Revolution:

2/14/13 (Week 5): Start reading “The Scientific Revolution” by L. Principe

Chapter 6. Galileo Galilei: Heliocentrism Gains a Champion:
1. Galileo's Early Career  
2. The Nature of Science: Mathematics and Nature  
3. Court Philosopher  
4. The Path to Conflict  
5. Last Years

*Chapter 8: Bringing Mathematics and Natural Philosophy Together: Johannes Kepler (SHST)*  
*Chapter 9: Mathematics and Mechanics (SHST)*  

- Pendulum Motion: The Value of Idealization in Science  
- Myth 8

**2/21/13 (Week 6)**

Chapter 7: Natural Philosophy Transformed.

1. British Conceptions  
2. French ideas on Matter and Motion  
3. The question of materialism  
4. The Mechanical Philosophy in Britain  
5. The Nature of Science: The Vulnerability of Experiment

*Chapter 10: Practice and Theory in Renaissance Medicine: William Harvey and the Circulation of the Blood (SHST)*  
*Chapter 11: The Spirit of the System: Descartes and the Mechanical Philosophy (SHST)*  
*Chapter 12: The Royal Society and Experimental Philosophy (SHST)*

- TIN: Science as Natural Philosophy, Science as Instrumentality; (pp. 1-14)  
- Myth 10 And 12

**2/28/13 (Week 7)**

Chapter 8. Isaac Newton: A Highpoint of Scientific Change

1. The Background to Newton's Achievement  
2. Newton's Central Interests  
3. The Nature of Science: The Status of Newton's Proof  
4. Fame and Power

*Chapter 13: Experiment, Mathematics and Magic: Isaac Newton (SHST)*  
*Chapter 14: The Newtonian Enlightenment (SHST)*  
*Chapter 16: Newtonian Optimism: Natural Theology and Natural Order (HSHT)*

- MMS 1.2 The Scientific Revolution (23-54):  
- TIN: The Mechanical Universe from Galileo to Newton, Chapter 1; (pp. 15-38)
• Myth 13

3/07/11  Spring Break (Week 8): Conclude reading of Principe.

3/14/13 (Week 9):

Chapter 10. The Emergence of Chemical Science:

1. "Chymistry" in the Seventeenth Century
2. German Rational Chemistry
3. British Contributors
4. The New French Chemistry
5. The Nature of Science: The Challenge of Objectivity

Chapter 15: The Chemical Revolution: Priestley and Lavoisier; John Dalton and Beyond. (SHST)

• MMS: The Chemical Revolution, Episode 3; (pp. 55-78)
• TIN: The Chemical Revolution Thwarted by Atoms, Chapter 3, (pp. 67-89)

Discussion of “The Scientific Revolution” by L. Principe

Conclusion to the scientific revolution

C. Biology and New Concerns

3/21/13 (Week 10):

Mid-Term Exam (does not include material assigned for this week).

Chapter 17: New Ideas About Life and Its Past: (pp. 352-364)

Chapter 18. Evolution Comes into Its Own:

1. Charles Darwin's Early Life and Education
2. A Formative Period for Evolution
3. The Making of Darwin's Origin
4. The Nature of Science: Cultural Influence on the Formation of Theory

Chapter 17: The Making of Geology: From James Hutton to Charles Lyell (SHST)
Chapter 18: The History of Plants and Animals: Successive Emergence or Evolution (SHST)

• MMS 1.6: The Darwinian Revolution, Episode 6; (pp. 129-164)
• TIN: A Place for Everything: The Classification of the World; Ch. 2; (pp. 39-66)
• Myth 15
3/28/13 (Week 11)

Chapter 22. The Changing Contours of Biology:

1. Heredity Reconsidered
2. Competing Ideas of Evolution
3. The Nature of Science: Evolution Versus Natural Selection
4. Turn-of-the-Century Debates About Darwinism

Chapter 19: Religion and progress in Victorian Britain: Robert Chambers versus Hugh Miller (SHST)
Chapter 20: Bringing it All Together? Charles Darwin's Evolution (SHST)
Chapter 21: Darwinian Aftermaths: Religion; Social Science; Biology (SHST)

- MMS: The New Biology, Episode 7; (pp. 165-188)
- TIN: Design and Disorder: The Origin of Species, Chapter 4; (pp. 91-114)
- Myth 17.
- Model Building Module: Piecing Together the Structure of DNA

4/04/13 (Week 12)

Chapter 23. The Synthesis of Biological Issues:

1. Genetics and the Resurgence of Darwinism
2. The Nature of Science: Idea and Reality in Population Thinking
3. Human Evolution
4. The Rejection of Lamarckism
5. Molecular Biology

- MMS: Science and Religion, Theme 15; (pp. 341-366)
- MMS: Biology and Ideology, Theme 18, (pp. 415-438)
- MMS: Genetics, Episode 8; (pp. 189-212)

4/11/13 (Week 13)

Chapter 16. An Era of Many Forces.

1. Investigating Nature's Mysterious Forces
2. The Nature of Science: Lasting Disagreements in Science
3. New Institutions of Natural Science

Chapter 21. The Erosion of Realism:
1. The Changing Structure of Order
2. The Enigma of the Ether
3. Unrealistic Radiation
4. The Nature of Science: Is Light a Particle?

Chapter 22: Beyond Newton: Energy and Thermodynamics (SHST)

- MMS: Conservation of Energy. Episode 4, (pp. 79-102)
- MMS: Science and Technology; Theme 17; (pp. 391-414)
- TIN: Dynamical Explanation: The Aether and Victorian Machines, Chapter 5; (pp. 115-140)

4/18/13 (Week 14)

Chapter 25. The Changing Worlds of the Large and Small:

1. A Changing Universe
2. The Quantum Mechanical Explanation of the Atom
3. The Nature of Science: Quantum Mechanics and the Nature of Knowledge
4. Toward a More Dangerous World

Chapter 23: Newton Deposed: Einstein and Relativity Theory
Chapter 24: Mathematics Instead of a World picture: From Atomism to Quantum Theory.

- MMS: 20th Century Physics, Episode 11, (pp. 253-276)
- TIN: How to Understand Nature? Einstein, Bohr, and the Quantum Universe, Chapter 6; (pp. 141-172)

4/25/13 (Week 15): Final Exam

- MMS: Revolutionizing Cosmology, Episode 12; (pp. 277-297)
- MMS: Science and Technology; Theme 17; (pp. 391-414)
- MMS: The Organization of Science; Theme 14; (pp. 319-340)
- Myth 22

5/02/13 (Week 16): Final Paper due

- MMS: The Emergence of the Human Sciences, Episode 13; (pp. 299-316)
- TIN: Conclusion: Making Sense of Science; (pp. 173-195)
- Myth 25
Additional Information:

The course is essentially divided into four parts

1. From Antiquity to the Scientific Revolution.
2. The Scientific Revolution
3. Darwin and the Revolution in Biology

Resources for Part 1: These are all papers by David C. Lindberg available in JSTOR

- Medieval Science and its Religious Context. *Osiris, 1986*
- Beyond War and Peace: A Reappraisal of the Encounter between Christianity and Science. *Church History, 1986*

In the Myth Book:

- Myths 1-5 are about the ancient period;
- Myths 6-14 concern the Scientific Revolution;
- Myths 15-20, 23 and 24 are about Darwin and Evolution
- Myth 21 and 22 are about Modern Physics.

Not all have been assigned but they are all somewhat connected and can be useful in providing context.

The following will be made available when we get to modern biology.

- The Molecular Revolution in Biology (Robert Olby) (article)
- The Discovery of the Structure of DNA: (articles)
- Rosalyn Franklin and the Double Helix (article)

Unfortunately, not all the readings from MMS can be covered. The following are useful in filling the gaps if you are so inclined.

- MMS: Continental Drift, Episode 10; (pp. 237-252)
- MMS: Science and Medicine, Theme 19; (pp. 439-461)

There is a tradition in popular History of Science of looking at Science by concentrating on outstanding scientist or revolutionaries. Whether this is legitimate is a point of the debate but doing so can be useful in organizing what is, admittedly, a lot of material. It can also be a useful tool for organizing presentations, so here are the folks that are likely to make anyone’s top 10 over the last 3000 years.
Antiquity and the Scientific Revolution

Revolutionary: Ptolemy
Revolutionary: Nicolaus Copernicus
Revolutionaries: Thyco Brahe and Johannes Kepler
Revolutionary: Galileo Galilei
Revolutionary: Isaac Newton
Revolutionaries: Lavoisier and later John Dalton

Revolution in Biology

Revolutionaries: Charles Darwin, Jean-Baptiste Lamarck
Revolutionaries: Gregor Mendel, Louis Pasteur, Barbara McClintock
Revolutionaries: James Watson and Francis Crick, Rosalyn Franklin

Modern Physics and Cosmology

Revolutionaries: Michael Faraday and James Clerk Maxwell

Revolutionaries: Marie Curie, Albert Einstein, Max Planck, Erwin Schrodinger, Werner Heisenberg, Paul Dirac, Ernest Rutherford, and Niels Bohr among others.

Revolutionary: Edwin Hubble; Henrietta Leavitt; Fred Hoyle