

Natural Sciences 1: Laws and Models in Chemistry

Fall 2011, Weekend Program

Bev Thurber

b.thurber@shimer.edu

312.235.3550

“Historical and logical methods are used to understand and analyze the atomic theory of matter. The basic question of the course is: What is the world made of? Scientific models which purport to answer this question have historically been classified under the science of chemistry. Hence, Natural Sciences 1 is a chemistry course that begins with the Ancient Greek philosophers and continues into the early twentieth century. It starts with the idea that matter is composed of Thales’ one element or Empedocles’ four elements, and ends with Mendeleev’s periodic table of some ninety-odd elements ordered in terms of weight. The course focuses upon several key concepts, such as weight, structure, and complexity, in an attempt to understand the material basis of the world.”¹

The expectations for this course are as follows:

Participation (40%): This is the way you will come to an understanding of the readings, which you are expected to do carefully before class on the specified day. In order to participate fully, you need to come to class on time every day. Every missed class, late arrival, early departure, and break counts against your participation grade. If you miss more than three class sessions (one weekend), you will not pass the course, except in unusual circumstances. I’ll warn you after two absences.

Written Work (60%): You may discuss all assignments with your classmates, but must do your own writing. This means that you may neither look at another student’s written work nor share your written work with others. All written work is due in hard copy at the beginning of class. If you are unable to turn in an assignment on time, speak with me in advance. Late work without an extension will receive a lower grade than it normally would. If an assignment is complete by the due date, you may revise it, provided you speak with me within one week of receiving your work back to arrange a new due date.

Focus statements (10%): At the beginning of each class or weekend, one student will present a short written statement that focuses the reading assignment. More details are given at the end of the syllabus.

Essay & Lab Report (15% each): You must write an essay of 4–6 pages on a system of natural philosophy of your own creation that explains what changes and what remains the same when we observe change in the physical world. In it, you will describe a world view in which you balance two issues: if we observe change in the world around us, why isn’t the world chaotic, and if the world is orderly and consistent, why isn’t it rigid and unchanging? You are expected to cite your sources correctly; see *Writing with Sources* or talk to me if you do not know how. Plagiarism will be strictly penalized. You must also write a lab report on one of the experiments we perform in class.

Problems & Final Exam (20%): Occasional homework problems (5%) will be assigned and a final exam (15%) will be due at the end of the semester.

¹“Natural Sciences Courses.” *Shimer College*. Shimer College, n.d. Web. 12 August 2011.

Learning Objectives

1. Explain Aristotle's classification of causes and identify how they relate to modern scientific thinking.
2. Carry out a written scientific procedure and write a lab report.
3. Balance the notions of change and constancy in a description of the world.
4. Describe the basic behavior of gasses, especially the relation between mass, temperature, pressure, and volume.
5. Explain the atomic model of matter and describe experiments that support that model.
6. Define "heat" and describe experiment(s) based on that definition.
7. Explain what a chemical equation means.

Booklist

1. Bacon, Francis. *The New Organon*. Ed. Fulton H. Anderson. Upper Saddle River, NJ: Prentice-Hall, 1960. Print.
2. Lucretius. *On the Nature of the Universe*. Trans. R. E. Latham. Revised ed. London: Penguin, 2005. Print.
3. Sachs, Joe. *Aristotle's Physics: A Guided Study*. New Brunswick: Rutgers UP, 2008. Print.
4. Shamos, Morris H., ed. *Great Experiments in Physics: Firsthand Accounts from Galileo to Einstein*. Mineola, NY: Dover, 1959. Print.
5. Shimer College. *Natural Sciences One*. 2 vols. Chicago: Dinosaur Press, 2010. Print.
6. Wheelwright, Philip, ed. *The Presocratics*. Upper Saddle River, NJ: Prentice-Hall, 1997. Print.

Calendar

Aug. 20	<p>1: <i>Presocratics</i>, p. 31–105</p> <p>2: <i>Presocratics</i>, p. 106–136, 143–154, 200–229</p> <p>21 3: Lucretius, <i>On the Nature of the Universe</i>, Book 1</p>
Sept. 10	<p>1: Lucretius, <i>On the Nature of the Universe</i>, Book 2</p> <p>2: Aristotle, <i>Physics</i>, II:1–9, III:1–3, IV: 1–9</p> <p>11 3: Bacon, <i>The New Organon</i>, Book 2, Aphorisms 1–22</p>
Oct. 1	<p>1: Pascal, “New Experiments Concerning the Vacuum,” p. 355–371</p> <p>Pascal, “Account of the Great Experiment,” p. 372–389</p> <p>Pascal, “Treatise on the Equilibrium of Liquids,” p. 390–403</p> <p>Pascal, “Treatise on the Weight and Mass of the Air,” p. 403–429</p> <p>2: Boyle, “Boyle’s Law” in Shamos, p. 36–41</p> <p>2 3: Stahl, “On Sulphur”</p> <p>Macquer, <i>A Dictionary of Chemistry</i></p> <p>Macquer, <i>Elements of the Theory and Practice of Chemistry</i></p> <p>PAPER DUE</p>
	<p>22 1: Priestley, <i>On Dephlogisticated Air</i>, p. 5–55</p> <p>2: Lavoisier, <i>Memoir on the Calcination of Tin</i>, p. 155–160</p> <p>Lavoisier, <i>Elements of Chemistry</i></p> <p>23 3: Black, <i>Lectures on the Elements of Chemistry</i></p> <p>Thompson, “An Inquiry Concerning the Source of the Heat...”</p>
Nov. 12	<p>1: Joule, “The Mechanical Equivalent of Heat” Shamos, p. 166–183</p> <p>2: Dalton, “Theory of the Absorption of Gases”</p> <p>Letters from Bostock & Dalton to Nicholson</p> <p>Dalton, 1808 Extract</p> <p>13 3: Gay-Lussac, “On the Combination of Gaseous Substances”</p> <p>Dalton, 1810 Extract</p> <p>LAB REPORT DUE</p>
Dec. 3	<p>1: Avogadro, “Essay on a Manner of Determining the Relative Masses...”</p> <p>2: Dulong, “Atomic Weights and Specific Heat”</p> <p>4 3: Clausius, “On the Nature of the Motion that We Call Heat”</p>
Dec. 17	<p>1: Berzelius, “Electrochemical Theory”</p> <p>Faraday, “On Electrochemical Decomposition”</p> <p>Berzelius, “Chemical Symbols and Formulas”</p> <p>2: Canizzaro, <i>Sketch of a Course of Chemical Philosophy</i></p>
Dec. 18	<p>3: Mendeleev, “A Natural System of the Elements...”</p> <p>The Periodic Table</p> <p>Curie, “Radium and the New Concepts in Chemistry”</p> <p>FINAL EXAM DUE</p>

Focus statements

A focus statement is a 1-2 page paper based on the assigned reading and intended for class discussion. It might take the form of a summary of the reading, a close analysis of a particular passage, a personal but textually and argumentatively supported reaction to a reading, an extended question or series of questions raised by the text, or a concise formal essay in which a thesis from or about a text is supported and discussed.

One possible approach is to use a point made by an author in a reading as your thesis (after considering whether it can be adequately discussed in a focus statement or essay of the prescribed length). Quote, paraphrase, and/or summarize passages from the text (citing them appropriately, including page numbers!) where the point you have chosen is being stated, where it is being argued, and, if appropriate, where it is being clarified or qualified. Add whatever clarifications and interpretations of your own you consider helpful. You may need to provide definitions of key terms, in the author's words if possible. Offering examples, the author's or your own, is almost always a good idea.

After you have presented and explained the author's point and argument, go on to your own response to it. Your response should be thought through, carefully phrased, and persuasively supported with arguments and/or examples. Whether you agree or disagree, be sure to consider both sides. If you disagree, do not confine yourself to giving your reasons, but also try to show what you think are the blind spots or logical errors or gaps in the author's discourse. Agreement and disagreement are not the only possible reactions. You may want to qualify, expand upon, or significantly rephrase the author's point, to consider its implications, or point out its logical or social consequences. A good way to end a focus statement is with a thought-provoking question for the class.

Be careful not to lose focus. You can bring in other texts that support, reflect upon, or contradict the primary text, but remember that you are writing about a particular idea in a particular reading and you only have 1-2 pages.

If all else fails or you are thoroughly confused by the text, share your confusion and list your questions. These sometimes serve as the basis of great class discussions.

Focus statement dates will be assigned as we go. We will only have time to discuss one focus statement per class, so once a focus statement date is reserved, it is not available to others. In class, the focus statement is first read aloud by the writer and then discussed by the group. Be sure to bring enough copies of your statement for everyone. If timely submission of a focus statement and copies for distribution will not be possible, it is your responsibility to switch the assigned focus statement date with another member of the class.