

SGBN 102: What is Matter?

Spring 2024

MWF 10:40-11:45am

Goldspohn 22

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Office: 5 S. Loomis St., Office 17 (in attic)

Office Hours: MWF, 1:15-3:00pm, or by appointment

Course Description

Western ideas of matter proceed from the Pre-Socratics through Aristotle, medieval scholastic-Aristotelianism and alchemy before being reshaped by the views enunciated by Bacon, which herald new practices and ideas (mathematization, experimentation, and mechanism). Through texts, experiments and observations developed from ancient to modern times, we see a shift in fundamental questions, particularly regarding the nature of matter. Through historical accounts of the transition, we come to distinguish between the ancient project to understand the world and the modern project to predict and control it.

The topics that the course examines have gone by different names, with Chemistry as the modern term. By reading and comparing authors across millennia, students will compare the different projects of science in the ancient and modern worlds and how innovation has evolved over the years into the current formulations of natural laws and continues into the future. Through simple hands-on experiments and activities, students will, on a basic level, actively engage the issues and complexities of scientific work.

Course Objectives

Course-Specific Goals

- Distinguish ancient and modern models and methods for understanding the natural world
- Carry out a written scientific procedure and write a lab report
- Balance the notions of change and constancy in a description of the world
- Describe the basic behavior of gasses, especially the relation between mass, temperature, pressure, and volume
- Explain the atomic model of matter and describe experiments that support that model
- Explain what a chemical equation means

Gen Ed Area: Science

- Identify some of the fundamental principles and laws in the physical and/or life sciences
- Explain how scientists ask and answer questions
- Apply the methods of scientific inquiry

Course Readings

Aristotle, *Physics* (Oxford UP, 2008) [ISBN: 978-0199540280]

Bacon, *The New Organon* (Cambridge UP, 2000) [ISBN: 978-0521564830]

Lucretius, *On the Nature of Things* (Hackett, 2001) [ISBN: 978-0872205871]

A Presocratics Reader, ed. Curd (Hackett, 2011) [ISBN: 978-1603843058]

All books must be purchased *in hard copy*, including the course pack.

Assignments and Grading

Courses in the Shimer Great Books Program are heavily discussion-based and student-driven. Accordingly, class participation counts for a much higher proportion of student grades than in most courses: 50%. The remaining 50% of the grade will be determined by a variety of written assignments.

Class participation presupposes careful and thorough preparation and serious intellectual involvement in class discussion. Students should come to class not only having read the text through, but having underlined, taken notes, and scanned over the marked text at least one additional time after the initial reading. On the basis of such preparation, students should be prepared for an intensive, text-focused discussion.

You must also come prepared to class, and that means having *hard copies* of the course materials with you. You should purchase all course textbooks (which are inexpensive and widely available used) and print any supplementary readings. For days when we are watching a film, written notes will take the place of the printed reading. No student will be permitted to use a smartphone at any point during class without explicit permission; persistent usage will result in the student losing all participation points for that class session. The professor reserves the right to count a class period where a student has not brought the reading to class as an absence.

My expectation for class participation is that every member of class will be able to contribute with remarks and citations that are on-topic and reflect solid preparation for class. A student who meets that baseline will receive a grade in the **B range** for their participation portion. Students whose contribution is notably lacking—for instance, those who speak very little, who give no evidence of having done the reading carefully, who consistently change the topic in a disruptive way, or whose primary contributions are jokes or personal anecdotes—will receive a participation grade in the **C or D range**. Students who distinguish themselves through some particular service—such as consistently contributing new topics that shape the discussion, serving as a resource for navigating the text, or making a special effort to draw in quieter classmates—will qualify themselves for a participation grade in the **A range**.

Your participation grades will be posted on Blackboard roughly every two weeks. Normal day-to-day participation for each class session is worth approximately 1% of your final grade. In addition, there will be a midterm and final **discussion exams** on the session following the written exam, each of which will be worth 5% of your total grade. These discussions will center around a short reading to be distributed after the written exam and will be completely student-led—the professor will play a strictly observational and assessing role for these sessions. Students will be graded not on whether they arrive at the “correct” interpretation of the class, but on their discussion skills. In case a student absolutely must be absent, we will devise a way to make up the discussion exam—but please make every effort to attend.

All students will be required to have a one-on-one meeting with the professor around the middle of the semester. The purpose of this conference will be an open-ended discussion of the student’s performance and any ways that their experience in class can be improved. This meeting will be worth 3% of the final grade, awarded on an all-or-nothing basis.

The baseline condition for class participation is of course physical presence in class. Absences not only affect the individual student, but the entire group, and the same is true of habitual lateness. Punctual attendance should be regarded as mandatory. Lateness will count against a student's participation for that session, and in extreme cases will be treated as the equivalent of an absence. An increasing number of absences carries with it increasing consequences, which are as follows:

1-2 absences No grade penalty, in recognition of our shared human frailties. (If students miss fewer than two classes, however, then in cases where a student is at the threshold between two grades, the professor will go with the higher one.)

3-5 absences A half letter grade is deducted from the student's final grade for each absence; this penalty may be lifted by doing an absence make-up for each missed class.

6-8 absences For each absence, the student *must* complete an absence make-up (described below) to avoid failing the course, and a half letter grade penalty is imposed on the student's final grade which *cannot* be made up.

9 absences Failure of the course, barring emergency circumstances.

In order to make up for an absence, students must write a paper summarizing and reflecting on the day's reading (at least one *full* page, double spaced) or schedule a meeting of at least 10 minutes to discuss the reading with the professor. Absence make-ups must be completed **within two weeks** of the absence being made up, though I strongly urge you to do so earlier.

Students requiring *additional accommodations* are urged to discuss this matter with the professor as early as possible in the semester and to devise a formal written plan in consultation with the relevant institutional offices. In line with the Shimer School's policies on attendance, accommodations will be made with the aim of allowing a student to attend at least 80% of class sessions synchronously and without placing undue burdens on either the accommodated student or the faculty member.

Written work will consist of a midterm and final exam, each worth 10% of the final grade or 20% total; a reading journal, worth 10%; and various lab activities, including exercise sheets and reports, worth 20% total. Details of the exams will be provided closer to the time they occur.

The *reading journal* will take the form of a notebook devoted to this class. I may ask to check your journals for work periodically, but will certainly take it briefly for grading at the middle and end of the semester following the mid-term and final exam, at which point I will provide a letter grade. Generally speaking, all of the written work of the course, including note taking and problem solving, should be done in or included otherwise (e.g. as scratch sheets in whatever form) in your journal. As a rough guide, your journal should include entries on every assigned reading and class discussion.

Note that reading journals will be graded on completeness, not correctness. The goal is not for you to come to class with all the right answers, but to begin working through the problems and questions on your own to prepare for our collaborative effort. You should, however, correct your notebook as appropriate to reflect our class discussion.

Note on Institutional Policies

Please note that the college-wide policy on plagiarism holds for this class. Plagiarism is a very serious academic and ethical offence that can lead to failure of the assignment or course—or, after multiple instances, expulsion from college. Please consult the Student Handbook for more details of the plagiarism policy. Note that the professor considers the use of AI text-generation software as a form of plagiarism. All other institutional policies apply equally, including those related to accommodations for students with learning disabilities or differences and Title IX protections. More details on those policies are available in the Student Handbook, and students are encouraged to approach the professor with any questions or concerns they may have.

Class Schedule and Readings

*This calendar provides the schedule for assignments and readings for our time together this semester. Students should be aware that the schedule is approximate and may change. All students will be alerted as soon as possible via email and Canvas announcement. Failure to check email regularly is no excuse for missing these updates. Readings from the course pack are labelled as follows: (**).*

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| Monday | January 8 | Course introduction and syllabus In-class reading: “Atomism in Early Greek Thought” |
| Wednesday | January 10 | <i>Presocratics Reader</i> : The Milesians (pp. 13-22) |
| Friday | January 12 | <i>Presocratics Reader</i> : Heraclitus of Ephesus (pp. 39-54) |
| Monday | January 15 | MLK Day—NO CLASS |
| Wednesday | January 17 | <i>Presocratics Reader</i> : Parmenides of Elea (pp. 55-65) |
| Friday | January 19 | <i>Presocratics Reader</i> : Zeno of Elea (pp. 66-72) and Anaxagoras of Clazomenae (pp. 101-108) |
| Monday | January 22 | <i>Presocratics Reader</i> : Empedocles of Acragas, intro, sections 47-55 and 101-120 (pp. 73-74, 83-89, 95-99) |
| Wednesday | January 24 | Lucretius, <i>On the Nature of Things</i> , Book 1 (pp. 1-19) |
| Friday | January 26 | Lucretius, <i>On the Nature of Things</i> , Book 1 (pp. 19-33) |
| Monday | January 29 | Lucretius, <i>On the Nature of Things</i> , Book 2 (pp. 34-49) |
| Wednesday | January 31 | Lucretius, <i>On the Nature of Things</i> , Book 2 (pp. 49-65) |
| Friday | February 2 | Aristotle, <i>Physics</i> , Book II, 1-3 and 7-9 (pp. 33-42, 48-55) |
| Monday | February 5 | Aristotle, <i>Physics</i> , Book III, 1-3; Book VIII, 4-5 (pp. 56-62, 195-207) |
| Wednesday | February 7 | Aristotle, <i>Physics</i> , Book IV, 1-5 (pp. 78-90) |
| Friday | February 9 | Aristotle, <i>Physics</i> , Book IV, 6-9 (pp. 90-102) |
| Monday | February 12 | Maimonides on Islamic Atomism (<i>The Guide for the Perplexed</i> , Chapter LXXIII, pp. 120-133) (**) |
| Wednesday | February 14 | Bacon, <i>The New Organon</i> , “The Great Renewal” (preface and plan of the work), pp. 6-25 |
| Friday | February 16 | Bacon, <i>The New Organon</i> , Book I, Preface, aphorisms 1-60, pp. 27-49. |
| Monday | February 19 | Bacon, <i>The New Organon</i> , Book II, aphorisms 1-12, pp. 102-119 |
| Wednesday | February 21 | Bacon, <i>The New Organon</i> , Book II, aphorisms 13-25, pp. 119-141 |

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| Friday | February 23 | Midterm Review Day |
| Monday | February 26 | MIDTERM WRITTEN EXAM |
| Wednesday | February 28 | MIDTERM DISCUSSION EXAM |
| Friday | March 1 | Pascal, "Preface to the Treatise on the Vacuum" and "New Experiments Concerning the Vacuum," pp. 355-371 (**) |
| Monday | March 4 | Pascal, "Account of the Great Experiment Concerning the Equilibrium of Fluids," pp. 382-389 (**) |
| Wednesday | March 6 | Lab: The Big Tube (meet in Wentz Science Center) |
| Friday | March 8 | Pascal, "Treatise on the Equilibrium of Liquids," pp. 390-403 (**) |
| Monday | March 11 | Spring Break—NO CLASS |
| Wednesday | March 13 | Spring Break—NO CLASS |
| Friday | March 15 | Spring Break—NO CLASS |
| Monday | March 18 | Pascal, "Treatise on the Weight of the Mass of the Air," pp. 403-429 (**) |
| Wednesday | March 20 | Lab: The Weight of the Air |
| Friday | March 22 | Boyle, "Boyle's Law: Pressure-volume Relations in a Gas" (from Shamos, <i>Great Experiments</i>) (**) |
| Monday | March 25 | Lab: Boyle's Law |
| Monday | March 25 | Du Chat let, <i>Dissertation on the Nature and Propagation of Fire</i> , First Part (**) |
| Wednesday | March 27 | Stahl, "On Sulfur"; Macquer, <i>Dictionary of Chemistry</i> (**) |
| Friday | March 29 | Good Friday—NO CLASS |
| Monday | April 1 | Priestley, "On Dephlogisticated Air" (to pg. 19) (**) |
| Wednesday | April 3 | Lab: "Dephlogistication" (or Calcination) of Magnesium |
| Friday | April 5 | Lavoisier, <i>Memoir on the Calcination of Tin</i> , pp. 155-163 (**) |
| Monday | April 8 | Lavoisier, <i>Elements of Chemistry</i> , pp. 1-15 (**) |
| Wednesday | April 10 | Joule, "On the Mechanical Equivalent of Heat" |
| Friday | April 12 | Lab: The Mechanical Equivalent of Heat |
| Monday | April 15 | Avogadro, "A Manner of Determining the Relative Masses..." (**) |
| Wednesday | April 17 | Cannizzaro, "Sketch of a Course of Chemical Philosophy" (up to pg. 20) (**) |
| Friday | April 19 | Lab: Cannizzaro Coin Lab |
| Monday | April 22 | Meyer, "Nature of the Chemical Elements..."; Mendeleev, "Relation Between Properties and Atomic Weight" (**) |
| Wednesday | April 24 | Final Exam Review Day |
| Friday | April 26 | FINAL WRITTEN EXAM |
| Monday | April 29 | FINAL DISCUSSION EXAM (10:30am-12:30pm) |