**SGBN 102: What is Matter?**
Spring 2019
MWF, 10:40-11:45am, Goldspohn 35

Professor: Adam Kotsko, akotsko@noctrl.edu
Office: Seybert 102 (far northeast corner of campus, across from chapel)
Office Hours: 9:15-10:15 MWF, 2:30-3:30 MW, or by appointment

## Course Description

Western ideas of matter proceed from the Presocratics 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.

In addition, this examines the themes of the Innovating the World iCon by inquiring into what comprises the world that we experience and how humans have come to understand and manipulate it. The central questions include determining how the "stuff" of the world behaves, how we come to know that, and the processes by which our predecessors came to this knowledge in their own ways. 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* (New York: Oxford UP, 2008) [ISBN: 978-0199540280]
Bacon, *The New Organon* (New York: Cambridge UP, 2000) [ISBN: 978-0521564830]

All other readings will be provided via a course packet that all students must purchase from the Shimer Great Books School.

## 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: 40%. The remainder of the grade will be determined by lab work, including problem worksheets and reports (28%), a pair of short essays (20%), and a take-home final exam (12%).

**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**.

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:

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| 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.) |

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| 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 | Automatic failure of the course. |

In order to make up for an absence, students must visit a museum or attend a cultural or academic event relevant to the content of the course. They must write a reflection on this experience (2 *full* pages, double spaced), relating it in some way to material that they have studied in the present class. Absence make-ups must be completed **within three weeks** of the absence being made up. Students have ample opportunities to attend events on the North Central campus, in Naperville, or in Chicago. Hence there should be no difficulty in finding an appropriate event or time for a museum visit (beyond the required visits listed on the schedule below).

**Lab work and reports** will take the form of simple, hands-on experiments that approximate key moments in the history of scientific discovery. I will provide a workbook including instructions on how the labs should be carried out as well as what students need to focus on in lab journals. As a part of each lab students must also give brief oral presentations in class. ***All lab reports will be due by the beginning of the class period after the lab was conducted*** (which will most often give you the weekend to work on it).

**Essays** will provide an opportunity to reflect more broadly at the problems that we are exploring in the course. Students will choose a key concept and compare the way that concept operates in at least two texts and/or labs. Each essay must be 2-3 pages in length (500-750 words) and must use references (quotations and page numbers) from the text(s) to support your claims.

***All written assignments must be turned in on Blackboard*** by the due date listed on the course schedule below; in case of technical difficulties with Blackboard, you may submit the paper via email or, in a true emergency, in print form for the sake of meeting the deadline, but the paper must be posted on Blackboard as soon as possible in order to receive comments and a grade. Outside of cases involving computer problems, students should ***not*** print their papers.

Students submit ***all written work*** in Microsoft Word (.doc or .docx) format; in case of technical difficulties submitting in the required format, you may use another format for the sake of meeting the deadline, but must resubmit in the required in order to receive comments and a grade. **Unless otherwise stated, the deadline is always *the beginning of class time* on the date in question.** Papers turned in within 24 hours of the deadline will receive a 5% grade penalty on the assignment; papers turned in within a week of the deadline will receive a 10% grade penalty, with an additional 10% penalty for each additional week (or portion of a week) the paper is late.

**Problem worksheets** will assess student's grasp of basic scientific principles and nomenclature. The final worksheet will serve as a take-home final exam.

## Note on Institutional Policies

Please note that the college-wide policy on plagiarism holds for this class and that student assignments may be run through plagiarism-detection software at the professor's discretion. 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.

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 may change, particularly given that this is the first time the course is being offered in its current form. All students will be alerted as soon as possible via email and Blackboard announcement to any changes.* ***Failure to check email regularly is no excuse for missing these updates.***

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| Monday | January 6 | Course introduction; Pre-Socratics (handout) |
| Wednesday | January 8 | Aristotle, *Physics*, Book II, 1-9 |
| Friday | January 10 | Aristotle, *Physics*, Book III, 1-3; Book IV, 1-5 |
| Monday | January 13 | Aristotle, *Physics*, Book IV, 6-9 |
| Wednesday | January 15 | Pascal, "New Experiments Concerning the Vacuum" (incl. preface); "Account of the Great Experiment" |
| Friday | January 17 | Lab: Air and hydraulic pressure |
| Monday | January 20 | **NO CLASS—Martin Luther King Day** |
| Wednesday | January 22 | Pascal, "Treatises on the Equilibrium of Liquids and on the Weight and the Mass of the Air" |
| Friday | January 24 | Lab: Weight of Air |
| Monday | January 27 | Campos, "Nature's Deterioration" |
| Wednesday | January 29 | Debus, "The Chemical Key"; Newman, "Medieval Alchemy" |
| Friday | January 31 | Bacon, *The New Organon*, Book 1, aphorism 1-60 |
| Monday | February 3 | Carolyn Merchant, *The Death of Nature* (selection) |
| Wednesday | February 5 | Bacon, *The New Organon*, Book 2, aphorism 1-12 |
| Friday | February 7 | Bacon, *The New Organon*, Book 2, aphorism 12-25 |
| Monday | February 10 | Bacon, *The New Organon*, Book 2, aphorism 26-35 |
| Wednesday | February 12 | Dear, "Miracles, Experiments, and the Ordinary Course of Nature" |
| Friday | February 14 | Boyle, "Boyle's Law: Pressure-volume Relations in a Gas" (from Shamos, *Great Experiments*)<br>Lab: Boyle's Law |

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| Monday | February 17 | Lavoisier, *Elements of Chemistry* (to pg. 15) |
| Wednesday | February 19 | Black, *Lectures on the Elements of Chemistry* |
| Friday | February 21 | Lab: Supercooling and Latent Heat |
| Monday | February 24 | Priestly, "On Dephlogisticated Air" |
| Wednesday | February 26 | Lavoisier, "Memoir on the Calcination of Tin" |
| Friday | February 28 | Lab: "Dephlogistication" of magnesium and calcination of iron |
| Monday | March 2 | **NO CLASS—Spring Break** |
| Wednesday | March 4 | **NO CLASS—Spring Break** |
| Friday | March 6 | **NO CLASS—Spring Break** |
| Monday | March 9 | Hankins, "Chemistry" from *Science and the Enlightenment* |
| Wednesday | March 11 | Joule, "On the Mechanical Equivalent of Heat" |
| Friday | March 13 | Lab: Mechanical equivalent of heat |
| Monday | March 16 | Faraday, "Chemical History of a Candle," Lectures I-III |
| Wednesday | March 18 | Faraday, "Chemical History of a Candle," Lectures IV-V |
| Friday | March 20 | **Paper #1 due; no class** |
| Monday | March 23 | Dalton, "Extracts from a New System of Chemical Philosophy"; Bostock, "Letter to Nicholson on Dalton"; Dalton, "Letter to Nicholson on Bostock" |
| Wednesday | March 25 | Gay-Lussac, "Memoir on the Combination of Gaseous Substances"; Dalton on Gay-Lussac |
| Friday | March 27 | Avogadro, "A Manner of Determining the Relative Masses…" |
| Monday | March 30 | Cannizzaro, "Sketch of a Course of Chemical Philosophy" (up to pg. 18) |
| Wednesday | April 1 | Cannizzaro, "Sketch of a Course of Chemical Philosophy" (up to pg. 34) |
| Friday | April 3 | Lab: Cannizaro coin lab |
| Monday | April 6 | Dulong, "Atomic Weights and Specific Heat"; Meyer, "Nature of the Chemical Elements…"; Mendeleev, "The Relation Between Properties and Atomic Weight" |
| Wednesday | April 8 | Rocke, "Ideas in Chemistry" |
| Friday | April 10 | **NO CLASS—Good Friday** |

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| Monday | April 13 | Berzelius, "Electrochemical Theory" and "Chemical Symbols and Formulas"; Faraday, "On Electric Decomposition" |
| Wednesday | April 15 | Homburg, "Chemistry and Industry" |
| Friday | April 17 | **NO CLASS—Honors Day** |
| Monday | April 20 | Curie, "Radium and the New Concepts in Chemistry" |
| Wednesday | April 22 | **Paper #2 due**<br>Examination of periodic table |
| Wednesday | April 29 | **Take-home final due by 10:00am** |