Chemistry 502: Development of Modern Chemistry
Syllabus (Spring 2020)

While our modern conception of chemistry began to emerge in the "Chemical Revolution" of the late 18th Century, the roots of chemistry extend far into antiquity. Two intertwined questions underlie inquiries of a chemical nature: (a) what is matter? and (b) how does it change? In this course, we will study the origins of "matter theory" in Ancient Greece, follow its meandering path through the Roman and Islamic Empires, and then investigate the practice of Alchemy in the Latin West through the Middle Ages and beyond. The evolution of theories regarding chemical change, from the "phlogiston" theory to modern mechanistic ideas, will be followed in parallel. The period from the late 17th to early 19th Century, during which a shift from alchemical ideas to more modern chemical concepts occurred, will be examined in particular. We will conclude with the introduction of modern concepts of chemical structure and reactivity that appeared in the late 19th Century.

This is a chemistry course, *not* a history course. Our approach will be to examine how specific experiments were designed, how they were executed, and how the data were interpreted and conclusions reached — all within the general context of the historical period, which we would be at peril to ignore. Several laboratory demonstrations, to include an alchemical procedure for creating an "elixir", a method to capture the elusive substance known as "phlogiston", and the first apparatus designed to study electro-chemical phenomena, will be studied as well. Questions that we will examine include: Why was Greek "matter theory" so enduring? Why was the concept of "atomism" so controversial? What was alchemy and to what extent were iconic figures such as Robert Boyle influenced by it? What was the "Chemical Revolution"? Why were women generally excluded from studies in chemistry until relatively recently? Less than a century transpired for the transition from the "Four Elements" theory of matter to the first Periodic Table, which had 56 elements — who were the key players in effecting this transformation and how did they make such astonishing progress?

Instructor:
Dr. J. Aldstadt Office: CHM 112 aldstadt @ uwm.edu Office Hours: by appt

Class Schedule:
Lecture: TR 3:00-3:50 pm CHM 110

Pre-requisites: Grades of C or better in: Elementary Quantitative Analysis (Chem 221) and Organic Chemistry I (Chem 341 *or* 343); junior standing is also required.

Required Course Materials:

- H. Salzberg. *From Caveman to Chemist: Circumstances & Achievements*; American Chemical Society, Washington, D.C.; 1991. ISBN-10: 9780841217874
- S. Johnson. *The Invention of Air: A Story Of Science, Faith, Revolution, And The Birth Of America*; Riverhead Books (Penguin), New York, NY; 2009. ISBN-10: 1594484015

Selections from the following will also be studied (provided by the Instructor): Plato's *Timaeus*, Aristotle's *Physics* and *Meteorologica*, Lucretius' *On the Nature of Things*, Geber's *The Sum of the Height of Perfection*, Boyle's *The Sceptical Chymist*, Black's *On Magnesia Alba*, and Lavoisier's *Elements of Chemistry*. Additional readings will include select writings of Priestley, Dalton, Cannizzaro, Mendeleev, & others.

POLICIES.

Department of Chemistry. You are expected to fully understand the policies posted on the bulletin boards across from Room 195 and adjacent to Room 164.

Academic Dishonesty. Academic dishonesty will not be tolerated. Cheating will result in a course grade of F — referral to the University Judiciaries may also occur. The University's policies are described in UWS Chapter 14 and Faculty Document No. 1686 and can be found at: uwm.edu/academicaffairs/facultystaff/policies/academic-misconduct.

Attendance. You are responsible for all material presented in class.

COURSE STRUCTURE.

The course grade will be determined from the following elements:

Essays	60%	eight essays (~3-4 pp) at approx. two-week intervals
Exploratory Writing	20%	short, informal in-class exercises on a weekly basis
Engagement	20%	extent of participation in discussions

LECTURE OUTLINE.

Week	Topic	Reading
1	Ancient: Thales & progeny – the first ideas about matter	Chapter I: Roots
2	Ancient: Plato & the Forms	Chapter II: Greek Plato *Timaeous*
3	Ancient: Aristotle & the Causes	Chapter II: Greek Lindberg *Aristotle*

Week	Topic	Reading
4	Ancient: Technology & translation	Chapter III: Roman Chapter IV: Islamic
	Medieval: The rise of the university	Chapter V: Artisans
5	Medieval: Alchemy	Chapter VI: Alchemists Principe *Secrets of Alchemy*
		Chapter VII: Medicine
6	Medieval: Bacon & the Scientific Revolution	Chapter VIII: Information Chapter IX: Revolution
7	Early Modern: Boyle I	Chapter X: Boyle Boyle *The Sceptical Chymist* Principe
8	Early Modern: Boyle II	Chapter X: Boyle Boyle *The Sceptical Chymist* Principe
9	Modern: Phlogiston	Chapter XI: Black Black *On Magnesia Alba*
10	Modern: Chemical Revolution I	Chapter XII: Priestley Johnson *Invention of Air*
11	Modern: Chemical Revolution II	Chapter XII: Lavoisier Lavoisier *Elements of Chemistry*
12	Modern: Atomic Theory	Chapter XIII: Dalton Thomson *System of Chemistry*
13	Modern: Molecular Structure	Chapter XIV: Organic
14	Modern: the "Periodic Law"	Chapter XV: Mendeleev
15	Modern: 20th Century & final thoughts	Levere *Transforming Matter*