

Hist Sci 250: Chemistry Through History Fall 2018

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Office Hours: F 10:00-12:00

Class meets:
TR 11:00-12:15
Humanities 2637

Welcome to Chemistry Through History! Today's chemists appear to control and manipulate the three-dimensional molecular micro world with ease – much like the models and computer simulations they use to guide their work. But what is the origin of this extraordinary capability? And why is it that – in the ever-changing disciplinary landscape – chemistry remains an essential science?

This course examines chemistry over the course of the long nineteenth century from the French Revolution (1789) to the First World War (1914-18). This was when chemists mastered nature, building a science that was both academically dominant, and of immense industrial, economic, and military significance. By about 1900, chemistry was the queen of the sciences, of unequalled status and power. Join this course to learn why and how chemists built this remarkable science.

There are no formal pre-requisites for this course, and it is open to students at any level. Students taking classes in chemistry and related disciplines may find this course of particular interest.

Learning Objectives:

By the end of this course you should:

- understand why and how chemistry became the dominant science of the late 19th and early 20th centuries;
- be able to outline some key conceptual changes in chemistry since 1780: how these were set in motion, why they mattered, and what were their consequences;
- appreciate chemistry as a contingent activity, as profoundly shaped by its context as it is effective in controlling and manipulating the material world;
- know that history (of chemistry) can serve a range of goals, depending on the questions it seeks to answer and the audiences it is intended to address.

This course will help you develop transferable skills in:

- analyzing and criticizing written argument (readings);

- evaluating and synthesizing information derived from a range of sources (reading, lectures, and informal discussions);
- constructing and defending written and verbal arguments (your contributions in the classroom, and your written work)

You will also gain experience in:

- planning and executing small-scale projects (historical exercises, short essay writing);
- working with others (participation in classroom exercises);
- interpreting historical sources (reading the primary and secondary literature)

Credit Policy

This class meets for two 75-minute class periods each week over the fall semester and carries the expectation that students will work on course learning activities (reading, writing, problem sets, studying, etc.) for about 3 hours out of classroom for every class period. This syllabus provides additional information about meeting times and expectations for student work.

Course Requirements

The accompanying class schedule clearly indicates which readings are required and which are optional. You should expect your understanding of the main content, argument and significance of **required readings** to be assessed – as they occur in the schedule (via in-class exercises) and in the final paper.

Completion of the course requires submission of all assignments, including all class preparation and participatory activities, to the instructor's satisfaction.

Final letter grades will be calculated according to the following formula:

- attendance and participation (20%);
- in-class exercises (20%);
- **due Oct 16:** secondary literature assignment (20%);
- **on Nov 27:** primary source assignment (20%);
- **due Dec 19:** final paper, 1,500 (+/-10%) words (20%). **Late papers will not be accepted.**

*Please make a note of these due dates and let me know ASAP if you anticipate any problem in meeting these deadlines. **It is your responsibility to make ensure you meet course requirements and deadlines.***

A Note on Attendance and Participation:

My expectation is that you come to class prepared for the activities listed in the syllabus; willing to discuss readings and field work; and prepared to engage with staff elsewhere who have generously given their time to host our visits. I understand you may miss a couple of classes during the semester due to minor illness or other unforeseen events. **Extended or repeated absence (without legitimate reason) and/or failure to participate in class activities will negatively impact your final grade.**

Plagiarism and Scholarly Integrity:

As with any course of this kind, it is your responsibility to avoid plagiarism. In the first instance, you are directed to the University of Wisconsin guidelines concerning plagiarism and scholarly integrity. If you are unclear in any specific instance – for example when writing the research paper required for this course – please ask for advice. Learning how correctly to acknowledge the contribution of other scholars, and understanding what constitutes originality, are essential to sound historical practice and are therefore skills this course is designed to help you acquire.

Class Schedule

Each week's lecture (T) is accompanied by a field trip, primary source lab, or workshop (R). Please make sure you know where we're meeting.

1. Introduction: The World of the 18th-Century Chemist (Sept 6 2018)

(R only; course introduction; no required reading)

2. The Chemical Revolution: Analysis, Elements, and Atoms (Sept 11, 13 2018)

T: Theory and Practice in early 19th C chemistry

Required: Trevor Levere, *Transforming Matter* (Baltimore: Johns Hopkins University Press, 2001), Chapter Six or Seven (as assigned).

Optional: Antoine Lavoisier, *Treatise on Chemistry*, trans. Robert Kerr (New York: Dover, 1965), Chapter One.

R: 19th Century Chemistry Textbooks, hosted by Dr Robin Rider, Curator of Special Collections, Memorial Library, UW-Madison

Class meets in Special Collections, Memorial Library, 9th Floor. I will be in the lobby of Memorial Library from 12:50 to help you find your way.

Our review of a range of 19th chemistry textbooks has **two main goals:** i) to see what a different science chemistry was in that period; and ii) to show you that textbooks can be important historical sources.

3. Organic Chemistry I: Analysis and Formula (Sept 18, 20 2018)

T: Liebig and the Problem of Organic Analysis

Required: MW Chapter One

Optional: Alan Rocke, "Organic Analysis in Comparative Perspective," pp. 275-310 in *Instruments and Experimentation in the History of Chemistry*, ed. Frederic L. Holmes and Trevor Levere (Cambridge MA: MIT Press, 2000); Justus Liebig, *Instructions for the Analysis of Organic Bodies* (Glasgow: Griffin, 1839).

R: Secondary Literature Assignment: An Introduction

This session introduces the secondary literature assignment, **due October 16**

4. Learning to be a Chemist: From Lecture Theatre to Laboratory (Sept 25, 27 2018)

T: Becoming a chemist in Giessen: Liebig and the development of practical laboratory training

Required: MW Chapter Two

Optional: Jack Morrell, "The Chemist Breeders: The Research Schools of Liebig and Thomas Thomson," *Ambix* (1972) **19:** 1-46.

R: Undergraduate Research in Chemistry Today, hosted by Dr Cheri Barta, Undergraduate Research Director, Chemistry Department, UW-Madison

Class meets in Chemistry 9341. Ask if you're unsure how to get there!

5. Doing Chemistry: Glassware Revolution (Oct 2, 4 2018)

T: Why and how did Liebig tackle the problem of organic analysis in glass?

Required: MW Chapter Three.

Optional: Melvyn C. Usselman, Christina Reinhardt, Kelly Foulser, and Alan J. Rocke, "Re-Staging Liebig: A Study in the Replication of Experiments," *Annals of Science* **62** (2005): 1-55.

R: What is scientific glassblowing? Hosted by Master Scientific Glassblower, Tracy O. Drier

Class meets in Chemistry B-201, Tracy Drier's Glass Shop. Please ask if you're unsure how to get there!

You may wish to view at least part of this PBS broadcast before class: <https://wpt.org/University-Place/glass-and-glassblowing-making-modern-chemistry>

6. Organic Chemistry II: Vitalism, Synthesis, and Model Compounds (Oct 9, 11 2018)

T: Organic Synthesis: Goals, Meaning, and Tools

Required: MW Chapter Four

Optional: James S. Muspratt and August W. Hofmann, "On Toluidine: A New Organic Base," *Mem. Proc. Chem. Soc.* **2** (1843): 367-83; August W. Hofmann, "Researches Regarding the Molecular Constitution of the Volatile Organic Bases," *Proc. Roy. Soc.* **140** (1850): 93-131.

R: Secondary Literature Assignment: Workshop

7. The Origins of Physical Chemistry (Oct 16, 18 2018)

T: Foundations of physical chemistry.

Required: John W. Servos *Physical Chemistry: From Ostwald to Pauling* (Princeton, NJ: Princeton University Press, 1996[1991]), Chapter Two: "Physical Chemistry from Europe to America."

Optional: Mary Jo Nye, *From Chemical Philosophy to Theoretical Chemistry: Dynamics of Matter and Dynamics of Disciplines, 1800-1950* (University of California Press: Berkeley, CA, 1993), Chapter Five.

R: Louis Kahlenberg and the Development of Physical Chemistry at UW-Madison, with Dr Robin Rider

Class meets in Special Collections, Memorial Library, 9th Floor.

This class will preview your Primary Source Assignment, due Nov 27.

Optional: Aaron Ihde, *Chemistry as Viewed from Bascom's Hill* (Madison: University of Wisconsin Press, 1990), 166-84.

8. Organic Chemistry III: Constitution, Structure, and Synthesis (Oct 23, 25 2018)

T: How could 19th C chemists produce chemical structures without spectroscopy?

Required: Catherine M. Jackson, "Emil Fischer and the 'Art of Chemical Experimentation'," *History of Science* **55** (2017): 86-120, 102-117.

Optional: Manfred Hesse, *Alkaloids: Nature's Curse or Blessing* (New York: Wiley, 2002), 115-168 (Chapter Three "Structure Elucidation of the Alkaloids," esp. 118-125 on coniine).

R: Modern Structure Determination, hosted by Dr Charlie Fry, Director of the Magnetic Resonance Facility, Chemistry Department, UW-Madison

Class meets in Chemistry, 2201A. Ask if you're unsure how to get there!

9. Re-organizing the Curriculum: the Periodic Table (Oct 30, Nov 1 2018)

T: Why was the Periodic Table introduced, and how did it change chemical education and research?

Required: Nathan Brooks, "Dimitrii Mendeleev's *Principles of Chemistry* and the Periodic Law of the Elements," 295-310, in *Communicating Chemistry*, ed. Bernadette Bensaude Vincent and Anders Lundgren (Canton, MA: Science History Publications, 2000)

Optional: Michael D. Gordin, *A Well Ordered Thing: Dimitrii Mendeleev and the Shadow of the Periodic Table* (New York, NY: Basic Books, 2004), Chapter One; Primo Levi, *The Periodic Table* (New York, NY: Shocken, 1984), "Potassium."

R: Primary Source Assignment: An Introduction, with Dr Robin Rider

Class meets in Special Collections, Memorial Library 9th Floor.

This class formally introduces your Primary Source Assignment, **due November 27.**

We will also be viewing some relevant primary sources for next week's sessions.

10. The Laboratory Revolution in Chemistry (Nov 6, 8 2018)

T: How does chemical education and research shape the laboratory?

Required: Catherine M. Jackson, "Chemistry as the Defining Science: Discipline and Training in Nineteenth-Century Chemical Laboratories," *Endeavour* 35 (2011): 55-62.

Optional: Images from the following primary sources: Paul J. Hofmann, *Das Chemische Laboratorium der Ludwigs-Universität zu Giessen* (Heidelberg: Winter, 1842); August W. Hofmann, *Report on the chemical laboratories in process of building in the universities of Bonn and Berlin* (London: Clowes, 1866); Emil Fischer and Max Guth, *Der Neubau des ersten Chemischen Instituts zu Berlin* (Berlin: Hirschwald, 1901); Emil Fischer, *Eröffnungs-feier des neuen I. Chemischen institutes der Universität Berlin* (Berlin: Hirschwald, 1900).

R: UW Madison Chemistry Building Project Workshop

11. Organic Chemistry IV: Making a Synthetic Organic Chemist (Nov 13, 15 2018)

T: Emil Fischer as paradigmatic synthetic organic chemist.

Required: Catherine M. Jackson, "Emil Fischer and the 'Art of Chemical Experimentation'," *History of Science* 55 (2017): 86-120, 86-102 and 117-20.

Optional: Peter J. Ramberg, *Chemistry in Space: The Early History of Stereochemistry, 1874-1913* (Aldershot: Ashgate, 2003), Chapter Eight; Jeffrey A Johnson, *The Kaiser's Chemists: Science and Modernization in Imperial Germany* (Chapel Hill: North Carolina University Press, 1990), Chapter One.

R: What can we learn from Emil Fischer's Textbooks? with Dr Robin Rider.

Class meets in Special Collections, Memorial Library, 9th Floor.

This class will give you an opportunity to develop your primary source assignment.

12. Primary Source Assignment Workshop (Nov 20, NO CLASS Nov 22 2018)

T: Primary Source Assignment: A Workshop

This will be an excellent opportunity to get feedback on your primary source assignment, **due Nov 27.**

R: Thanksgiving Holiday

13. The Chemists' War (Nov 27, 29 2018)

T: Chemistry applied to agriculture and warfare.

Required: Dietrich Stoltzenberg, *Fritz Haber: Chemist, Nobel Laureate, German, Jew: A Biography* (Philadelphia: Chemical Heritage Foundation, 2005), Chapters Six and Seven (On the KWI and the Chemists' War)

Optional: Hasok Chang and Catherine M. Jackson, eds. *An Element of Controversy: The Life of Chlorine in Science, Medicine, Technology and War* (BSHS, 2007), Chapter Seven (Chlorine as the First Major Chemical Weapon); Hannah Gay, *History of Imperial College, 1907-2007* (London: Imperial College Press, 2007), Chapter Five

R: Essay Writing Workshop

Your chance to get peer-to-peer feedback on your final essay draft.

14. The Professional Chemist (Dec 4, 6 2018)

T: Chemists everywhere!

Required: John A. Heitmann, "A New Science and a New Profession: Sugar Chemistry in Louisiana, 1885-1895," in *Essays on the History of Organic Chemistry* ed. James G. Traynham (Baton Rouge, LA: Louisiana State University Press, 1987), 78-84; **or** Sally M. Horrocks, "A promising pioneer profession? Women in industrial chemistry in inter-war Britain," *BJHS* (2000) **33**: 351-67.

R: A Century in Primary Sources, hosted by Dr Robin Rider

Class meets in Special Collections, Memorial Library, 9th Floor.

15. Conclusion (Dec 11 2018)

T: Essay Drafts Workshop