

**SYLLABUS**  
Chemistry 150/360  
**Great Discoveries in Science**

or

**An Essential Unity: Humanities, Social Sciences, Sciences**  
**Inclusion/Exclusion: The Nature of Scientific Discovery**  
**Bodies That Matter: The Nature of Scientific Discovery**  
**No Man Is an Island: The Nature of Scientific Discovery**

**ALL ASSIGNMENTS DONE OUTSIDE OF CLASS TIME MUST BE TYPED.**

**If you need to send me an assignment by email, always create a fresh/new document.**

Fall 2022

**CLASS ATTENDANCE IS REQUIRED!!!**

No man is an island,  
entire of itself;  
every man is a piece of the continent,  
a part of the main.

If a clod be washed away by the sea,  
Europe is the less,  
as well as if a promontory were.

as well as if a manor of thy friend's  
or of thine own were.

Any man's death diminishes me,  
because I am involved in mankind;

and therefore never send to know for whom the bell tolls;  
it tolls for thee.

(John Donne, 1572-1631, poem ca. 1623; Francis Bacon 1561-1626)

Instructor: D. W. Thompson, Phone: 757 291 8007 cell 757 221 2545 (W&M)  
Email: dwthom@wm.edu Send emails to me from this address only, not via of Blackboard.  
Office: Integrated Science Center, Rm 2279 Office hours: By appointment—I am flexible.

### I. General Information

Class Meeting Times: Tuesday-Thursday 12:30 pm to 1:50 pm and Tuesday-Thursday 3:30 pm to 4:50 pm. ISC Room 0248.

Final Exam Date/Time: Thursday, Dec 20 (first exam period) for 12:30 pm Tu-Th class///Tuesday Dec 14 (second exam period) for 3:30 pm Tu-Th class. The final exam will consist of an in-class, closed-book exam for approximately the second half of the course and a final  $\geq 2000$  word paper with references/citations, this paper being due by the end of the final period, Dec 20.

### Required Books:

- The Annotated and Illustrated Double Helix* by James D. Watson, Alexander Gann, Jan Witkowski  
 Hardcover: 368 pages  
 Publisher: Simon & Schuster; annotated edition (November 6, 2012)  
 ISBN-10: 1476715491  
 ISBN-13: 978-1476715490
- The Alchemy of Air: A Jewish Genius, a Doomed Tycoon, and the Scientific Discovery That Fed the World but Fueled the Rise of Hitler* by Thomas Hager  
 Paperback: 336 pages  
 Publisher: Broadway Books (August 18, 2009)  
 ISBN-10: 0307351793  
 ISBN-13: 978-0307351791
- Marie Curie: A Life* (Radcliffe Biography Series) by Susan Quinn  
 Series: Radcliffe Biography Series  
 Paperback: 528 pages  
 Publisher: Da Capo Press (April 10, 1996)
- The Structure of Scientific Revolutions: 50th Anniversary Edition* by Thomas S. Kuhn, with an Introduction by Ian Hacking  
 Paperback: 264 pages  
 Publisher: University Of Chicago Press; Fourth Edition (April 30, 2012)  
 ISBN-10: 0226458121  
 ISBN-13: 978-0226458120
- Whose Community? Which Interpretation?: Philosophical Hermeneutics ...* by Merold Westphal (Distinguished Professor of Philosophy, Fordham University), Baker Academic, 2009.
- Harvard Case Studies in Experimental Science—The Overthrow of the Phlogiston Theory: The Chemical Revolution of 1775-1789* by James Bryant Conant, Harvard University Press, 1948.

**Other readings in the syllabus/schedule will be provided without charge.**

**Purchase only 1, 2, 3, and 4; do not purchase 5 and 6.**

## II. Course Description:

This course will look at great discoveries in physics and chemistry including the structure of atoms, radioactivity and nuclear phenomena, the structure and significance of DNA, and chemicals with profound social consequences such as ammonia and their dominant place in chemistry, biology, and physics. Besides fundamental scientific and historical interest, these discoveries will be used to illumine the philosophical foundations of research in science. Several biographical works will be examined including those of Marie Curie, James Watson and Francis Crick, Henri Becquerel, Fritz Haber, Frederick Banting, etc. Philosophical works such as Thomas Kuhn's *The Structure of Scientific Revolutions*, Jacob Bronowski's *Science and Human Values*, and Wendell Berry's *Life is a Miracle* (the latter addressing the consilience of E. O. Wilson) will or may be examined. The syllabus may vary with regard to topics as time restraints dictate and as determined by the instructor.

## III. Grading and Student Responsibilities.

**Please. For assignments that require written answers to the assignment's questions, download the Word doc assignment and type in your answers after each question, so that the question and your answer are both contiguously visible. Thank you.**

**Grades will be assigned based on the following:**

Lecture Test	30%
Writing/reading assignments of various sorts	30%
Final examination and final paper (2000 words)	25% exam and 15% final paper

**No one can receive an A grade for the entire course without writing at least a B+ final paper!**

Absences and late assignments. **Class attendance is required as per Department of Chemistry protocol. Each student may miss only one class for any reason.** You may not miss student *presentations*. In order to be excused from attendance beyond the single "for any reason" absence, you must contact me before the absence or provide notification of illness or college-sponsored function. You will need to write a 150-word science news summary to turn in for each excused absence, for example, an illness or an out-of-town chess club tournament or a football trip. *Each unexcused absence will decrease your overall grade by one-third of a letter grade (e.g., A<sup>-</sup> to B<sup>+</sup>).* Assignments turned in beyond one week of the original due date on the class-by-class schedule will have a 20% penalty; assignment turned in beyond two weeks of the original deadline may have a 50% penalty. All assignments must be turned in by the first Monday after the lecture term ends. Turning in assignments, on semi-regular or regular basis, after their due date may result in a maximum of a one letter grade reduction in the final course grade.

Films, movies, documentaries, and such like. During these types of presentations the departmental protocol is that all electronic devices be closed, e.g., computers, smart phones, cell phones, tablets, etc.

## V. Topics and schedule of class periods (continually tentative)

See the Class-by-Class schedule on Blackboard.

## VI. Great Discoveries in Science—What does this course title mean? To what is it referring?

The meaning of "great." Synonyms: vast, large, distinguished, celebrated, wonderful, magnificent, paradigm changing, life changing, density of affect, etc.

The meaning of "discovery." Synonyms: unearthing, uncovering, breakthrough, innovation, revelation, etc.

The meaning of "science." Synonyms: discipline, knowledge, skill, art, learning, scholarship, physics, chemistry, biology, sociology, government, etc.

"Those who cannot remember the past are condemned to repeat it."  
George Santayana, American philosopher.

## VII. Where are we going in Chemistry 150/360?

We are going to the suggestion—

1. that science is a thoroughly human activity. (Watson, Crick, the Curies, Banting, Haber, etc.)
2. that there is a unity and thus beauty within the domain of human intellectual achievement and that beauty is an essential criterion of truth. (Watson, Crick)
3. that beauty and myth are necessary and essential to understanding of all that is important. (Dirac, Chandrasekhar)
4. that there is no essential difference between the humanities and the sciences. (Berlin, Thompson)
5. that valid/true/compelling knowledge is discovered and created by the same human-centered foundational approach (a hermeneutical circle a la philosophers Schleiermacher, Heidegger, Ricoeur, Gadamer).
6. that science has limitations. (As Bacon wrote, "*ipsa scientia potestas est*" ("knowledge itself is power," *Meditationes Sacrae* (1597)); however, such power can be put to good or ill. (Curies, Haber, Einstein, Oppenheimer)
7. that the world is made of stories, not of atoms. (Rukeyser, Bagdassarian)
8. that there is a "fatal flaw" (harmatia-Greek: ἀμαρτία-missing the mark) within humans. (Koestler)
  - a. "We knew the world would not be the same. A few people laughed, a few people cried, most people were silent. I remembered the line from the Hindu scripture, the *Bhagavad-Gita*... "Now, I am become Death, the destroyer of worlds." (Oppenheimer)
  - b. "In some sort of crude sense which no vulgarity, no humor, no overstatement can quite extinguish, the physicists have known **sin**; and this is a knowledge which they cannot lose." (Oppenheimer)
9. that human knowledge results from "working up the raw material of sensation into the finished product of thought." (Durant)

But then, do we always have to be going somewhere? Is destination the substance and joy of life? Is not joy in the journey as significant as the joy in the destination? Maybe at times more important because often we will not reach the destination for one reason or another? We are going "to travel farther north than anyone [has] ever gone, farther north than [our] people's stories went." (Barry Lopez in *Crow and Weasel*)

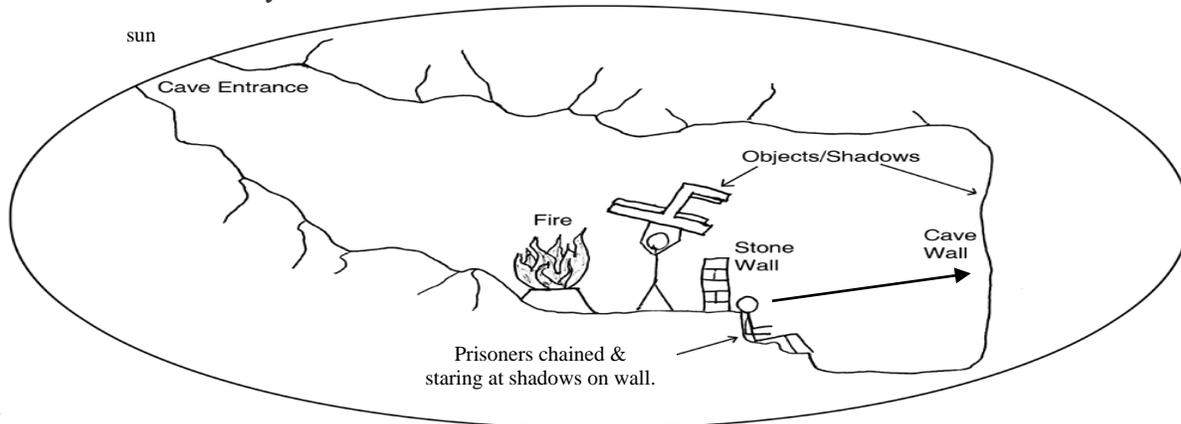
**VIII. Topics for a Chemistry 150/360 final paper (≥2000 words). You must write on one of these topics. Your final paper must have a title. Your paper must have a clear, precise, and well-defined thesis that you are addressing, or put another way: You need a thesis statement that provides a specific focus for the essay and that organizes what is to be discussed in the body of the text. Also, review Professor Griffith's criteria for papers under Chem 150/360 Documents.**

1. The marginalization/exclusion/neglect/disdain (etc.) of women in science throughout history, thinking here of people such as Marie Curie, Rosalind Franklin, Jocelyn Bell Burnell, Esther Lederberg, Lise Meitner, Clara Immerwarf, Emmy Noether (mathematician) or others that may come to your attention. **You may not not write on Rosalind Franklin** as we have devoted much time to her story in the context of class material and assignments.
2. Should Nobel Prizes be awarded to scientists (not more than 3 in number for any one Nobel) or should they be awarded to discoveries rather than to individuals? What are the limitations and even injustices at times to awarding Nobel Prizes to only three (at most) scientists for a single Nobel Prize? Be sure to cite cogent examples of perceived

injustices of the past ca. 120 years of Nobel awards. Here are two introductory pieces on this topic; find and cite other resources as well.

1. [http://www.slate.com/articles/health\\_and\\_science/science/2017/10/the\\_nobel\\_prize\\_does\\_science\\_a\\_serious\\_disservice.html](http://www.slate.com/articles/health_and_science/science/2017/10/the_nobel_prize_does_science_a_serious_disservice.html)
2. <https://www.theatlantic.com/science/archive/2017/10/the-absurdity-of-the-nobel-prizes-in-science/541863/> 1/6

3. An essay on Plato's *Allegory of the Cave*. You will first need to read Plato's *Allegory of the Cave*. It is a short piece. It is found on Blackboard for Great Discoveries under Documents. Your task is to apply Plato's allegory of the cave to modern times, most particularly to natural science. However, you may apply the "cave" story to any aspect of modernity. For example, does the "cave" intersect with the film *The Matrix*? *The Little Prince*—"What is essential is invisible to the eye." What does the cave represent? How about the prisoners, the shadows on the wall, the marionette players, the fire, and the area outside the cave? In other words, explain the allegory from a modern perspective, particularly with regard to sciences. In no way do I want to limit your creativity here. A pictorial representation of the "cave" story is below.



4. An essay on genome editing technique with regard to the manipulation of human cells. Here is a paragraph from a recent article (file:///C:/Users/dwthom/Downloads/EMBO%20Reports%20-%202015%20-%20Caplan%20-%20No%20time%20to%20waste%20the%20ethical%20challenges%20created%20by%20CRISPR.pdf).

The term "CRISPR" has gained a lot of attention recently as a result of a debate among scientists about the possibility of genetically modifying the human germ line and the ethical implications of doing so. However, CRISPR is not just a method to edit the genomes of embryonic cells, as the public discussion might have implied; it is a powerful, efficient, and reliable tool for editing genes in any organism, and it has garnered significant attention and use among biologists for a variety of purposes. Thus, in addition to the discussion about human germ line editing, CRISPR raises or revives many other ethical issues, not all of which concern only humans, but also other species and the environment.

#### **With regard to a final paper:**

Please see the course syllabus for topics, length ( $\geq 2000$  words), etc. for a final paper. It is a typical research/response erudite paper. It is due by the last day of finals. It will be graded for coherence, fidelity, form, content, and style. The paper must incorporate with exact citation substantive aspects related to at least **two** individuals (e.g., Marie Curie, James Watson, Antoine Lavoisier, Fritz Haber, and others) in at least **two** of the five

“great discoveries” addressed in the Chem 360/150 course material. You must also include exact citations from at least **two** external references, i.e., references other than the books and papers that were required for this 150 course. Thus your bibliography with exact and full citations at the end of your paper will be at least **five** in number. Place the bibliography/references at the end of the paper.

Format your paper according to either the **APA or MLA** formatting styles. (See <https://www.scribbr.com/research-paper/research-paper-format/>.) Your paper must minimally have **five cogent references** to books, articles, scholarly papers, other documents, etc. You must have at least three references that are not one of the five assigned books for Chemistry 150/360. Further you must have exact citations within your paper to and from your references (author, title, publisher, date of publication, page numbers of paragraph number, etc.) formatted appropriately (**APA or MLA**). Your paper must include at least three forceful/illuminating/succinct quotes from your references.

Two samples of what a research paper should address.

## Sample Research Paper

### The Many Faces of Generalissimo Fransisco Franco: His Legacy Remembered

By: **Erinn Heubner**

① When American schoolchildren are educated about Europe between the years 1936 through 1975, they are taught about the aftereffects of World War I and about World War II. Europe, in high school history classes, ceases to exist after 1945 and the close of World War II unless, of course, one is learning about the Cold War and the Berlin Wall may be mentioned. They do not learn, however, that World War II era Spain—because Spain was neither an ally or a foe during the war—went through enormous conflict of its own. The three-year Spanish Civil War and the fascist dictatorship that followed are largely kept out of the American history books. Yet, the world is privy to much of its legacy through literature, art, film, and personal memory. Spain certainly remembers three hellish years of war and thirty six years of repression under Generalissimo Fransisco Franco, but how is General Franco remembered by the rest of the world? What legacy did he leave internationally? ② It is a confused and varied one: to those closest to him he was a husband, father, and statesman; to Hitler, he was an obstacle on the road to world domination; to the Jews who fled from Hitler he was a hero; but to the many Spanish minorities and to his opponents in the Spanish Civil War he was a monster. ③

① *The introduction sets up the context for an overall question of focus and addresses why the topic is new and important.*

② *The writer poses an interesting and engaging set of research questions.*

③ *The paper is “thesis-driven;” this is a good, clean thesis statement that suggests an answer and sets up the argument that follows.*

Another Sample Research Paper:

**MLA Style Research Paper**  
based on the 7<sup>th</sup> ed. of the *MLA Handbook for Writers of Research Papers*. Created Nov 10, 2009.

Your last name, and page # on upper right corner of each page ½ inch from top border.

Smith 1

Your name

John Smith

Professor

Professor Williams

Course name

American Studies 104

Date

14 March 2008

Use Times New Roman 12 pt. or similar easy to read font.

Title is centered

Found Voices: Carl Sagan

Double space entire paper

Carl Sagan was perhaps one of the most influential scientific minds that the world has ever experienced. When he learned that stars were actually extremely distant suns, his world was changed and the magnitude of the universe opened up to him. Another strong motivator into science came with his reading of a popular science fiction book of the time, *The Burroughs Tales*. The stories were not extremely sound scientifically, but still presented ideals of adventure and the unknown. The idea that life could exist elsewhere in the universe fascinated Sagan and remained with him for the rest of his life (Eicher).

Indent 1 inch from left border

Italicize names of books, plays, poems, television shows, newspapers, magazines, websites, databases, art, ships, and space craft.

Indent additional ½ inch when beginning a new paragraph

Perhaps one of Sagan's most famous individual accomplishments was his involvement with the *Pioneer 10 Space Probe*. The probe was created to be the first object to exit our galaxy. Sagan acknowledged that the chances of anything actually discovering the probe were astronomical, but believed that it was important to promote public appreciation for science and thought the project to be "all in good fun" (McDonough 50).

In-text citation pointing to a specific source in the works cited list.

Citation with page number of quotation.

Public appreciation for science was, in fact, what made Sagan the "superstar scientist" that we hear of today. His ability to portray complex