

USC School of Pharmacy

Pharmacy Undergraduate Programs

Fall 2022

RXRS 304-Mysterious Deaths: From Poisons in History to Forensic Toxicology 8/19/2022

Instructors:

Martine Culty, PhD
Associate Professor, Department of Pharmacology and Pharmaceutical Sciences
School of Pharmacy, University of Southern California
culty@usc.edu (323) 865-1677
Office Location: HSC campus PSC 702; Office Hours (by appt).

Daryl L. Davies, PhD
Professor, Department of Clinical Pharmacy
School of Pharmacy, University of Southern
Californiaddavies@usc.edu
(323) 442-1427
MCA-9121
Office Location: HSC campus PSC 506; Office Hours (by appt).

Mary Ellen Cosenza, PhD
Adjunct Faculty, Department of Regulatory and Quality
Sciencesmecosenza@gmail.com

Terry David Church, DRSc, MA, MS
Assistant Professor, Department of Regulatory and Quality
SciencesUSC School of Pharmacy
tdchurch@usc.edu

Hovhannes Gukasyan, PhD,
Associate Professor, Department of Pharmacology and Pharmaceutical
SciencesSchool of Pharmacy, University of Southern California
gukasyan@usc.edu

Course Weight: 4 Units

Days/Time/Location: Wednesday 3:30 pm - 6:20 pm* in KAP 159 Kaprielian Hall
**the last 30 min of class consist of writing a short Reflection Essay on the lecture, which can be done at home)*

Course catalogue description: The story of poisons and their deliberate use told through the prism of history and literature, as a way to discover forensic toxicology.

Introduction

The use of poisons is weaved into human history, from the natural substances that humans learned to use for healing and criminal purposes, to the man-made chemicals of the 20th century inducing sickness or death, including those designed to improve life, and those purposely created for biological or chemical warfare. Poisons have fascinated and inspired people, occupying a prominent place in historical and fictional stories. Sadly, the topic of poisons has not faded in time, as we are regularly reminded through the recounting of recent poisoning events, accidental or deliberate, by the media. This course will take advantage of this rich but sometimes unsettling heritage to introduce students to major classes of poisons and to the basic concepts of forensic toxicology, balancing them against the beneficial (medicinal), and industrial uses of many of these substances.

The goal of the course is to make students aware of the pertinence of toxicology in our daily life, to teach them the basic tools allowing them to assess the risks and benefits of chemical exposures and to trigger their curiosity for learning more about toxicology.

Objectives

The course is designed for undergraduates of both scientific and non-scientific majors with an interest in understanding how the knowledge of poisons led to the development of toxicology. This will be done through an overview of major poisons, their traditional and medicinal uses, and industrial purposes, and how the understanding of their toxicity evolved over time.

We will discuss the emergence of forensic toxicology in USA following the intentional poisoning of American citizens by the government during the Prohibition in the 1920s-1930s; and many more puzzling mysteries that inspired writers such as Agatha Christie.

Chapters from the required textbook will be supplemented with a variety of source materials, including documentaries, media articles and book chapters. Emerging “hot” topics in poisoning incidents will be discussed, and students will get the opportunity to discuss the poisons of their choice through short presentations with their peers.

Upon successful completion of this course a student should be able to:

- Discuss how poisons have influenced human history.
- Explain the basic principles of toxicology and the main mechanisms behind the danger of poisons.
- Describe the origins and basic principles of forensic toxicology.
- Generate a comprehensive and compelling presentation on a poison, as a team or individually.

Assignments and Grading:

| | |
|---|---------------------|
| Class participation: | 20 pts (8%) |
| 2 quizzes @ 10 pts each | 20 pts (8%) |
| 3 short presentations on a poison @ 10 pts each | 30 pts (12%) |
| 2 midterm exams @ 35 pts each: | 70 pts (28%) |
| 1 written report due on the day of the exam | 50 pts (20%) |
| 1 final exam (partially cumulative): | <u>60 pts (24%)</u> |
| Total: | 250 pts – 100% |

Class Participation and Attendance (20 pts):

Participation includes asking and answering questions and being actively involved in the discussion. Students are encouraged to express freely their opinions on the topics that are discussed, being ready to articulate their reasoning in a collegial and constructive manner that incites discussion; taking into consideration all sides of a story with an open mind, given them tools to reassess dogma or preconceived ideas if applicable.

Attendance at all classes is expected. Students are expected to read the assigned papers prior to the lecture and be prepared to discuss the background, current understanding, and gaps in knowledge for the topic in each lecture.

30 min home-assignment (1/2 point per reflection essay): Students are expected to spend 30 min at home to write a **short “reflection” essay** on the class (1 page), explaining what they learned from the lecture, their thoughts about the relevance of the topic and any suggestion they have. **This activity can lead to a maximum of 7 bonus points** (2.8% of the total) by the end of the course.

Written report (50 pts): The class deliverable will be a 5 page write up, which can be based either on one of the chapters of the required text “**The Poisoner’s Handbook**” by D Blum, or on one of the other recommended readings and class sources of information, based on a toxin or poison of choice. While “No deliverable turned in” will be scored 0, the highest score will be given to an excellent synopsis of the extracurricular source of information. It is expected that the students will engage one of the extracurricular sources of information (based on one of the cited videos, the reading of one of the recommended or suggested sources, or reading of one of the reviewed pieces of literature [e.g. a book by Agatha Christie]) of a subject of interest.

Quizzes (10 points each) include 10 questions (multiple choice questions, T/F questions, fill-in the blank questions).

Short presentations (10 points each) consist of oral presentations (~ 5 slides) by students (individual or teams) on a poison of their choice.

Midterms (35 points each) will include multiple choice questions, and T/F questions and fill-in the blank or short answer questions.

Final exam (60 points) will have a similar format as the midterms. The final exam will be cumulative but will emphasize material covered after the 2nd midterm.

There are no make-up exams. If exceptional circumstances prevent you from attending an exam, your reason for missing it must be accompanied by a written statement from a third party (e.g. a note from a medical doctor).

Notes, books, calculators, electronic dictionaries, regular dictionaries, cell phones or any other aids are not allowed during exams.

Students will be asked to complete an anonymous critical evaluation of the course at its completion.

Required Text:

The Poisoner's Handbook: Murder and the Birth of Forensic Medicine in Jazz Age New York. By **Deborah Blum**
ISBN-13: 978-0143118824; ISBN-10: 014311882X
Available on Amazon for ~ \$9.00 - \$15.00

We will supplement the reading with segments from videos/movies on the poisons discussed in class.

Course Readings

Required Readings: selected, short, easy to read chapters from the following books:

- John Emsley. *Molecules of Murder: Criminal and Classic Cases.* (2008) RCS Publishing, Thomas Graham House, Science Park, Milton Road, Cambridge CB4 0WF, UK
- John Emsley. *The Elements of Murder: A History of Poisons.* (2005) Oxford University Press, Great Clarendon Street, OX2 6DP
- Kathryn Harkup. *A is for Arsenic: The Poisons of Agatha Christie.* (2015) Bloomsbury Sigma, 1385 Broadway, New York, New York 10018.
- Deborah Blum. *The Poison Squad: One Chemist's Single-Minded Crusade for Food Safety at the Turn of the Twentieth Century.* Penguin Press. ISBN-13: 978-1594205149; ISBN-10: 1594205140

Although not mandatory, it is strongly suggested that the students purchase these books, as it will provide a resource to reinforce and supplement the lectures, and support their learning process throughout the semester. Moreover, this material can be used as source for their written report.

Suggested articles to read or listen to:

Acocella, J. Murder by Poison. *The New Yorker*, October 14, 2013.

Alizadeh et al. Black henbane and its toxicity – a descriptive review. *Avicenna J of Phytomedicine*, 4:297-311, 2014.

Chidiac, EJ, et al. Mandragora: Anesthetic of the Ancients. *Anesth Analg* 115:1437-41, 2012. Holzman, RS. *The Legacy of Atropos, the Fate Who Cut the Thread of Life.* 89:241-249, 1998.

Langman, LJ and BM Kapur. Toxicology: Then and Now, *Clinical Biochemistry* 39:498-510, 2006.

Pearce, DN. Sherlock Holmes, Conan Doyle and cocaine. *Journal of the History of Neurosciences* 3:227-232, 1994.

Rozman KK and J Doull. Paracelsus, Haber and Arndt. *Toxicology* 160:191-196, 2001.

Bardell, EB. Literary Reflections of Pharmacy XI: Thallium as "An Untraceable Poison". *Pharmacy in History* 30:188-190, 1988.

Dayon, AD. What killed Socrates? Toxicological considerations and questions. *Postgrad Med J* 85:34-37, 2009.

Hughes, MF et al. Arsenic Exposure and Toxicology: A Historical Perspective. *Toxicological Sciences* 123:3005-332, 2011.

Lee, MR. Solanaceae IV: Atropa belladonna, Deadly Nightshade. *J R Coll Physicians Edinb* 37:77-84, 2007.

Reynolds, T. Hemlock alkaloids from Socrates to poison aloes. *Phytochemistry* 66:1399-1406, 2005.

Murder by poison – the rise and fall of arsenic.

<https://www.newyorker.com/magazine/2013/10/14/murder-by-poison>

Other course materials, including but not limited to the syllabus, supplemental reading assignments and additional handouts will be posted on <http://blackboard.usc.edu/>. Students are encouraged to use the onlinediscussions among students via Blackboard.

Course Outline

This course will be in the format of lectures given by instructors on specific topics. During each weekly session, the instructor will engage students with questions and draw comments or interpretations primarily based on the assigned reading. Some classes will include student short presentations. Students are expected to ask questions and participate in an interactive fashion.

Course schedule is as follows:

| Week & Date Fall 2022 | Topic | Subtopics to be Included | Assigned and Supplemental Reading |
|---|--|--|---|
| Introduction and Background | | | |
| August 24 (wk 1) DD | Introduction: expectations and goals of this class. Overview of toxicology vs pharmacology | <ul style="list-style-type: none"> Understand the basic principles of toxicology <ul style="list-style-type: none"> Hazard, risk and exposure Dose response | |
| Aug 31 (wk 2)MC | History of the Use of Poisons: Overview | <ul style="list-style-type: none"> Learn about famous poison victims Learn about poison use in politics Understand how chemicals can be used as both medicines and poisons | |
| Sep 7 (wk 3) MEC | Milestones in Forensic Analysis of Poisons | <ul style="list-style-type: none"> Learn about the development of assays to measure poisons <ul style="list-style-type: none"> Understand how forensic toxicology has progressed over time | <ul style="list-style-type: none"> Introductory Chapter, Emsley, 2008 Langman and Kapur, 2006 Norris & Gettler, NY Coroner's Office, 1918 |
| Sep 14 (wk 4) MC Quiz 1 (wk1-3) | Ricin | <ul style="list-style-type: none"> Learn about the use of ricin in history, literature and political poisonings Understand how ricin works <ul style="list-style-type: none"> | Chapter 1, Emsley, 2008 Chapter R, Harkup, 2015 The Umbrella Assassin https://www.youtube.com/watch?v=WgLVMXGqFeI https://www.youtube.com/watch?v=HsVRYhLLPCM |
| Sep 21MC (wk 5) | Cyanide: Nazi Regime, Tylenol, Jonestown Massacre and others | <ul style="list-style-type: none"> Understand the historical uses of cyanide <ul style="list-style-type: none"> Learn about natural cyanides Understand how cyanide works | Chapter 8, Emsley, 2008 Chapter C, Harkup, 2015 Cyanides in Excedrin: https://www.youtube.com/watch?v=b0reHh7Sq9s |
| MIDTERM 1 - Sep 28 (first hour, covering weeks 1-4) | | | |
| Sept 28MC (wk 6) Midterm 1 (wk1-4) | Environmental poisoning, Mercury, Lead, POPs, pesticides, phthalates | <ul style="list-style-type: none"> Learn about poisons you are exposed to from the environment <ul style="list-style-type: none"> Learn about the history and medicinal use of mercury and lead Understand the mechanisms of toxicity of mercury and lead Learn about historical toxic accidents that affected humans | Chapters 2-4; 12-14, Emsley, 2005 One Man's Experience with Methyl Mercury Poisoning https://www.youtube.com/watch?feature=player_embedded&v=e2Nsy0c22R8 Website: http://www.environmentalhealthnews.org/ Reference Movie: a civil action |
| Oct 5MC (wk 7) 1st short presentation | Morphine and Morphine Like Compounds | <ul style="list-style-type: none"> Learn about the historical uses of opiates Review the use of opiates in literature Understand the medicinal uses and abuse-associated risks of opiates | Chapter 4 Emsley, 2008 Chapter O, Harkup, 2015 Opioid Nation: The Making of an Epidemic: https://www.youtube.com/watch?v=ygqalpOT3T |

| | | | |
|---|--|---|--|
| Oct 12 MEC (wk 8) | Arsenic toxicity; food as poison in the 1800-1900s and the birth of the FDA. | <ul style="list-style-type: none"> Learn how people were exposed to toxicants via food, and how Wiley and his team of chemists fought to ensure food quality in USA. Learn about the use of arsenic as a medicine, preservative, and poison through history and literature Learn about natural forms & industrial use of arsenic | Chapters 2-4; 12-14, Emsley, 2005 Chapter A, Harkup, 2015. "The Poison Squad" book by Deborah Blum. Talk show by D. Blum Kinter Lecture Arsenic by D. Blum: https://www.youtube.com/watch?v=elSqUjkMWFU |
| MIDTERM 2 - Oct 19 (first hour, covering weeks 5-8) | | | |
| Oct 19 MC (wk 9) Midterm 2 (wk 5-8) | Carbon Monoxide | <ul style="list-style-type: none"> Understand the toxicity of carbon monoxide, and how it works Learn about the sources of carbon monoxide | Chapter 7, Emsley, 2008 Poisoner's Guide to Communicating Chemistry (CO at ~ 9 min): https://www.youtube.com/watch?v=QPDwzcppG0o CO at ~ 20-30 min): https://video.mainepublic.org/video/university-place-poisoners-guide-life/ |
| Oct 26 (wk 10) MEC | Methanol and ethanol | <ul style="list-style-type: none"> Learn about the use of methanol in improper alcoholic drink production Understand how methanol and ethanol toxicities differ | Methanol poisoning https://www.youtube.com/watch?v=PsVwJBSfBAY MeOH at ~ 32 min in video: https://video.mainepublic.org/video/university-place-poisoners-guide-life/ |
| Nov 2 (wk 11) MC 2nd short presentations | Poison Hemlock | <ul style="list-style-type: none"> Learn about the use of hemlock in history and literature Understand how hemlock works | Chapter H, Harkup, 2015 Five Little Pigs; Agatha Christie (trailer) Y |
| Nov 9 (wk 12) MEC Quiz 2 (wk 9-11) | Polonium and Thallium | <ul style="list-style-type: none"> Learn about the use of polonium and thallium in history and literature Understand how polonium and thallium kill | Chapter 10, Emsley, 2008 Chapter T, Harkup, 2015 The polonium plot https://www.youtube.com/watch?v=1FqcFaJEnh8 https://www.youtube.com/watch?v=z8tJzsFEq8M |
| Nov 16 (wk 13) MC & TC | Renaissance poisons: Belladonna, Henbane and Mandrake | <ul style="list-style-type: none"> Learn about the historical and cultural uses of plant alkaloids Understand the medicinal uses of materials derived from these plants Understand how they work | Chapter 2, 3, Emsley, 2008; Chapter B, Harkup, 2015 The use of sacred weeds https://www.youtube.com/watch?v=iQepGtmpUR4 https://www.youtube.com/watch?v=uLZiKBdMEIc |
| Nov 23 | Thanksgiving Recess | | |
| Nov 30 (wk 14) MC & HG 3rd Short presentations | Botulinum toxin and BOTOX | <ul style="list-style-type: none"> Understand how botulinum toxins work Learn about the history and the cosmetic and therapeutic uses of Botox | |
| RXRS 304 Final Exam: Monday, December 12, 2022 from 2 to 4 pm in KAP 159 | | | |

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on [Research and Scholarship Misconduct](#).

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University’s educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
studenthealth.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call
suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call
studenthealth.usc.edu/sexual-assault

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086
eetix.usc.edu

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298
usc-advocate.symplcity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776
osas.usc.edu

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - (213) 821-4710
campussupport.usc.edu

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - (213) 740-2101
diversity.usc.edu

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call
dps.usc.edu

Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)
ombuds.usc.edu

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - (323) 442-3340 or otfp@med.usc.edu
chan.usc.edu/otfp

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.