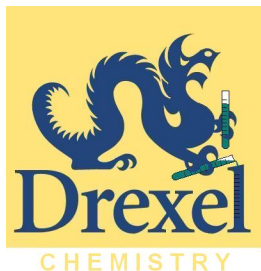


# Chemistry Department Faculty Mini-Symposium

2015-2016

Team-Oriented

Senior Research Course



# 2015-16 Senior Research Course Topic



# 2015-16 Senior Research Course Topic

## • From Grain to Tap: The Science of Brewing

- Ms. Marisa Egan, Lead Chemist, Victory Brewing (Downingtown & Parkesburg, PA)
- Dr. Jon Soffer
- Dr. Kevin Owens



Roger Barth, The Chemistry of Beer: The Science in the Suds, Hoboken, NJ: John Wiley & Sons, Inc., 2013.

George Fix, Principles of Brewing Science: A Study of Serious Brewing Issues, 2<sup>nd</sup> ed., Brewers Publications, 1999.

Paul D. Hooker, William A. Deutschman, Brian J. Avery, “The Biology and Chemistry of Brewing: An Interdisciplinary Course”, *J. Chem. Ed.*, 2014, 91, 336-9.  
(Westminster College, Salt Lake City, UT)

# The Science of Brewing

- Possible biochemistry, analytical chemistry and organic chemistry related research projects:
  - Comparison of methods (IR, NIR, headspace GC, etc.) for alcohol by volume (ABV) measurement
  - Development of a method for the analysis of fermentable sugars by LC-MS
  - Quantitation of diacetyl (or other desirable or off-flavor components) in beer by GC-MS
  - Effect of oxidation on the flavor components present via LC-MS
  - Kinetics of diacetyl production and consumption in beer as a function of temperature or time of fermentation
  - Comparison of  $\alpha$ - and  $\beta$ - acids in hops by LC-MS (how they change throughout the brewing process and in aging/storage, and the role that the ratio plays on taste)
  - Quantitation of beer bitterness by LC-MS and RP-HPLC (comparison to standard UV methods)
  - Effects of temperature and pH on the brewing process (raw materials to end product) by LC-MS.

# From Grain to Tap: The Science of Brewing

- Possible biochemistry/molecular biology related research projects:
  - Determining Amylase activity, and stopping a runaway reaction
  - Comparison of yeast metabolism under a variety of conditions (sugar content, pH, and temperature) by LC-MS and headspace GC
  - Yeast identification and validation via MALDI MS
  - Monitoring yeast flocculation under a variety of conditions (sugars, pH, and temperature)
  - Examination of non-essential oil contributions to hop aroma during the beer making process
  - Investigation of hop polyphenols (proanthocyanidins) during the the brewing process
  - Investigation of yeast interactions with proanthocyanidins during the brewing process (hops exhibit toxicity towards fungi yeast and bacteria)

# The Science of Brewing

- All students will learn the basics of the brewing process, and be trained in basic analysis techniques.
- Small teams will be assigned to a main research project- they will research the topic, get trained in use of the appropriate instrumentation, perform the experimental work towards the project goal and report on the results.
- Different groups of students will be responsible for basic analyses needed to troubleshoot problems that may arise in the brewing process.
- Analytical techniques that may be used in this work:
  - FT-IR
  - UV/visible/NIR
  - LC-MS
  - GC-MS
  - GC
  - AA (flame and graphite furnace)
  - FT-MS



# Senior Research Course

- 9 credits (3 credits/term fall/winter/spring) of CHEM480
- There will be scheduled blocks of time during the week
  - Lab meeting/journal club held in Disque 406 computer lab
  - Lab(s) will be open with faculty available during scheduled periods
- There will be both individual and team deliverables
  - Individual deliverables
    - Presentation of recent journal article (once each term)
    - Assigned effort on research project
  - Team deliverables
    - Design of the workflow
    - Management of the project
    - Presentation to the group on the analytical technique and research plan
    - Continuous effort towards project goal
    - Final report on research results
- 1 credit in spring term (CHEM480) as a wrap-up course
  - Writing final report (ACS requirements)
  - Development of presentation skills