

**FDSC/CSES Special Topics - Introduction to Brewing Science**  
**HOEC 005, Thursday 3:30-5:30**

Instructor

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Office Hours: By appointment (PTSC 115)

Rationale

The class is designed to give an overview of the biological and chemical processes involved in brewing beer and an appreciation for beer styles and flavors. Perspectives of brewing from the homebrewer to the industrial brewer will be discussed.

General Course Objectives

Have an appreciation for beer's role in society including history, distribution and economic importance

Have an understanding of the raw materials used in brewing

Have an understanding of the biological and chemical processes involved in brewing

Have an appreciation of the different styles, flavors, and quality characteristics of beer

Materials of Instruction

No textbook will be required but books listed in the reference section can provide in-depth information.

On-line articles will also be used to provide additional information.

Instructional Modes to be used

Lectures will be used to present information that will be used for evaluation (quizzes and tests). Field trips and hands-on exercises will also be utilized.

Academic integrity

As a core part of its mission, the University of Arkansas provides students with the opportunity to further their educational goals through programs of study and research in an environment that promotes freedom of inquiry and academic responsibility. Accomplishing this mission is only possible when intellectual honesty and individual integrity prevail.

Each University of Arkansas student is required to be familiar with and abide by the University's 'Academic Integrity Policy' at [honesty.uark.edu/policy](http://honesty.uark.edu/policy). Students with questions about how these policies apply to a particular course or assignment should immediately contact their instructor.

Attendance

Attendance is expected during all class periods. Excused absences include personal illness (with a doctor's note), illness or death of a family member, and participation in official university events (must be notified in advance).

### Student Evaluation

Mid-term exams (2@100 pts)

Brewery tours (2@35 pts)

Comprehensive Final exam (150 pts)

Homework (30 pt)

**TOTAL 450 PTS**

The semester grade will be determined by dividing the total points accumulated by the total possible to obtaining a percentage. The following percentages will be used to determine letter grades:

A	90-100%
B+	85-89%
B	80-84%
C+	75-79%
C	70-74%
D+	65-69%
D	60-64%
F	<60%

Instructor consent and additional assignments are required for graduate credit.

## Course Outline

### 1. Background

- What is beer – water, malt, hops, and yeast
- Cereals as staples -reason for, civilizations and their staple
- Bread and beer
  - Cereal seed structure and growth–embryo, scutellum, aleurone, endosperm, hulls
  - Seed composition– starch (2 types,) protein, oil, and husks
- Historical look at beer
  - Worldwide
  - United States
- Current production and consumption

### 2. Brewing process overview

- Malting
- Milling
- Mashing – gelatinization, liquefaction, and saccharification
- Wort separation -sparging and lautering
- Boiling and bittering
- Fermentation
- Aging and packaging

### 3. Malting process and types of malt

- Process – cleaning, steeping, germination, kilning
- Base malts vs specialty malts – diastatic power, color, flavor, dextrins
- Malting grains – barley, wheat, rye (others)
  - Other malts and adjuncts – non-barley malt, cereal adjuncts, sugars, malt extracts

### 4. Wort production

- Milling malt
- Mashing grist –gelatinization, liquefaction, and saccharification
- Wort separation - sparging and lautering
- Boiling – sterilization, isomerization, hot break, Malliard reaction, sulfur compounds
- Wort strength – influencing factors, measurement

### 5. Hops

- History of bittering ingredients - gruit, hops & others
- Classification, growth habit, production
- Alpha acids and bitterness
  - Isomerization
  - IBU calculation
  - Balance GU and BU
- Beta acids and essential oils
- Antimicrobial properties
  - Hop forms – wet hops, whole hops, pellets, extracts
  - Protection from blue light

## 6. Yeast

Evolution of brewing yeast

Preparation - wort cooling and oxygenation

Fermentation – overview, fermentation of sugars, other yeast products

Types of brewing yeast - ale, lager, wine, strains within species

Factors affecting yeast performance – pitching rate, oxygen, temperature

Other organisms used in beer brewing *Brettanomyces*, *Lactobacillus*, wild yeasts

Contaminant types

Yeast as a waste byproduct

## 7. Water profiles

Brewery needs

General fitness - pH and hardness, minerals

## 8. Packaging and distribution

Maturation – aging, secondary fermentation, lagering

Stabilization

Clarification – centrifugation, cold conditioning, fining agents, filtration

Microorganism removal - pasteurization, sterile filtration

Gas control – CO<sub>2</sub>, nitrogen

Packaging - Bottles, cans, kegs

Quality control

Distribution

## 9. Beer styles

General Characteristics – gravity, strength, attenuation, color, bitterness, clarity, carbonation

Recipe formulation

BJCP guidelines

Lagers

Pale lager

Amber lager

Dark lager

Munich/Dunkle

Bock

Ales

Light colored ales - wheat, whit, Saison

Hoppy – bitters, pale ales, IPAs

The dark side – porters, stouts, and brown ales

Kitchen sink – spiced, vegetable, smoked

Pucker up- sour, gose, Lambics

Are you kidding – light, non-alcoholic, gluten-free

## 10. Beer and Food

Flavor components

Quality - flaws, freshness/aging

Serving – temperature, presentation

Pairing beer and food

Cooking with beer

## REFERENCES

### **General Brewing**

Bamforth, Charles. 2009. Beer: Tap into the art and science of brewing, 3<sup>rd</sup> Edition. Oxford University Press, New York, NY.

Bath, Roger. 2013 The chemistry of beer: The science of suds. John Wiley & Sons, Inc. Hoboken, New Jersey.

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

Garrett, Oliver. 2012. The Oxford companion to beer. Oxford University Press, New York, NY.

Lewis, Michael J., and Tom W. Young. 2001. Brewing (2<sup>nd</sup> Edition). Springer Science + Business Media, LLC. New York, NY.

### **History**

Ogle, Maureen. 2006. Ambitious brew: The story of American beer. Harcourt books. Orlando, Florida.

Sinclair, Thomas R., and Carol Janas Sinclair. 2010. Bread, beer and the seeds of change; Agriculture's Imprint on World History. CAB International, Cambridge, Massachusetts.

Smith, Gregg. 1998. Beer in America; The early years- 1587-1840. Brewers Publications. Boulder, Colorado.

### **Ingredients**

Hieronimus, Stan. 2012. For The Love of Hops: The Practical Guide to Aroma, Bitterness and the Culture of Hops. Brewers Publications. Boulder, Colorado.

Mallett, John. 2014. Malt: A practical guide from field to brewhouse. Brewers Publications. Boulder, Colorado.

Mosher, Randy. 2004. Radical Brewing: recipes, tales and world-altering meditations in a glass. Brewers Publications. Boulder, Colorado.

Palmer, John and Colin Kaminski. 2013. Water: A Comprehensive Guide for Brewers. Brewers Publications. Boulder, Colorado.

White, Chris and Jamil Zainasheff. 2010. Yeast: The practical guide to beer fermentation. Brewers Publications. Boulder, Colorado.

### **Styles and Food Pairing**

Bernstein, Joshua M. 2013. The complete beer course: Boot camp for beer geeks. Sterling Publishing. New York, New York.

Herz, Julia and Gwen Conley. 2015. Beer pairing: The essential guide from the pros. Voyageur Press. Minneapolis, Minnesota.

Mosher, Randy. 2009. Tasting beer: An insider's guide to the world's greatest drink. Storey Publishing. North Adams, Massachusetts.

Sanders, Lucy. 2007. The best of American beer and food: Pairing & cooking with craft beer. Brewers Publications. Boulder, Colorado.