

(Plan Created 12/18/2022)

**Program Assessment Plan  
Certificate of Proficiency in Brewing Science  
University of Arkansas**

**1. Department Name & Contact Information for the Certificate of Proficiency in Brewing Science,**

Department of Food Science  
2650 North Young Avenue  
Fayetteville, AR 72704  
479-575-4605

Dr. Renee Threlfall, Research Scientist ([rthrelf@uark.edu](mailto:rthrelf@uark.edu)) and Dr. Scott Lafontaine, Assistant Professor ([scottla@uark.edu](mailto:scottla@uark.edu))

**2. Food Science Department Vision and Mission**

Strengthen sustainable local and global food systems with innovations for improving human health and food security through education, research, and outreach.

1. Lead scientific discovery and innovations for enhancing food quality, safety, security, sustainability, and accessibility.
2. Understand the relationships among food, health, and consumer behavior to enhance human health and well-being
3. Provide approved curriculum, distance learning, and extension materials to train workforce for supporting food industry
4. Build a community of students, staff and faculty that reflects the land grant mission of serving our pluralistic society by embracing diversity, equity and inclusivity.

**3. Certificate of Proficiency in Brewing Science Program Goals**

The Certificate of Proficiency in Brewing Science Program (BREWCP) at the University of Arkansas is an interdisciplinary collaboration across three colleges that combines the science and engineering knowledge needed to produce skilled employees in the craft brewing industry. BREWCP combines theoretical understanding with practical application. The certificate is made up of six credit hours of required courses, three hours of internship/special problems, and six hours of electives. In total, the BREWCP is 15-hour certificate program that incorporates core brewing and fermentation courses, chemistry, biology and engineering electives, as well as applied work and research opportunities which are designed to provide students with a well-rounded understanding of beer brewing. The program is housed in the Department of Food Science, and incorporates courses from the Dale Bumpers College of Agricultural, Food and Life Sciences, the Fulbright College of Arts and Sciences, and the College of Engineering. At the end of the brewing certificate program, the following are the expectations.

1. Graduates will develop core brewing skills which are required to perform at a high level in industry related positions and/or will help them to continue their education in a professional program
2. Graduates will be able to integrate, examine, and assess new information to make knowledgeable decisions.
3. Graduates are expected to be able to communicate effectively in oral and writing scenarios

**4. Student Learning Outcome 1.** Students will demonstrate theoretical foundational knowledge of core/ foundational brewing science topics such as but not limited to the physical, chemical, microbiological aspects of beer production as well as the sensory

analysis of raw materials and different beer styles. Students will also show that they are aware of the historical, legal, and economic aspects brewing.

#### **A. BREWCP Pre and Post Assessment Test**

- Pre-tests will be administered in FDSC 2723 (Introduction to Brewing Science) and the same test will be administered again at the end of BREW 4573/BREW 5573 (Beer Production And Analysis) or BIOL 2723L (Microbial Fermentation Laboratory) as a post examination of the BREWCP. The test includes questions from required brewing core courses listed above. The pre-test and the post-test will be scored separately and serve as a direct measure of a student's success in the BREWCP.

#### **B. Acceptable and Ideal Targets** (not required for indirect measures).

- It is likely that incoming students will perform poorly on the pretest. We would expect an average score for the pretest to be less than or equal to 55%. We would expect an average score for the posttest to be greater than or equal to 80%.

#### **C. Key Personnel**

Dr. Scott Lafontaine, Food Science Department, Assistant Professor,  
[scottla@uark.edu](mailto:scottla@uark.edu)

**5. Student Learning Outcome 2.** Students will develop practical and critical-thinking skills which they apply to issues in the brewing industry. Students will demonstrate these skills through written and oral communication. This will be done through an oral presentation and a written report which are required after a special problems or internship. This Learning Outcome uses rubrics as the direct measure.

#### **A. Rubrics for BREWCP Internship/Special Problems**

- Two rubrics, an oral presentation rubric and written communication rubric, will be used to evaluate the oral presentation and written reports from the student internship/special problem.

#### **B. Acceptable and Ideal Targets** (not required for indirect measures).

- For the Internship/Special Problems rubrics, it is expected that 80% of the students will meet expectations 10% will exceed expectations and 5% will not meet the expectations.

#### **C. Key Personnel** (Department Head, Faculty, Department Administrative Manager).

Dr. Scott Lafontaine, Food Science Department, Assistant Professor,  
[scottla@uark.edu](mailto:scottla@uark.edu)

#### **6. Certificate of Proficiency in Brewing Science Exit Survey**

- The Exit Survey is given to students during their final year in the certificate program.
- Self-reported competency levels are included.
- The survey is an indirect measure.

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#### **7. Supporting Attachments**

Pre-test and Post-test

Exit Survey

Oral Presentation Rubric

Written Communication Rubric

## Certificate of Proficiency in Brewing Science Pre and Post Assessment Test

The Certificate of Proficiency in Brewing Science Program (BREWCP) at the University of Arkansas is an interdisciplinary collaboration across three colleges that combines the science and engineering knowledge needed to produce skilled employees in the craft brewing industry. This 15-hour certificate program incorporates core brewing and fermentation courses, chemistry, biology, and engineering electives, and applied work and research opportunities designed to provide students with a well-rounded understanding of beer brewing. This program is housed in the Department of Food Science, and incorporates courses from the Dale Bumpers College of Agricultural, Food and Life Sciences, the Fulbright College of Arts and Sciences and the College of Engineering. The BREWCP is comprised of six credit hours of required courses, three hours of internship/special problems, and six hours of electives. The purpose of the test is to determine the knowledge prior to starting the BREWCP and upon completion of the BREWCP.

**Student Background and Experience– Fill in the correct answer.**

**Student Name** \_\_\_\_\_ **Date** \_\_\_\_\_

**List Major:** \_\_\_\_\_ **List College:** \_\_\_\_\_

**Student Status:**

\_\_\_ **Check if degree seeking and circle level**

**Freshman      Sophomore      Junior      Senior**

\_\_\_ **Check if non degree seeking**

**Student Brewing Experience:**

**Have you brewed beer at home? (select one)**    \_\_\_Yes    \_\_\_No

**Have you worked in a research or commercial laboratory? (select one)**

\_\_\_Yes    \_\_\_No

**Have you worked in a commercial brewery? (select one)**    \_\_\_Yes    \_\_\_No

**Have you toured a commercial brewery? (select one)**    \_\_\_Yes    \_\_\_No

**Have you analyzed quality attributes of beer in a laboratory? (select one)**

\_\_\_Yes    \_\_\_No

**Multiple choice questions – circle the correct answer.**

1. What is the primary goal of steeping in the malting process?
  - a. Production of a rootlet.
  - b. **Achieving a desired moisture content in the barley prior to germination.**
  - c. Development of enzymes by the aleurone layer.
  - d. Creating precursors for flavor development.
  - e. All of the above.
  
2. How long does the malting process typically take?
  - a. 3 days.
  - b. 5 days.
  - c. **7 days.**
  - d. 9 days.
  - e. 11 days.
  
3. What is the correct sequence of events during the malting process?
  - a. Blending > Steeping > Germination > Kilning > Cleaning
  - b. Steeping > Blending > Kilning > Germination > Cleaning
  - c. Cleaning > Germination > Steeping > Kilning > Blending
  - d. Germination > Kilning > Steeping > Cleaning > Blending
  - e. **Cleaning > Steeping > Germination > Kilning > Blending**
  
4. What is the advantage of steam-conditioned milling?
  - a. It makes the malt easier to mill.
  - b. **It makes the malt husk more pliable.**
  - c. It allows adjunct and malt to be milled together.
  - d. It compensates for poor quality malt.
  - e. It allows grain without husks, such as wheat, to be more easily milled.
  
5. When using rice or corn grits why are they boiled separately prior to mixing with the main malt mash?
  - a. Boiling separately speeds the wort production step(s) in the brew house.
  - b. Boiling inactivates the endogenous enzymes in the rice and /or corn.
  - c. **Boiling for an extended period time fully gelatinizes the starch in the rice/corn grits.**
  - d. Boiling the entire mash together (rice/corn plus malt) would cause pasting of the mixture.
  - e. Boiling, like decoction, is a carryover from historical brewing practices and is used for historical and/or brewer-preference reasons because of the perceived flavor contribution that comes from boiling.
  
6. Consider a 100% barley malt mash. What is a reasonable level of fermentability you might expect from wort produced using a single temperature infusion mashing regime at (60°C) with typical, commercial pale malt?
  - a. 100% fermentable
  - b. 90% fermentable
  - c. **70% fermentable**
  - d. 50% fermentable
  - e. 30% fermentable

7. What is the primary reason for using an internal calandria to boil wort relative to using a direct-fired or steam-jacketed kettle?
- a. **To increase the amount of available heat transfer area.**
  - b. To be able to start heating wort before the kettle is full.
  - c. To prevent scorching of the heat transfer surface.
  - d. To improve ease of maintenance.
  - e. To help with trub formation.
8. Comparing copper with stainless steel in terms of heat transfer media, which one of the following is a **not** feature of copper?
- a. Copper has higher thermal conductivity.
  - b. Copper has higher wettability.
  - c. Copper has lower mechanical strength.
  - d. **Copper is easier to clean.**
9. What is an optimal temperature difference between a heating surface and wort for the most effective and efficient boiling?
- a. 2°C
  - b. 5°C
  - c. **25°C**
  - d. 40°C
  - e. 80°C
10. Which one of the following answers may result in high levels of DMS in boiled wort?
- a. Using malt that has been kilned at higher temperatures.
  - b. Quick whirlpool process.
  - c. Maintaining vigorous wort boiling conditions.
  - d. **Evaporation rate that does not exceed 3%.**
  - e. Using a wort stripper prior to wort cooling.
11. Approximately how much of the US hop crop is grown in Washington?
- a. 17%
  - b. 34%
  - c. 51%
  - d. **75%**
  - e. 92%
12. Which one of the following hop components contributes the most to the bitterness of beer?
- a. Alpha acids.
  - b. **Iso-alpha acids.**
  - c. Beta acids.
  - d. Oxidized beta acids.
  - e. Humulene.
13. What is approximately the highest hop utilization one can expect to achieve when using a single addition of standard pellet hops at the beginning of a 60 minute boil?
- a. 5%
  - b. 20%
  - c. **35%**
  - d. 50%
  - e. 65%
14. Which one of the following steps differentiates Type 45 hop pellets from Type 90 hop pellets?

- a. **Type 45 pellets are sieved to remove hop material and concentrate the lupulin.**
- b. Type 45 pellets are dried to a greater extent thereby increasing the relative amount of lupulin in the final pellet.
- c. Type 45 pellets contain magnesium oxide, which increases the amount of iso-alpha acids in the finish pellet.
- d. Type 45 pellets are made from super alpha hops while Type 90 are made from lower alpha, aroma hops.
- e. None of the statements are correct regarding differences between Type 45 and Type 90 pellets.
15. What is the typical range of oil in hops?
- a. **0.5 – 3 ml/100 g**
- b. 3 – 6 ml/100 g
- c. 6 – 9 ml/100 g
- d. 9 – 12 ml/100 g
- e. 12 – 15 ml/100 g
16. Methylene blue stain is used to measure which yeast property?
- a. **Viability.**
- b. Vitality.
- c. Total cell number.
- d. Presence of bacteria.
- e. Budding index.
17. What is an appropriate pitching rate of viable yeast cells to start a fermentation in 10°P wort?
- a.  $10^5$  cells/ml
- b.  $10^6$  cells/ml
- c.  **$10^7$  cells/ml**
- d.  $10^8$  cells/ml
- e.  $10^9$  cells/ml
18. Which of the following is most likely to result in poor fermentation performance?
- a. **Low yeast viability**
- b. High pitch rate
- c. Higher than desired wort temperature
- d. High wort dissolved oxygen
- e. Low wort BU's
19. Estimate the time it takes to start with a single loopful of yeast from a slant and have enough yeast to pitch a 1000 hL fermentation.
- a. 3 days
- b. 5 days
- c. 7 days
- d. **14 days**
- e. 28 days
20. What is the most abundant ester formed during a beer fermentation?
- a. Ethyl octanoate.
- b. Isoamyl acetate.
- c. **Ethyl acetate.**
- d. 3 methyl butyl acetate.
- e. 2 phenyl ethanol.
21. At approximately what temperature does beer have maximal density?
- a. 1°C
- b. 0°C

- c. 1°C
- d. 2°C
- e. 3°C

22. Haze in beer can be produced by...?

- a. Suspended yeast.
- b. Bacterial infection.
- c. Colloidal interaction of protein and polyphenols.
- d. **All of the above, a, b & c.**

23. Which of the following products is used for pre-coating a beer filter?

- a. **Perlite.**
- b. Isinglass.
- c. PVPP.
- d. Silica gel.
- e. Tannic acid.

24. Which species of common beer spoilage organisms produces lactic acid and depending on species may also produce acetic acid, ethanol and carbon dioxide?

- a. *Brettanomyces*.
- b. ***Lactobacillus*.**
- c. *Pediococcus*.
- d. *Acetobacter*.
- e. *Citrobacter*.

25. During the bottle/can filling operation, oxygen pickup should be kept as low as possible. What is a maximum oxygen pickup that breweries with modern fillers shoot for?

- a. < 4 ppb
- b. **< 40 ppb**
- c. < 400 ppb
- d. < 4 ppm
- e. < 40 ppm

26. Which of the following packaging operations has the lowest operational capacity?

- a. Depalletizer.
- b. Empty bottle inspector.
- c. **Filler.**
- d. Pasteurizer.
- e. Case packer.

### True / False questions – Circle the correct answer

27. A whirlpool hop separator can be used to separate hops from hopped wort regardless of whether they are whole or pelletized.

- a. True.
- b. **False.**

28. Hops are a diecious plant - there are male and female hop plants.

- a. **True.**
- b. False.

29. Commercial hop farms grow hops. Once the hops vines are cut they are sent to a separate hop processor (hop company) for picking, drying and baling.





**Certificate of Proficiency in Brewing Science Exit Interview**

Date \_\_\_\_\_ Name \_\_\_\_\_

Address, City, Zip: \_\_\_\_\_

Email: \_\_\_\_\_ Telephone: \_\_\_\_\_

**Why did you enroll in the Certificate of Proficiency in Brewing Science?**

**Which term and year did you enroll?**

**What class did you like the most and why?**

**What class did you like the least and why?**

**Do you feel prepared for the work force?**

**Have you accepted a job or are currently employed?**

**In the job related to the brewing industry?**

**Please give company name and location.**

**What was your starting salary?**

**Indicate your level of satisfaction with the supervision and guidance you received from your advisor (check one)**

<b>Low or poor</b>	<b>Below average</b>	<b>Average</b>	<b>Above average</b>	<b>Excellent</b>

**My GPA for the classes that I took for this program was (check one)**

<b>2.00 to 2.49</b>	<b>2.50 to 2.99</b>	<b>3.00 to 3.49</b>	<b>3.50 to 4.00</b>

**Please rate your level of general competence in the following areas on a scale of 1 to 5 (1 = I don't feel competent in this area; 5 = I feel competent in this area)**

<b>Area of Competence</b>	<b>Score (1 to 5)</b>
History of brewing	
Beer production process	
Sanitation during beer production	
Analysis of beer quality	
Economics of beer production	
Microbiology of beer production	
Legal aspects of beer production and sales	
Sensory analysis of beer	
Leadership ability	
Written communication	
Oral communication	
Critical thinking/problem solving skills	
Laboratory skills	
Creativeness	
Professionalism	

**Do you have additional questions or comments?**

## Oral Presentation Rubric

Student's Name: \_\_\_\_\_

Max points=28

Date: \_\_\_\_\_

Title: \_\_\_\_\_

Reviewer's Name: \_\_\_\_\_

### Oral Presentation Rubric

TRAIT	1	2	3	4
<b>NONVERBAL SKILLS</b>				
Maintains good eye contact and rapport with audience without excessive use of notes.	No eye contact with audience, as entire report is read from notes. <input type="checkbox"/>	Displayed minimal eye contact with audience, while reading mostly from the notes. <input type="checkbox"/>	Consistent use of direct eye contact with audience, but still returns to notes. <input type="checkbox"/>	Holds attention of entire audience with the use of direct eye contact, seldom looking at notes. <input type="checkbox"/>
Exhibits good body language that enhances the presentation.	No movement or descriptive gestures. <input type="checkbox"/>	Very little movement or descriptive gestures. <input type="checkbox"/>	Made movements or gestures that enhances articulation. <input type="checkbox"/>	Movements seem fluid and help the audience visualize. <input type="checkbox"/>
Controls anxiety to present a relaxed presentation without verbal errors.	Tension and nervousness is obvious; has trouble recovering from mistakes. <input type="checkbox"/>	Displays mild tension; has trouble recovering from mistakes. <input type="checkbox"/>	Makes minor mistakes, but quickly recovers from them; displays little or no tension. <input type="checkbox"/>	Student displays relaxed, self-confident nature about self, with no mistakes. <input type="checkbox"/>

COMMENTS:

VERBAL SKILLS				
Speaks clearly with confidence, enthusiasm and authority.	Does NOT speak clearly with confidence, enthusiasm and authority. <input type="checkbox"/>	SOMETIMES speaks clearly with confidence, enthusiasm and authority. <input type="checkbox"/>	OFTEN speaks clearly with confidence, enthusiasm and authority. <input type="checkbox"/>	ALWAYS speaks clearly with confidence, enthusiasm and authority. <input type="checkbox"/>

COMMENTS:

CONTENT				
The presentation is concise, clear, logical and includes all the requested elements.	The presentation is NOT concise, clear, logical and does not include all the requested elements. <input type="checkbox"/>	SOME of the presentation is concise, clear, logical and includes some of the requested elements. <input type="checkbox"/>	MOST of the presentation is concise, clear, logical and includes most of the requested elements. <input type="checkbox"/>	The presentation is CONSISTENTLY concise, clear, logical and includes all the requested elements. <input type="checkbox"/>
Slides are clear, well organized with appropriate use of color and effects.	Slides are NOT clear or well organized and lack appropriate use of color and effects. <input type="checkbox"/>	SOME of the slides are clear and well organized and there is some appropriate use of color and effects. <input type="checkbox"/>	Slides are MOSTLY clear and well organized and most contain appropriate use of color and effects. <input type="checkbox"/>	Slides are CONSISTENTLY clear, well organized with appropriate use of color and effects. <input type="checkbox"/>
Effectively answers related questions.	Effectively answers NONE of the related questions. <input type="checkbox"/>	Effectively answers SOME of the related questions. <input type="checkbox"/>	Effectively answers MOST of the related questions. <input type="checkbox"/>	Effectively answers ALL related questions. <input type="checkbox"/>

COMMENTS:

## Written Report Rubric

Student's Name:

Max points=25

Date:

Title:

Reviewers Name:

### Written Report Rubric

	2	3	4	5
<b>Company Background</b>	Minimal overview of the company. <input style="float: right; margin-top: 5px;" type="checkbox"/>	Incomplete overview of the company. <input style="float: right; margin-top: 5px;" type="checkbox"/>	Concise overview of the company with limited history, products/services and customer base. <input style="float: right; margin-top: 5px;" type="checkbox"/>	Concise overview of the company including history, products/services and customer base. <input style="float: right; margin-top: 5px;" type="checkbox"/>
<b>Internship Description</b>	Description of internship duties is poorly organized and lacks details. <input style="float: right; margin-top: 5px;" type="checkbox"/>	Description of internship duties includes minimal details and is somewhat organized. <input style="float: right; margin-top: 5px;" type="checkbox"/>	Description of internship duties is presented in an organized fashion and includes a moderate amount of detail. <input style="float: right; margin-top: 5px;" type="checkbox"/>	Presents internship duties in a detailed, but concise, logical and organized fashion. <input style="float: right; margin-top: 5px;" type="checkbox"/>
<b>Application of classroom into "real world"</b>	No understanding of how principles learned in the classroom were applicable to the internship. <input style="float: right; margin-top: 5px;" type="checkbox"/>	Minimal attempt to evaluate how principles learned in the classroom can be applied to this internship experience. <input style="float: right; margin-top: 5px;" type="checkbox"/>	Some evaluation of how principles learned in the classroom can be applied to this internship experience. <input style="float: right; margin-top: 5px;" type="checkbox"/>	Thoughtful evaluation of how principles learned in the classroom can be applied to this internship experience. <input style="float: right; margin-top: 5px;" type="checkbox"/>
<b>Contribution to future career</b>	Minimal insight with little or no explanation on how and why the internship could contribute to future career decisions and opportunities. <input style="float: right; margin-top: 5px;" type="checkbox"/>	Weak insight with little explanation on how and why the internship could contribute to future career decisions and opportunities. <input style="float: right; margin-top: 5px;" type="checkbox"/>	Some insight including explanations on how and why the internship could contribute to future career decisions and opportunities. <input style="float: right; margin-top: 5px;" type="checkbox"/>	Strong insight including explanations on how and why the internship could contribute to future career decisions and opportunities. <input style="float: right; margin-top: 5px;" type="checkbox"/>
<b>Spelling and Grammar</b>	Extensive spelling and grammatical errors. <input style="float: right; margin-top: 5px;" type="checkbox"/>	Some spelling and grammatical errors. <input style="float: right; margin-top: 5px;" type="checkbox"/>	No spelling errors but some grammatical errors. <input style="float: right; margin-top: 5px;" type="checkbox"/>	No spelling or grammatical errors. <input style="float: right; margin-top: 5px;" type="checkbox"/>

Comments: