

The USU undergraduate food science program is approved by the Institute of Food Technologists (IFT). IFT is an international, non-profit society of food science, food technology and related areas. The Higher Education Board (HERB) at IFT rigorously assesses undergraduate programs in food science to ensure they meet high standards, and provides content and assessment guidelines and resources to facilitate quality and promote continuous improvement. IFT is not an accrediting agency, and is not interested in being so. Rather, IFT receives substantial input from the food industry on student preparedness, and works with academic programs to insure the material covered is substantial and relevant. As a faculty, we have agreed we want our program to be 'approved' and thus have worked to remain so for >20 years.

In 2018, the assessment program of HERB was revised, and to receive continued approval, all food science programs were required to submit a new, 5-year assessment plan on October 31<sup>st</sup> of 2019. Programs approval is contingent on the a) presence of core facilities for teaching, b) the suitability of the faculty, c) foundational content in the sciences, and d) a new assessment plan. The new assessment program includes 11 'Standards' that encompass academic content and skills across the breadth of a disciplines covered in food science. Each Standard has an accompanying set of Essential Learning Outcomes (ELOs) which are measurable statements that describe the knowledge or skills student should acquire by then end of an assignment, class, course or program. The new plan calls for assessment of 2-3 ELOs per standard. Programs will begin assessing ELOs in the fall of 2020, and the first assessment will be submitted in the fall of 2021. The recently approved USU assessment plan is presented in Appendix A.

One fundamental difference in the new assessment plan is that ELOs were written with verbs that were chosen to facilitate evaluation of student capabilities at varying levels of complexity. In some cases, instruction and student learning is at lower levels of Bloom's Taxonomy, and ELO verbs for such learning are 'define' and 'list.' In other cases, the verbs used in ELOs are at higher levels of Bloom's Taxonomy, and the assessment tool should be appropriate. One example in our new assessment plan for the Standard 'Data and Statistical Analysis' is the ELO 'Construct visual representation of data.' This ELO uses the verb 'construct'

which is associated with the 'create' domain at the top of the pyramid. The HERB at IFT has left it to food science programs to determine the best Learning Assessment Techniques (LATs) to use in assessing the ELOs, but has provided suggested tools that vary in the complexity of assessment preparation, implementation and analysis.

In the 2019 assessment, the food science program worked to familiarize ourselves with modes of assessment that differ from subjective student evaluations, such as measured by IDEA, as well as more traditional assessment methods such as exams and quizzes.

### **Assessment of data presentation**

Based on the new Standards and ELOs in our assessment plan, upon completing our program, students should be able to *Assemble food science information for a variety of audiences, write relevant technical documents, and construct visual representation of data.* These ELOs are from the **Food Science Communication** and **Data and Statistical Analysis** Standards. In our courses with laboratories, students collect data, and are tasked with preparing reports describing the activity and relevance to the field. Consequently, students often have to choose how to present the data. As the focus of the instruction is often on the underlying scientific principal being investigated, we have not placed emphasis on the best practices used for data presentation, and have not evaluated students for this skill. Thus, in 2019, we assessed the use of Tables, Figures and Photographs in laboratory reports. A variety of documents and sources describing best practices for use of figures and tables were used to design an evaluation tool. For Tables, best practices indicate each table should have a caption that is placed above the table, and the table should be numbered sequentially. The caption should be a brief, yet complete summary of the data. Each column in the table should have a caption, and units should be identified for quantitate data where appropriate. In addition, every table must be referred to in the text, and tables should 'stand-alone' in their provision and interpretation of data. Figures are similar, except that the axes should be labelled (with units if appropriate), and the caption should be at the bottom. For images, the same standards apply, and captions should be at the bottom, and a key should be provided when necessary.

To assess if students in the food science program were using best practices for tables, figures and photographs, laboratory reports from NDFS 5560 (Food Chemistry) from the fall of 2018 were analyzed. Each table, graph and photo in the laboratory reports submitted were scored according to the criteria above. There were 10 points evaluated for tables, 11 points for graphs, and 8 points for photographs. The data is presented in Figure 1. According to the data, students were not following the best practices for the presentation of tables, figures and photographs.

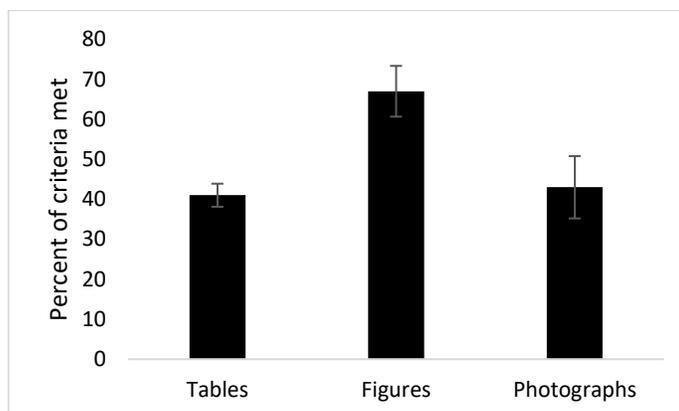


Figure 1. Percent of tables, figures and photographs that were properly used in laboratory reports in the fall of 2019 in NDFS 5560. The appropriate formatting and use of tables, graphs and photographs was evaluated in all laboratories submitted in the course.

NDFS 5500 (Food Chemistry) is an upper division course in the food science curriculum that is typically taken in the fall of the junior year. The prerequisites are CHEM 3700 (Introductory Biochemistry) and CHEM 3710 (Introductory Biochemistry Lab), and prior to taking biochemistry, our students will have completed one year of general chemistry with laboratories. While there are two food sciences courses that are taught in the freshmen and sophomore years, this is one of the first instances where our faculty interact extensively with students in our program, despite the fact that they have been at USU two years. It is unclear to us if students are given any instruction in presenting data in their foundation chemistry courses, but we can see that when they start in the upper division courses in our program their data presentation is subpar. While this was a disappointment to see, we have explicitly provided instruction in this area, or previously assessed the students for their capabilities.

To improve assessment, we are using a Learning Assessment Technique (LAT) cycle. This is a multistep, circular process. In Phase 1, we determine what we will assess and why. In the previous example, the assessment was for data presentation, and we assessed that because we want our students to be effective at producing technical documents. In phase 2 we select a

Learning Assessment Technique, and implement it. In the previous case it was an assessment of data presentation. In Phase 3, we analyze the data and make changes in our curriculum as need to improve learning. It is clear from assessment of data presentation that we should provide instruction in the proper use of tables, figures and photographs in technical documents, and we should evaluate student performance in preparing them. In the spring of 2020 we will discuss these results in a food science faculty meeting. Most likely the instructor NDFS 5560 will provide students with a guide to data presentation, and will make it clear that students will be held to these standards in lab report grading. A possible guide for such work is available on the USU website in the College of Engineering (<https://engineering.usu.edu/students/ewc/writing-resources/tables-figures>).

### **Principles of Quality Assurance and Quality Control**

Also in 2019, we assessed the ELO, *Apply principles of quality assurance and control* in the standard **Quality Assurance** based on a student project in NDFS 5920 (Food Product Development). In the ELO, the verb 'apply' implies a middle level of Bloom's Taxonomy. In other courses in our curriculum, principles of quality assurance and quality control are introduced and explained. In those courses we expect students can remember what these principles are and to differentiate them. However, to 'apply' them, the students are introduced a new problem, and they must use their knowledge of the subject to identify how quality can be assured and controlled. NDFS 5920 is a capstone course in which students utilize knowledge gained in the core areas of food science (i.e. chemistry, engineering, microbiology, sensory science) to develop a novel food product. The principles of quality assurance and quality control are addressed in several courses, but NDFS 5920 is the appropriate place to assess this ELO. In this course, students prepare a report on a food they have developed, and thus it is up to them to determine where and how to assess quality.

To assess the application of quality assurance and control, they were evaluated in the project reports using a simple rubric. A value of zero was given when there was no plan. For reports where a plan was poorly explained a value of 1 was given. If the plan was good, but not

complete a score of 2 was applied. An excellent plan was given a score of 3. The results are shown in Figure 2. A priori, we would expect that our students would score an average of >2.5, which would be consistent with the majority having a solid grasp of these principles. As can be seen in the figure, the average was less than 2.5 for applying the principles of quality assurance.

However, the score for the application for quality control was very low (0.4). The value for a HAACP plan was similar to the value for the quality assurance plan. HAACP is a key concept in food science, and it is not surprising students would at least have a rudimentary HAACP plan, as it is covered in several courses.

In food production, quality assurance refers to the steps manufacturers take to assure their products are of high quality. This may include testing the purity of ingredients, calibrating instruments and machinery, and implementing good manufacturing practices (GMPs). Quality control, on the other hand, refers to routine testing of the finished product to establish it meets established quality parameters. The most important message to take from from the assessment of the student projects from NDFS 5920 is that students did not include quality control plans in their reports. There may be several explanations for this, the most likely being that they were not shown prior examples of excellent projects where such a process was included. This is a new ELO, and its inclusion in the assessment plan by the HERB of IFT is likely a result of industry input into student preparedness in the food industry. In January of 2020 we will discuss this finding at a faculty meeting, and consider where in our curriculum we can address this discrepancy.

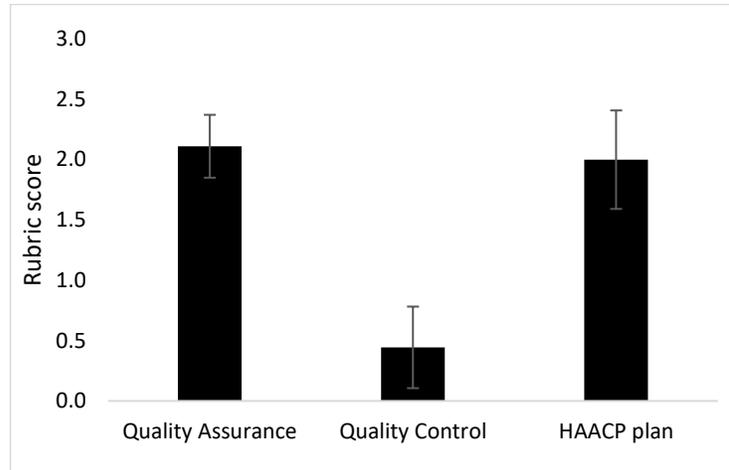


Figure 2. Evaluation of the *Apply principles of quality assurance and control* rubric in NDFS 5920. HAACP is an acronym for Hazard Analysis Critical Control Points.

**Appendix A. Food Science Assessment Plan, 2020-2025**

<b>Year</b>	<b>Standard</b>	<b>Essential Learning Outcomes</b>
2021	<i>Sensory Science</i>	<ul style="list-style-type: none"> <li>• Apply experimental designs and statistical methods to sensory studies</li> <li>• Select sensory methodologies to solve specific problems in food</li> <li>• Discuss the physiological and psychological basis for sensory evaluation</li> </ul>
		<i>Food Laws and Regulations</i>
		<ul style="list-style-type: none"> <li>• Recall government regulatory frameworks required for the manufacture and sale of food products</li> <li>• Describe the processes involved in formulating food policy</li> <li>• Locate sources of food laws and regulations</li> </ul>
2022	<i>Data and Statistical Analysis</i>	<ul style="list-style-type: none"> <li>• Use statistical principles in food science applications</li> <li>• Employ appropriate data collection and analysis technologies</li> <li>• Construct visual representation of data</li> </ul>
		<i>Food Chemistry</i>
		<ul style="list-style-type: none"> <li>• Discuss the major chemical reactions that limit the shelf life of foods</li> <li>• Demonstrate laboratory techniques common to basic and applied food chemistry</li> <li>• Explain the principles behind analytical techniques associated with food</li> </ul>
2023	<i>Food Microbiology</i>	<ul style="list-style-type: none"> <li>• Identify relevant beneficial, pathogenic and spoilage microorganisms in foods and the conditions under which they grow</li> <li>• Describe the conditions under which relevant pathogens are commonly destroyed or controlled in foods</li> <li>• Discuss the role and significance of adaptation and environmental factors (e.g. water activity, pH, temperature) on growth response and inactivation of microorganisms in various environments</li> </ul>
		<i>Food Engineering and Processing</i>
		<ul style="list-style-type: none"> <li>• Define principles of food engineering (mass and heat transfer, fluid flow, thermodynamics)</li> <li>• Explain the source and variability of raw food materials and their impact of food processing operations</li> <li>• Use unit operations to produce a given food product in a laboratory or pilot plant</li> </ul>
2024	<i>Critical Thinking and Problem Solving</i>	<ul style="list-style-type: none"> <li>• Apply critical thinking skills to solve problems</li> <li>• Select appropriate analytical techniques when presented with a practical problem</li> <li>• Evaluate scientific information</li> </ul>
		<i>Food Science Communication</i>
		<ul style="list-style-type: none"> <li>• Write relevant technical documents related to food science</li> <li>• Deliver oral presentations related to food science</li> <li>• Assemble food science information for a variety of audiences</li> </ul>
2025	<i>Professionalism and Leadership</i>	<ul style="list-style-type: none"> <li>• Demonstrate the ability to work independently and in teams</li> <li>• Discuss examples of ethical issues in food science</li> </ul>
		<i>Quality Assurance</i>
		<ul style="list-style-type: none"> <li>• Define food quality and safety terms</li> <li>• Apply principles of quality assurance and control</li> </ul>

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*Food Safety*

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- Identify potential hazards and food safety issues in specific foods
  - Discuss methods for controlling physical, chemical and biological hazards
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