Food Science Self-Assessment

Student Evaluations

Like all courses at USU, students evaluate food science courses and instructors using the IDEA system. Each faculty member is encouraged to list at least three IDEA objectives on their syllabus, and these are the then scored by the students towards the end of the semester. The 2021 IDEA ratings for all Food Science Courses are listed below in Table 1.

Table 1: Summary of IDEA scores for food science faculty for courses taught in 2021*

Spring 2021	***Instructor***	***Progress on Objectives***	***Excellent Teacher***	***Excellent Course***
Sanitation and Safety	Nummer	Similar	Lower	Lower
Sensory Science	Martini	Similar	Higher	Higher
Food Analysis	Martarneh	Higher	Higher	Much Higher
Food Microbiology	Oberg	Similar	Higher	Higher
Dairy Processing	McMahon	Lower	Higher	Similar
Fall 2021	***Instructor***	***Progress on Objectives***	***Excellent Teacher***	***Excellent Course***
Chocolate Science	Martini	Similar	Similar	Similar
Food Chemistry	Ward	Lower	Similar	Similar
Meat Technology	Martarneh	Higher	Lower	Similar
Food Engineering	Bastarrachea	Much Lower	Much Lower	Much Lower
Food Laws	Savello	Similar	Similar	Similar
Product Development	Walsh	Similar	Higher	Much Higher

* ***Much Higher*** *represents top 10% of scores reported,* ***Higher*** *represents scores from 70-90%,* ***Similar*** *is the middle 40%,* ***Lower*** *is between 10% and 30%. Much Lower represents scores in the lowest 10% recorded.*

According to the table, 72% of the scores for *Progress on Objectives* were similar or higher than all scores reported to IDEA. For *Excellent Teacher*, 70% were similar and or higher. For Excellent Course, 80% were similar or higher than all scores reported to IDEA. We do not have an *a priori* expectation for these evaluations, and as a program, we do not use the IDEA outcomes to drive decisions on our pedagogy. Junior faculty may use the information to document their teaching effectiveness for promotion and tenure purposes, and individual faculty discuss their instructor and course ratings with the department head during their yearly review. The primary reason this information is not used at the program level is that the ratings are subjective according to student experience and are not objective measures of performance.

Program Approval and Assessment for the Institute of Food Technologists

The Food Science BS program at Utah State University is an approved program by the *Institute of Food Technologists (*www.IFT.org*)*. Globally, IFT sets guidelines for the background courses and curriculum to be covered in an approved food science program. USU received a new five-year approval by IFT in the Fall of 2019 which was based on a) *the appropriateness and expertise of the faculty*, b) *appropriate infrastructure including research and teaching laboratories*, and c) *a five year assessment plan*. The food science program will begin to submit assessment reports to IFT in the fall of 2022. In this assessment scheme, the overall curriculum of food science is broken down into 11 major areas, called **Standards**, which have associated **Learning Outcomes**, called **Essential Learning Outcomes (ELOs)** For the first 4 years, we will assess three ELOs across two Standards per year. In the fifth year, we will assess two ELOs across two Standards.

The ELOs were written and approved by the Higher Education Review Board (HERB) at IFT to facilitate assessment of learning objectives critical to the development of a capable food scientist. More specifically, the verbs used in the ELOs describe a learning outcome and suggest a level at which the ELO can be assessed. Beyond the Standards and ELOs, IFT has also suggested that approved programs should go beyond subjective student course evaluations and grades in assessing student learning and provided some examples of Learning Assessment Techniques (LATs). In 2020 and 2021 the food science faculty have met to discuss implementing novel LATs for student evaluation. All food science programs are given flexibility in implementing the LATs and the first review of their appropriateness by the Higher Education Review Board (HERB) will be conducted in the spring of 2023. In the 2020 and 2021 assessments the food science program has utilized traditional assessment of student learning. The three areas assessed in the 2021 calendar year, as well as the LAT are shown in Table 2.

Table 2: Standards and Essential Learning Outcomes assessed in 2020-2021

Standard	Essential Learning Outcome	Learning Assessment Technique	Assessment
Data and Statistical Analysis	*Construct visual representation of data*	*Evaluation of laboratory reports*	*Rubric for data presentation*
Food Chemistry	*Demonstrate laboratory techniques common to basic and applied food chemistry)*	*Evaluation of data interpretation*	*Lab report evaluation for accuracy*

The first ELO evaluated in the 2021 calendar year was the **ELO** *Construct visual representation of data* (Table 3) which falls under the **Standard** *Data and Statistical Analysis* (Table 2). The verb ***construct*** is listed in the third tier of Bloom's Taxonomy in the 'Applying' domain. Thus, it is considered more cognitively rigorous than tier I (i.e. **Remembering**) but less cognitively advanced than tier IV (**Analyzing**). Previously, in 2018-2019 we assessed data presentation according to a rubric we developed using a 'best practices' document on the visual representation of data. The results of this evaluation indicated students were not properly presenting data in figures, images and tables in their lab reports.

Table 3: Evaluation of student's use of data visualization in lab reports

LAT used	Rubric for evaluation of visual data representation
Outcomes	Three data visualization elements were evaluated in 2021: tables, graphs, and photographs. A rubric was used to evaluate the use of each element. For example, there were 11 points possible for a properly used graph. The points were given for correct data visualization elements. For example, a properly used graph should have a title, correctly labeled axes, effective data presentation as well as an informative caption. In addition, the data in the graph should be referred to in the text of the laboratory report. Tables, graphs, and photographs from laboratory reports from the Food Chemistry class (NDFS 5560) were evaluated. Our *a priori* expectations were that the average score for each chart element would be above 80%.

Results and data-based decisions	According to the data (Figure 1), student performance was better for table presentation in 2021, compared to 2019, but not for figures and photographs. Student performance was not up to our expectations, and simply providing the students with a document for data presentation was insufficient. To improve data presentation, we will discuss the results as a faculty and prepare our own document on data presentation. This should standardize data presentation and evaluation across our core laboratory-containing courses.

To address this discrepancy, we provided students with the same 'best practices' document in the lab report introduction at the beginning of the semester in the fall of 2020 and again in 2021 and told them to use it in data presentation. Next, we reapplied the rubric developed in 2019 to determine if students were presenting data more effectively. Labs in several food science courses are turned in on Canvas as PDF documents, thus we can access them at the end of the semester to carry out such *post hoc* reviews.

Comparative data from 2019 and 2021 are shown in Figure 1. As is noticeable from the figure, the presentation of tables in the lab reports was improved, but there was no change in either the figures or photographs.

When we examined the scores of each table element, it was noted that the most students had an acceptable title, and basic table elements. However, few referred to the data in the tables in their lab reports, and the tables were not generally sufficiently informative when read alone. Our *a priori* expectations were that the scores would be >80% for each data element, which we clearly did not meet.

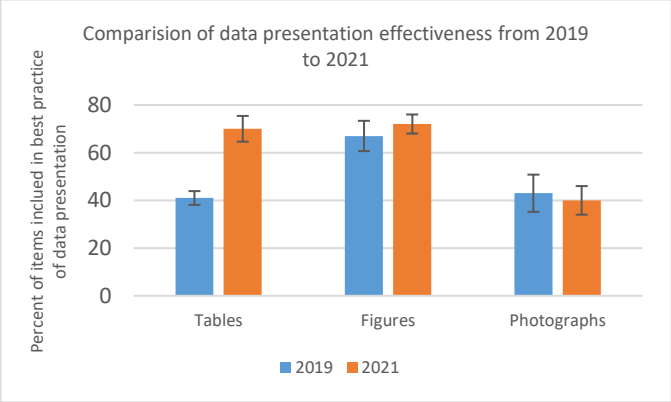

Figure 1: Data presentation comparison between labs from 2019 to 2021. A 10-point rubric was used to evaluate the presentation and incorporation of Tables, Figures and Photographs in lab reports.

Effective data presentation is a core skill that ever food scientist should know. While we do not expect all students to publish research in peer-reviewed journals, they should use tables, figures and photographs in technical documents. Thus, we will continue to try and improve in this area.

Prior to the 2022-2023 academic year, we will create an internal document for data presentation. All faculty with laboratory classes will participate in this exercise. Next, we will incorporate evaluation of data presentation into our grading schemes for laboratory reports.

The second area evaluated in 2021 was an evaluation of laboratory techniques (Table 4) or the ability of students to collect, plot and analyze data. In a Food Chemistry laboratory, students titrate several amino acids using a basic solution (i.e. sodium hydroxide), and monitor the change in pH as a function of volume added. Next, they are told to plot this data and observe the relationship. While seemingly mundane, the ability of different amino acids to release protons is a key function in the solubility of proteins and affects a range of food properties from milk curd formation to the juiciness of meat. In addition, the laboratory provides students a chance to develop basic laboratory skills which will be value

for those who work in quality assurance labs, or for those who go onto graduate programs with a bench research component.

Table 4: Evaluation of laboratory technique

LAT used	Evaluation of data interpretation from laboratory experiment
Outcomes	In a Food Chemistry lab (NDFS 5560), students are given an amino acid to titrate. This process involves adding a base and recording the change in pH as a function of volume added. This data is then plotted. Students are instructed to find a place where the pH change is reduced, and to estimate a chemical parameter (i.e. pKa) based on this observation. To evaluate student lab technique, a simple 6 point score rubric was used to score the data collection (2), presentation (3), and interpretation (2). *A priori* we expected the average to be >5.
Results and data-based decisions	Results indicate the average was >6.5, and students performed well in all three categories evaluated. No change will be made to this laboratory. However, efforts will be made to link the development of skills across labs within the food chemistry course, and across other laboratory courses in the food science program.

The results are shown in Figure 2 and were collected from ~20 students over three years of this laboratory. From the data students can effectively collect the data, present it and interpret it to determine the chemical parameter of interest.

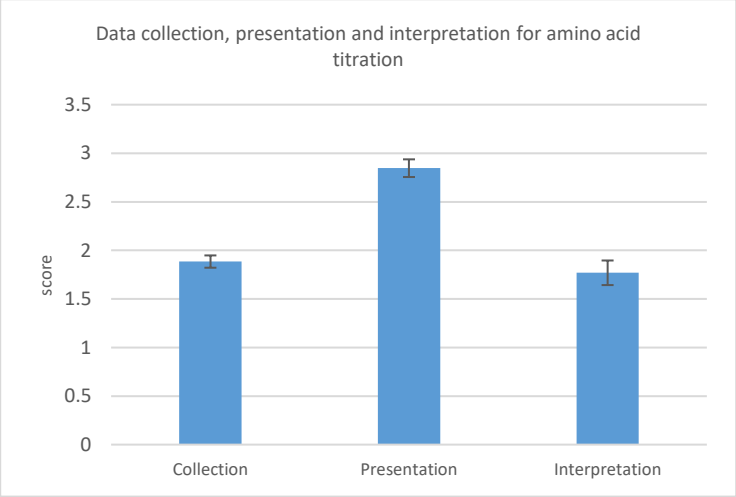

Figure 2: Evaluation of student performance on amino acid titration laboratory.

Recent Data Based Decisions

Based on our assessment this year, we will work as a faculty to coordinate student training on using visual aids in the preparation of technical documents, such as laboratory reports. This was clear from our evaluation of the change in student performance since this was last evaluated. However, the second item assessed, data collection and interpretation is an area we are stronger in. In the spring of 2022, we will work as a faculty to develop an implement different LATs to facilitate our assessment that will be submitted to the Institute of Food Technologists yearly for the next five years.

Moving forward, we will also be making two changes to our food science curriculum. First, we had previously required PSC 4600 (Cereal Science) as a required course. However, the instructor, David Hole, retired in 2020, and the Plant, Soils and Climate Department will no longer be offering that course. As a faculty we discussed the material that was presented in that class and determined that we effectively cover that material in our existing classes. Thus, we will remove it from our curriculum without any further changes.

In addition, we removed NDFS 3110 (Food, Technology and Health) from our required courses. This is because we cannot offer a 3000-level class to sophomores. This class has a sizable enrollment (~50-60) each fall, and we will continue to teach it as a depth science elective for nonfood scientists. To replace this class, our food engineer, Luis Bastarrachea has created a new 2000-level class called 'Fundamentals of Food Processing.' This will be offered for the first time in the spring of 2022.

Five Year Assessment plan

The USU Food Science 5-year assessment plan is shown in Appendix A. In the fall of 2022 the food science program will submit the first report of the new cycle to IFT.

Appendix A. Food Science Assessment Plan, 2020-2025

Year	Standard	Essential Learning Outcomes
2021	*Sensory Science*	
		• Apply experimental designs and statistical methods to sensory studies • Select sensory methodologies to solve specific problems in food • Discuss the physiological and psychological basis for sensory evaluation
	Food Laws and Regulations	
		• Recall government regulatory frameworks required for the manufacture and sale of food products • Describe the processes involved in formulating food policy • Locate sources of food laws and regulations
2022	*Data and Statistical Analysis*	
		• Use statistical principles in food science applications • Employ appropriate data collection and analysis technologies • Construct visual representation of data
	Food Chemistry	
		• Discuss the major chemical reactions that limit the shelf life of foods • Demonstrate laboratory techniques common to basic and applied food chemistry • Explain the principles behind analytical techniques associated with food
2023	*Food Microbiology*	
		• Identify relevant beneficial, pathogenic and spoilage microorganisms in foods and the conditions under which they grow • Describe the conditions under which relevant pathogens are commonly destroyed or controlled in foods • 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
	Food Engineering and Processing	

		• Define principles of food engineering (mass and heat transfer, fluid flow, thermodynamics) • Explain the source and variability of raw food materials and their impact of food processing operations • Use unit operations to produce a given food product in a laboratory or pilot plant
2024	*Critical Thinking and Problem Solving*	
		• Apply critical thinking skills to solve problems • Select appropriate analytical techniques when presented with a practical problem • Evaluate scientific information
	Food Science Communication	
		• Write relevant technical documents related to food science • Deliver oral presentations related to food science • Assemble food science information for a variety of audiences
2025	*Professionalism and Leadership*	
		• Demonstrate the ability to work independently and in teams • Discuss examples of ethical issues in food science
	Quality Assurance	
		• Define food quality and safety terms • Apply principles of quality assurance and control
	Food Safety	
		• Identify potential hazards and food safety issues in specific foods • Discuss methods for controlling physical, chemical and biological hazards