Food Science Program 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 2023 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 2023*

Spring 2022	**Instructor**	**Progress on Objectives**	**Excellent Teacher**	**Excellent Course**
Sanitation and Safety	Reidhead	Similar	Similar	Similar
Sensory Science	Martini	Higher	Similar	Higher
Food Analysis	Martarneh	Higher	Higher	Higher
Food Microbiology	Oberg	Lower	Much Lower	Lower
Dairy Processing	Sharma	Similar	Similar	Similar
Fall 2022	**Instructor**	**Progress on Objectives**	**Excellent Teacher**	**Excellent Course**
Chocolate Science	Martini	Similar	Similar	Similar
Food Chemistry	Ward	Higher	Higher	Much Higher
Meat Technology	Martarneh	Higher	Higher	Higher
Food Engineering	Bastarrachea	Similar	Similar	Similar
Food Laws	Savello	Similar	Similar	Similar
Product Development	Walsh	Much Higher	Higher	Much Higher

According to the table, 91% of the scores for *Progress on Objectives* were similar or higher than all scores reported to IDEA. For *Excellent Teacher*, 91% were similar and or higher. For Excellent Course, 91% were similar or higher than all scores reported to IDEA. *In all three categories our scores were improved from 2021.*

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 began 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 **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 cognitive domain level at which the ELO can be assessed. IFT has also advised approved programs to go beyond subjective student course evaluations and grades in assessing student learning and provided some examples of Learning Assessment Techniques (LATs). In 2021 and 2022 the food science faculty 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) was conducted in the fall of 2022. As the IFT assessments are due in October of each year, the assessment we sent to them in October of 2022 reflected assessments collected in the fall of 2022 and spring of 2023. This assessment was approved in December of 2023.

Results

The results are shown below. In 2022/2023 we assessed two standards (Data and Statistical Analysis and Food Chemistry) and for each, there were three ELOs. Next, for each ELO, we used two different LATs. The results are presented in a table. The Standard, ELO, LATs, implementation, findings, and anticipated corrective actions are presented sequentially.

Standard	Data and Statistical Analysis
ELO assessed	Use statistical principles in food science applications
Course ELO was assessed in	NDFS 5500, Food Analysis
Period ELO was assessed	Spring 2023
Name of LAT 1	Lab experiment and report
Description of LAT 1	Lab manual for guidance, lab report template, and lab report rubric
Description of how LAT 1 was implemented with students	This laboratory experiment requires the collection of replicate measurements using various laboratory glassware and equipment. Students are asked to evaluate the precision and accuracy of these items by calculating %error, mean, standard deviation, relative standard deviation, standard error, and confidence intervals. It is essential that students not only perform these calculations but also present them in the context of significant figures within their lab reports. Furthermore, within the same lab report, students are asked a series of short questions

	that assess their understanding of precision, accuracy, and the practical application of statistical principles.
Description of the tool(s) used for LAT 1analysis	Grading rubric was categorized into 5 categories: Absent, Developing, Competent, Good, and Outstanding. Across all lab reports, the mean score was 88.8%, while 75% of the class attained a grade of 85% or greater.
Key Findings for LAT 1	The LAT was sufficient to assess students' ability to use statistical principles in food science applications, as shown by the good performance in the lab reports.
Description of how student performance for LAT 1 related to expectations for Standard 3 ELO 1	Student performance met/exceeded expectations.
Description of how anticipated actions were implemented from the previous year as connected to the anticipated actions for improvement of teaching and learning	No changes are planned for this assessment.
Course ELO was assessed in	Dairy Processing and Technology
Period ELO was assessed	Spring 2023
Name of LAT 2	Lab experiments and report
Description of LAT 2	Students were asked to find whether there was significant effect of composition on titratable acidity and pH measurements of four different type of milk samples.
Description of how LAT 2 was implemented with students	Students were given four milk samples with varying composition to measure titratable acidity and pH. They were asked to run the experiments in triplicate and calculate, standard deviation, standard error of mean for each sample. They were also asked to find whether composition or treatments had significant effect on the pH and TA values of the milk using one-way ANOVA at 5% of level of significance. They were told to infer the data in the report based upon the statistical differences. At the end of the experiment, they

	were given 6 questions related to the lab to assess their learning outcome.
Description of the tool(s) used for LAT 2 analysis	Students were assessed for their learning outcome using a quiz and lab report. They were graded as outstanding, very good, good and need improvement based upon their responses. Based upon the use of statistical analysis in the lab report, 60% were outstanding and 40% were very good. All students score >90% score.
Key Findings for LAT 2	Use of ANOVA as LAT was effective in differentiating between students. Students found this tool very innovative. All the students (100%) were effective in utilizing this LAT in their lab reports.
Description of how student performance for LAT 2 related to expectations for Standard 3 ELO 1	Student performed really well in using this LAT. We expect in the future students would be able to learn how to present differences in mean in table systematically.
Description of how anticipated actions were implemented from the previous year as connected to the anticipated actions for improvement of teaching and learning	Based upon previous discussions, we included use of statistical tools in the lab reports. In the future, use of statistical tools in analyzing data will be promoted in other labs too, more specifically making them learn how to interpret fat particle size distribution.
Standard	Data and Statistical Analysis
ELO assessed	Employ appropriate data collection and analysis technologies
Course ELO was assessed in	NDFS 5560
Period ELO was assessed	Spring 2022, 2023
Name of LAT 1	Case Study in lab report format.
Description of LAT 1	Students assessed oxidative status of several food oils in a laboratory setting.
Description of how LAT 1 was implemented with students	Sixteen students were given several oils in a laboratory and instructed to determine the peroxide value, anisidine value, using standardized protocolsa and to calculate the TOTOX. Based on the data, students were

	asked a series of questions regarding the oxidative status of the oil.
Description of the tool(s) used for LAT 1analysis	A rubric was developed for evaluation of a) data collection b) data transformation c) data presentation and d) data interpretation. Five points were available in each section, and we expect the class average to be >75%.
Key Findings for LAT 1	Students were effective in collecting (91%), transforming (87%%) and interpreting data (90%). However, the rubric value for data presentation (74%) was below the preset threshold of adequacy.
Description of how student performance for LAT 1 related to expectations for Standard 3 ELO 2	We anticipated students would be proficient, on average, in the collection and analysis of data from a lab focused on lipid oxidation in food oils. Student performance was ok in 3 of 4 domains, but inadequate in data presentation.
Description of how anticipated actions were implemented from the previous year as connected to the anticipated actions for improvement of teaching and learning	Moving forward, more emphasis will be placed on the data reporting and evaluation in class, as well as in the laboratory lecture that proceeds the lab.

Course ELO was assessed in	NDFS 5100
Period ELO was assessed	Spring 2022/2023
Name of LAT 2	Food Fermentation Lab Report
Description of LAT 2	Assessing different fermentation conditions and source products in food fermentations.
Description of how LAT 2 was implemented with students	A lab report with descriptions of the lab protocol were given to students along with verbal instructions on setting up the lab experiment. The students conducted two separate fermentations. First, students tested how the fermentation temperature affects the acid production during a sauerkraut fermentation. The measurements taken were lactic acid bacteria plate counts and titratable acidity. The second fermentation tested how different juices/cider affected the acid production in a two-step Orleans fermentation

	for vinegar production using titratable acidity as the measurement. Students had to convert each titratable acidity into a percent of the target acid (lactic and acetic) using the correct conversion, and $\log_{10}$ transform their plate count data for analysis. Students then used their data to write a lab report on their findings.
Description of the tool(s) used for LAT 2 analysis	Student performance was assessed using a grading rubric to determine their skill/understanding of a) proper data collection, b) proper data analysis, c) data presentation using figures, and d) interpretation of results. Each rubric section was worth 25 points with the expectation that the average for the class will be 80%.
Key Findings for LAT 2	Over the last 2 years, the average for this lab assignment was 82%, but in looking at the grades given, there was a bimodal distribution which showed a division in performance among students. Looking further into the data, the data analysis and data presentation areas of assessment were identified as the areas that some students struggled with.
Description of how student performance for LAT 2 related to expectations for Standard 3 ELO 2	At this course level, students should be proficient in all areas that were assessed. The main gap that was identified was in transformation of plate count data and proper presentation of that data.
Description of how anticipated actions were implemented from the previous year as connected to the anticipated actions for improvement of teaching and learning	In evaluating the gaps in student performance, a lab section has been added to the beginning of the semester to help students understand how to deal with data that is non-normal using transformations and the proper way to present this data.
Standard	Data and Statistical Analysis
ELO assessed	Construct visual representation of data
Course ELO was assessed in	NDFS 5560, Food Chemistry
Period ELO was assessed	Fall 2021, 2022
Name of LAT 1	Open ended questions

Description of LAT 1	Open ended questions in laboratory report
Description of how LAT 1 was implemented with students	Sixteen students were shown examples of amino acid titrations and the data that can be determined from the titration data when plotted on an xy axis. Students then conducted a titration, plotted the data, and determined the pKa and isoelectric point of the amino acid and compared it to a literature value.
Description of the tool(s) used for LAT 1analysis	Student performance was judged against a 4-component rubric that allowed evaluation on a) plotting data b) estimating pKa c) estimating isoelectric point, and d) comparison to literature values. For each column, student performance was evaluated on a 1-5 scale. We expect the average score to be 4 in each category.
Key Findings for LAT 1	The average scores were 4.3, 3.9, 3.8 and 3.9. However, the rubric data obscure what was essentially a bimodal distribution. Thus, it seems some student 'get it' and know how to estimate pKa and IEP from the graphs, while others do not.
Description of how student performance for LAT 1 related to expectations for Standard 3 ELO 3	It is clear that all students were capable of producing visual representations of their data, but that some struggled to use the plots to determine physicochemical parameters of the amino acid.
Description of how anticipated actions were implemented from the previous year as connected to the anticipated actions for improvement of teaching and learning	Students were generally proficient in the collection and plotting of the data, but were less so in estimating parameters from the data. More time will be spent in the lecture that proceeds the laboratory on evaluating the titration curves.
Course ELO was assessed in	NDFS 4440, Fundamentals of Food Engineering
Period ELO was assessed	Fall 2022
Name of LAT 2	Case study
Description of LAT 2	Differentiation of fluids via rheological analysis.

Description of how LAT 2 was implemented with students	In a laboratory session, students were asked to subject 2 different types of fluids to rheological analyses using a cylindrical rheometer. One of the fluids was Newtonian and students were asked to measure shear stress versus increasing levels of shear rate at 3 different temperatures to build the corresponding linear plots at each temperature and build an Arrhenius plot of the natural logarithm of viscosity versus the inverse of absolute temperatures (through linear regression analyses). For the case of the non-Newtonian fluid, students were asked to also measure shear rate versus shear rate to determine what type of fluid it was based on non-linear regression analyses constructing the corresponding plot using the Herschel-Bulkley equation.
Description of the tool(s) used for LAT 2 analysis	Grading
Key Findings for LAT 2	The results showed that the ELO was met, as the average grade received was 95.8 ± 2.9 (range: 93 – 99).
Description of how student performance for LAT 2 related to expectations for Standard 3 ELO 3	Students were able to perform linear and nonlinear regression analyses, and classify accordingly the type of fluids tested (either Newtonian or non-Newtonian), based on the criteria determined by the Herschel-Buckley model and the plots obtained (visual representation of data).
Description of how anticipated actions were implemented from the previous year as connected to the anticipated actions for improvement of teaching and learning	No changes to this assessment are planned.
Standard	Food Chemistry
ELO assessed	Discuss the major chemical reactions that limit the shelf life of foods
Course ELO was assessed in	NDFS 5560, Food Chemistry
Period ELO was assessed	Fall 2021, 2022

Name of LAT 1	Open ended questions
Description of LAT 1	An open-ended question was posed as a question at the end of a laboratory report. Students were asked to name a food in which the Maillard reaction can limit product quality/shelf life and then asked to list the ways it could be prevented.
Description of how LAT 1 was implemented with students	This question was part of a lab report on the Maillard reaction and was administered to 16 students as part of a lab report.
Description of the tool(s) used for LAT 1analysis	Rubric
Key Findings for LAT 1	The evaluation rubric had two parts, and the average score on part 1 was 93% and 85% for the second part.
Description of how student performance for LAT 1 related to expectations for Standard 4 ELO 1	Based on the rubric scores, we conclude this ELO was met.
Description of how anticipated actions were implemented from the previous year as connected to the anticipated actions for improvement of teaching and learning	The way the question was asked in the lab report did not allow for complete student learning evaluation. In the future, the questions will be more open ended to allow students to demonstrate the level of their understanding.
Course ELO was assessed in	Meat Technology and Processing (NDFS 5020/6020)
Period ELO was assessed	2022
Name of LAT 2	Clickers: Kahoot Polling
Description of LAT 2	Students respond electronically using their smartphones to answer questions posed by the instructor, with little time to prepare the answers.
Description of how LAT 2 was implemented with students	Multiple-choice questions were administered via Kahoot, a game-based platform used as an educational tool, to test student recall and understanding of the biochemical processes responsible for lipid and myoglobin oxidation, as

	well as their influence on meat quality and shelf life.
Description of the tool(s) used for LAT 2 analysis	Ten multiple-choice questions, with one point each.
Key Findings for LAT 2	Q1 analysis: 11/13 students answered correctly (85%). Q2 analysis: 13/13 students answered correctly (100%). Q3 analysis: 9/13 students answered correctly (69%). Q4 analysis: 12/13 students answered correctly (92%). Q5 analysis: 13/13 students answered correctly (100%). Q6 analysis: 8/13 students answered correctly (62%). Q7 analysis: 12/13 students answered correctly (92%). Q8 analysis: 11/13 students answered correctly (85%). Q9 analysis: 10/13 students answered correctly (77%). Q10 analysis: 11/13 students answered correctly (85%).
Description of how student performance for LAT 2 related to expectations for Standard 4 ELO 1	The average score for all students was 84.6%, indicating that the ELO was successful.
Description of how anticipated actions were implemented from the previous year as connected to the anticipated actions for improvement of teaching and learning	Questions in which students did not perform well (Q3 and Q6) will receive more in-depth discussion in future classes.
Standard	Food Chemistry
ELO assessed	Demonstrate laboratory techniques common to basic and applied food chemistry
Course ELO was assessed in	NFDS 5560, Food Chemistry
Period ELO was assessed	Fall 2021, 2022
Name of LAT 1	Case study/Laboratory skill test
Description of LAT 1	Students performed analysis of sugars using the Fehling's test, optical rotation, and brix

	measurement. The results were used to guess the identity of an unknown.
Description of how LAT 1 was implemented with students	Sixteen students performed measurements and then evaluated results compared to literature values, and summed up the findings in a laboratory report.
Description of the tool(s) used for LAT 1analysis	A rubric was divided into 4 categories of 5 points each and used to evaluate the lab report. Three were used to evaluate the individual lab tests, and the fourth was for the data synthesis. We expected the average for each section to be >4.
Key Findings for LAT 1	Students did very well in this assignment, and all average scores were >4.5
Description of how student performance for LAT 1 related to expectations for Standard 4 ELO 2	The Fehling's test is a relatively simple assay and differentiates reducing sugars from non-reducing sugars. While we expected students to do well, we also use this analysis as the concept of reducing vs. non-reducing sugars is fundamental to other areas of food science, such as controlling the Maillard reaction. While optical rotation is not a common analysis done on foods currently, we use it as the concept is important in carbohydrate nomenclature.
Description of how anticipated actions were implemented from the previous year as connected to the anticipated actions for improvement of teaching and learning	We do not anticipate making any changes in this laboratory.
Name of LAT 2	Case study
Description of LAT 2	Laboratory practical
Description of how LAT 2 was implemented with students	During a laboratory session, students were given an unknown protein sample alongside a protein standard containing ten proteins of known molecular weights. Their task was to employ sodium dodecyl sulfate polyacrylamide gel electrophoresis to estimate the molecular weight of the unknown protein. To facilitate this experiment, the students used gels they had previously prepared. After subjecting the

	sample and the standard to electrophoretic separation and staining, two images were acquired: one for the standard proteins and another for the unknown protein within the gel. These images were provided to the students for analysis, during which they measured the migration distance of each standard protein. Subsequently, they applied linear regression to obtain a regression equation for calculating the molecular weight of the unknown protein, considering the distance it migrated during the process.
Description of the tool(s) used for LAT 2 analysis	Students who achieved estimations within the range of 90-100% received a full score of 100%. Those whose estimations fell within the range of 80-89% were awarded a score of 90%. For estimations in the range of 70-79%, a score of 80% was assigned. Students who estimated the molecular weight at less than 70% accuracy received a score of 70%.
Key Findings for LAT 2	We chose an average score of 85% to meet the ELO.
Description of how student performance for LAT 2 related to expectations for Standard 4 ELO 2	The average score for all students was 91.7% (range: 100 – 80), which exceeds the targeted score (85%).
Description of how anticipated actions were implemented from the previous year as connected to the anticipated actions for improvement of teaching and learning	No changes are planned for this assessment.
Standard	Food Chemistry
ELO assessed	Explain the principles behind analytical techniques associated with food
Course ELO was assessed in	NDFS 5560, Food Chemistry
Period ELO was assessed	Fall 2021, 2022
Name of LAT 1	Open Ended Questions
Description of LAT 1	Students were asked a series of interrelated questions on water activity.

Description of how LAT 1 was implemented with students	The questions were asked during an open book online exam to 16 students.
Description of the tool(s) used for LAT 1analysis	Six questions were included in the section on water activity, and a total of 17 points were possible. The questions ranged from the definition of water activity, to the application and included a case study on determining water activity using a series of desiccators with saturated salt solution.
Key Findings for LAT 1	The average score for all 6 questions was >85%.
Description of how student performance for LAT 1 related to expectations for Standard 4 ELO 3	The results indicate students were effective in answering questions related to water activity.
Description of how anticipated actions were implemented from the previous year as connected to the anticipated actions for improvement of teaching and learning	No changes are planned for this assessment.
Course ELO was assessed in	NDFS 5560, Food Chemistry
Period ELO was assessed	Fall 2021, 2022
Name of LAT 2	Case study, open ended questions on lab practical
Description of LAT 2	Students used a colorimetric method to determine the ascorbic acid content of several commercial juices. The method requires a standard curve to be made with fresh ascorbic acid. Students were given three different ascorbic acid standards, two of which were old and oxidized. Students plotted the standard curves and then were asked to speculate as to how using an old standard would affect the measurement.
Description of how LAT 2 was implemented with students	Sixteen students answered three open ended questions on a lab report. The questions were designed to assess student understanding of the method. The questions were used to evaluate student grasp of the principles behind the analytical technique.

Description of the tool(s) used for LAT 2 analysis	A rubric was used with the open-ended questions (n=3), which were all worth 5 points.
Key Findings for LAT 2	Averages were Q1=3.75, Q2=4.5, Q3=3.69.
Description of how student performance for LAT 2 related to expectations for Standard 4 ELO 3	The LAT was an effective tool to assess student understanding of the lab principles. Based on the results, students understood the basics of how the method works, but were unable to clearly articulate how using a bad standard would affect the data.
Description of how anticipated actions were implemented from the previous year as connected to the anticipated actions for improvement of teaching and learning	No changes are planned for this assessment.

Our five-year assessment plan is presented below. In the fall of 2024, we will submit an assessment for the Standards *Food Microbiology* and also *Food Engineering and Processing*.

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
2022	*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
2023	*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
2024	*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
2025	*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
2026	*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