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 2020 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 2020*

Spring 2020	***Instructor***	***Progress on Objectives***	***Excellent Teacher***	***Excellent Course***
Sanitation and Safety	Nummer	Higher	Lower	Lower
Sensory Science	Martini	Higher	Higher	Higher
Food Analysis	Martarneh	Much Higher	Much Higher	Higher
Dairy Processing	McMahon	Similar	Similar	Lower
Fall 2020	***Instructor***	***Progress on Objectives***	***Excellent Teacher***	***Excellent Course***
Chocolate Science	Martini	Similar	Similar	Similar
Food Chemistry	Ward	Lower	Similar	Similar
Meat Technology	Martarneh	Similar	Higher	Higher
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, 80% of the scores for *Progress on Objectives* were similar or higher than all scores reported to IDEA. For *Excellent Teacher*, 80% were similar and or higher. For Excellent Course, 70% 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 (IFT)*. Globally, IFT sets guidelines for the background courses and curriculum to be covered in an approved food science program. USU received a new 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 2021. 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 Essential Learning Outcomes (ELOs) across two Standards. 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).

Faculty have been tasked with incorporating relevant ELOs into their courses, and embedded assessments are being designed to evaluate the ELOs at the appropriate level. In 2020, the USU food science program assessed a few of the ELOs to gain experience in this new assessment scheme. The ELOs evaluated in 2020 are shown below in Table 2. Dr. Ward is the food science program director, and a member of the HERB at IFT that approves undergraduate food science programs. In 2020, Dr. Ward recruited Drs. Matarneh and Bastarrachea to assist in the assessment.

Table 2: Standards and Essential Learning Outcomes assessed in 2020

Standard	Essential Learning Outcome	Learning Assessment Technique	Assessment
Food Chemistry	*Discuss the major chemical reactions that limit the shelf life of foods*	*Exam questions*	*Answer rubric*
Critical Thinking and Problem Solving	*Evaluate scientific information*	*Manuscript Review*	*Report and presentation*
Food Engineering and Processing	*Define principles of food engineering (mass and heat transfer, fluid flow, thermodynamics)*	*Case Study*	*Laboratory Report*
Food Engineering and Processing	*Use unit operations to produce a given food product in a laboratory of pilot plant*	*Case Study*	*Laboratory Report*

The first ELO evaluated was *Discuss the major chemical reactions that limit the shelf life of foods* (Table 3). The verb *discuss* is in the lower tier of Bloom's Taxonomy and implies an *understanding* of the topic. In NDFS 5560 there are two major chemical reactions that limit the shelf life of food: lipid oxidation and the Maillard reaction, also known as non-enzymatic browning. To *understand* these reactions, it is necessary that a student knows what foods the reaction will happen in, as well as the external conditions that promote it. This ELO was assessed in a traditional way via evaluation of student responses on exam questions.

Table 3: Discuss the major chemical reactions that limit the shelf life of foods

LAT used	Evaluation of exam questions
Outcomes	For this ELO, the verb used is 'discuss.' For a student to discuss a chemical reaction they must be able to name the substrates and the conditions that favor the reaction to proceed. In NDFS 5560 there is one test question for the Maillard Reaction and one for lipid oxidation. Test questions were evaluated to determine if the students listed both the substrates and the reaction conditions. This was judged on a four-point rubric. When all substrates were listed and all reaction conditions were listed, a 4 was awarded. A 3 was given to an answer that lacked one substrate or reaction conditions.

	A 2 was given for an answer that reflected some understanding. A 1 was for an answer that had some component of the reaction listed. Exams evaluated for 2017-2020 indicated that the average score was 3.6. This is considered acceptable.
Major observations and future courses of action	It appears the amount of time spent in class on the Maillard reaction and lipid oxidation is sufficient. No changes will be made in the presentation or the assessment of learning these components of food chemistry.

The second ELO evaluated (Table 4) indicated that students should be assesses for their ability to evaluate scientific information. The verb evaluate is higher up in Bloom's Taxonomy and implies students can comprehend what is being presented and determine its relative value.

Table 4: Evaluate scientific information

LAT used	Analytic memo. Students were asked to summarize a scientific publication in a two-page paper written for a lay audience.
Outcomes	Student memos were evaluated based on their a) understanding of what was presented in the papers and b) their ability to summarize this information. This is a challenging assignment for undergraduate students, as they are not familiar with all the analytical methodology at this point in their studies. However, in general, students were able to apply the information covered in the course to evaluate the studies they were assigned. Very few could accurately describe how the methods worked, but they were able to evaluate the results and present them coherently.
Major observations and future courses of action	One goal of the food science program is to incorporate aspects of cocoa processing into our curriculum. This is due to the fact that we have a processing facility dedicated to producing chocolate from beans. In 2020 this assignment was shifted to studying papers on cocoa processing. This will continue in the future.

The third ELO evaluated (Table 4) was related to principles of food engineering. The verb define is low in Bloom's Taxonomy and was assessed via evaluating performance in the laboratory.

Table 5: Define principles of food engineering (mass and heat transfer, fluid flow, thermodynamics)

Description of LAT (Case Study)	Two different laboratory sessions were conducted. In the first session, students were asked to define the types of liquid foods based on their rheological behavior, and were also asked to calculate their apparent viscosities at different levels of shear rate. In a different session, students were asked to calculate the energy and thermodynamic requirements of a cold storage system.
Outcomes	For the first laboratory session, the average score was 85 ± 13, with 50% of the students scoring > 90, 25 % of the students scoring between 80 and 90, and 25% of the students scoring between 60 and 70. For the second laboratory session, the average score was 87 ± 9, with all the students scoring > 80.

Major observations and future courses of action	Even though this is a program with a small number of students, it is common to have within the same class individuals with very different levels of academic performance. Some students learn fast, and others show substantial lack of previous knowledge (from the course prerequisites), which affects their understanding of the course materials. To address this, students are often given the opportunity to improve their grades and understanding with extra credit activities.

The last item assessed in 2020 was also in food engineering, and was written with the verb use. This suggests the assessment should be at the level of application, which is in the middle of the cognitive domains of Bloom's Taxonomy. This was evaluated in laboratory.

Table 6: Use unit operations to produce a given food product in a laboratory of pilot plant

Description of LAT (Case Study)	A laboratory session was conducted in which students were asked to freeze-dry fruits, and asked to calculate the corresponding energy, heat, and mass balances.
Outcomes	The average score was 78 ± 14, with 50% of the students scoring > 75, 25 % of the students scoring between 70 and 75, and 25% of the students scoring < 60.
Major observations and future courses of action	As explained in Table 5, students are given the opportunity to improve their grades and understanding with extra credit activities.

2021 Assessment plan

The 2021 assessment plan is shown in Appendix A. In the fall of 2021 the food science program will submit the first report of the new cycle to IFT.

Recent Data Based Decisions

NDFS 3110 (Food, Technology and Health) is a course that has been taught in the food science program in the sophomore year. However, this course will be removed from our curriculum as it is considered an upper division course and not appropriate for sophomores. The food science program is considering a second possible curriculum change as the future of Plant, Soils and Climate 4600 (Cereal Science) is unclear due to a faculty retirement. This is not a required course for any of the PSC majors and the course that takes its place will depend on the expertise of the new faculty hire. If the course is discontinued, the food science program will develop a cereal science course in its place.

The following changes to specific courses are a result of our 2020 assessment.

- Instruction on the Maillard Reaction and Lipid Oxidation is appropriate and will not change in NDFS 5560.
- Laboratories in NDFS 5560 will focus on cocoa processing to take advantage of the Aggie Chocolate Factory.

- Evaluation of peer-reviewed manuscripts on cocoa science will become a permanent end-of-semester activity in NDFS 5560.
- Students will be given opportunities to improve grades via resubmission of assignments and extra credit opportunities in NDFS 4400.

Appendix A. Food Science Assessment Plan, 2020-2025

Year	Standard	
2021	*Sensory Science*	*Essential Learning Outcome*
		• 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	*Essential Learning Outcome*
		• 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*	*Essential Learning Outcome*
		• Use statistical principles in food science applications • Employ appropriate data collection and analysis technologies • Construct visual representation of data
	Food Chemistry	*Essential Learning Outcome*
		• 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*	*Essential Learning Outcome*
		• 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	*Essential Learning Outcome*
		• 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*	*Essential Learning Outcome*

		• Apply critical thinking skills to solve problems • Select appropriate analytical techniques when presented with a practical problem • Evaluate scientific information
2025	*Professionalism and Leadership*	*Essential Learning Outcome*
		• Demonstrate the ability to work independently and in teams • Discuss examples of ethical issues in food science
	Quality Assurance	*Essential Learning Outcome*
		• *Define food quality and safety terms* • *Apply principles of quality assurance and control*
	Food Safety	*Essential Learning Outcome*
		• Identify potential hazards and food safety issues in specific foods • Discuss methods for controlling physical, chemical and biological hazards