Meet Your Meats: Integrated STEM Lessons

Yufei Guo, M.S.
Purdue University -- Department of Animal Sciences
270 S. Russell Street
Creighton Hall, Room 3078
W. Lafayette IN, 47907
765-494-4902
guo335@purdue.edu

Miranda R. McGuire, M.S.
Purdue University -- Department of Agricultural Sciences Education and Communication
915 W. State Street Lilly Hall of life Sciences, Room 4-401
W. Lafayette IN, 47907
765-494-8430
mcguir18@purdue.edu

Neil A. Knobloch, Ph. D
Purdue University-Department of Agricultural Sciences Education and Communication
915 W. State Street
Lilly Hall of life Sciences, Room 3-232
W. Lafayette IN, 47907
765-494-8439
nknobloc@purdue.edu

Stacy M. Zuelly, Ph. D
Purdue University-Department of Animal Sciences
270 S. Russell Street
Creighton Hall, Room 1072
W. Lafayette IN, 47907
765-494-3276
szuelly@purdue.edu

Hui-Hui Wang, Ph. D
Purdue University-Department of Agricultural Sciences Education and Communication
915 W. State Street
Lilly Hall of life Sciences, Room 3-223
W. Lafayette IN, 47907
765-494-6897
huiwang@purdue.edu

Introduction

Middle and high school students can be engaged in learning science, technology, engineering and mathematics (STEM) through Agriculture, Food, and Natural Resources (AFNR). Integrated STEM education is defined as "the approach to teaching the STEM content of two or more STEM domains, bound by STEM practices within an authentic context for the purpose of connecting these subjects to enhance student learning" (Kelley & Knowles, 2016). In our lesson, we wanted to implement student-centered teaching and the engineering design process. STEM education can connect scientific inquiry to engineering design by developing questions that can be answered through discovery to inform students before they begin the engineering design process to find solutions (Kennedy et al., 2014). Meat science is a relevant topic for students because meat is an essential protein and enjoyed by many youth. As such, an integrated STEM unit was designed for grades 6-12 in an afterschool program. The purpose of this unit was for participants to gain knowledge about meat science and food safety through STEM-related activities, and how to marinate meat for better flavor and palatability using the engineering design process,by applying multidisciplinary learning approaches. Implementing effective STEM through AFNR education allows for students' future success and motivates students to careers in STEM fields (Stohlmann et al., 2012).

How it Works

This unit integrates learning standards from the Indiana Department of Education in STEM through an experiential learning method. This lesson was designed to promote knowledge of fresh red meat quality and different cookeries to the younger generation to increase meat palatability and food safety for more families.

The five-lesson unit incorporates AFNR as both the content and context of student learning. The first lesson starts with "where your meat comes from and what is meat color?" where participants will learn the locations of various meat cuts, why meat changes color, and what meat color means from a meat quality perspective. In the second lesson, students learn USDA beef quality grades and what water holding capacity has to do with color and juiciness. The third lesson is about cut selection and the safe handling of meat products. Participants learn about the variations in meat tenderness based on the muscle locations within the carcass and commonly missed places during hand washing. The fourth lesson is about technologies used to improve the tenderness and function of different types of marinades. Participants learn to apply the engineering design process by determining what marinade is best for various meat cuts provided and identify the roles of marinade. The last lesson is about end-point cooking temperatures and cooking methods best suited for different cuts. In this lesson, participants learn why and how to use a meat thermometer in relation to food safety and eating experience. Integrated STEM through AFNR helps enhance participants' learning experiences and development of problem-solving as well as critical thinking skills through the application of obtained knowledge into real-life scenarios (Wang & Knobloch, 2020). The unit is very flexible; although it was intended to be taught as a whole, each lesson can be used individually with some modifications to better fit any curriculum.

Two lessons were implemented sequentially by two instructors in an online after-school program--Meet Your Meats Part 1 and Part 2. The sessions were presented as part of Purdue University's PK-12 outreach event known as the Virtual Ag+STEM Camp. The presenters adapted topics and activities from the five lessons to be combined for the two sessions. These

topics included: where your meat comes from, meat color, marbling, basic USDA beef quality grade, tenderness, methods of tenderization, and final end-point cooking temperature. Activities were modified to include only ordinary household items to facilitate student participation in a virtual setting. For methods of tenderization, paper towels were used to represent meat. Students were asked to perform different tasks with three pieces of paper towels to mimic mechanical, brine, and no tenderization. Students received visual and hands-on feedback on the effects of the various methods of tenderization of meat through the activity.

Results to Date

Two sequential virtual STEM sessions that included basic meat science knowledge and activities were generated from the unit. A total of 12 students participated in the virtual lessons. All participants actively took part in question-based class discussions and the end-of-session assessments presented in the format of Kahoot game. The Kahoot assessments' results showed that participants comprehended the content. An online survey was sent to the participants after the completion of the program to collect students' feedback. Participants rated positively on their experiences and the virtual lessons. The overall engaging class environment, especially considering the sessions were taught virtually, and positive participant feedback suggested that students enjoyed the various topics of meat science covered in the two-part STEM sessions.

Future Plans/Advice to Others

The unit was developed to be taught as a whole to provide students a thorough understanding of basic topics of Meat Science. However, each lesson can be utilized individually with some modifications. Ideally, the entire unit will be implemented in-person in the future. Teaching the unit in-person will likely maximize hands-on experiences through the activities embedded in each lesson plan to enhance student learning. For example, a sensory test where students can taste a variety of meat to better understand the differences in tenderness could be accomplished in an in-person setting. Educators who wish to continue the online format can modify the activities to be virtual friendly to help students stay engaged and better their learning experience. A limited number of participants was the major challenge encountered during implementation. To address the challenge, the program should increase the number of students allowed to register per session and potentially add small incentives or consequences to ensure attendance after registration. Ideally, the lessons can reach larger student audiences in future implementations, and more data could be collected to assess the unit's overall effectiveness, especially through student feedback.

Costs/Resources Needed

All the resources required for lesson implementation were included in the lesson plan. A list of materials needed for execution is provided for each lesson in the unit and costs of materials could vary based on activities implemented. For example, the cost for conducting activities in-person (e.g., taste test) would be higher than lessons taught online. Computer and Mentimeter access are highly recommended for unit implementation. In-person teaching cost would be higher due to printing supplies for student handouts, physical copies of USDA Grading Supplies (Marbling Pictures about $26.25/set, etc.), various types of steaks for sensory testing (market price), meat thermometers ($15-$100+), and playdough (product specific). A total cost estimate of the complete lesson plan implemented in-person would differ based on the variety and depth of the taste test, which can vary largely depending on instructor preference. Relatively fewer financial costs are associated with the online implementation of this unit because most pictures, and materials such as interactive websites are free for public access.

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