

**Sweet Soldering:
Using Crème Brûlée to Teach Soldering Skills in an Agricultural Mechanics Course**

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Introduction

In a study published by Rayfield et al. (2012), it was projected that agricultural education programs would use an elevated level of innovative ideas facilitated by highly motivated teachers by 2020. Hence, agricultural educators were highly recommended to be prepared to teach and promote technology-based concepts. In a study conducted by Albritton and Roberts (2020), the demographics in agricultural education are evolving, and more pre-service agricultural educators come from less agricultural-focused backgrounds. Consequently, educators need to have various skills in different content areas related to agricultural education (Albritton & Roberts, 2020). By using modern technologies in classroom settings through innovative methods, agricultural educators can better teach new concepts and promote the growth and sustainability of different agricultural systems (Lindner et al., 2016). The Council for Agricultural Education (2015) determined that in the Power, Structural, and Technical Systems Career pathway, educators should focus on teaching agricultural equipment and technologies skills to define student competency in Agriculture, Food, and Natural Resources (AFNR) settings.

In a study conducted by Saucier et al. (2012), after three rounds of a ranking-based questionnaire, soldering was ranked as the least important agricultural mechanics skill required by beginning agricultural educators. Furthermore, 48.4% of pre-service agricultural educators reported receiving no instruction on soldering skills (Clark et al., 2021), and at least 75% of agricultural educators have reported having moderate to no competency in teaching soldering techniques (Shultz et al., 2014). Additionally, less than 60% of agricultural educators have reported having either somewhat inadequate or completely inadequate tools and resources needed to teach soldering skills (McCubbins et al., 2016). Saucier et al. (2014) also found that agricultural educators are utilizing unsafe and hazardous materials when teaching mechanics-based concepts in an agricultural mechanics laboratory due to the cost of materials.

How it Works

Before conducting the activity, we baked crème brûlée in individual serving-sized ramekin dishes and cooled them in a refrigerator. Following the cooling period, we removed the mixtures from the fridge and arranged them at individual stations with sugars and Butane Micro-Torches for each student. Before the activity, we presented a short lecture-based lesson on soldering and plumbing concepts. After the lesson and receiving their individual ramekins, we instructed students to choose from a selection of either cane sugar, brown sugar, powdered sugar, or Turbinado sugar to pour on their mixture. Afterward, we instructed students on operating their Butane Micro-Torches properly and gave brief instruction on proper safety procedures.

We then instructed students to pour a light layer of the sugar they chose on top of the crème brûlée mixture. Using the Butane Micro-Torch, we instructed students to slowly heat the sugar with the tip of the flame in a circular motion and continue this process over the entire surface until all the sugar had been caramelized. We instructed students that they could unintentionally burn the sugar if they remained in one location with the torch for an extended period. Once the entire layer of sugar had melted, we instructed students to turn off their torches and allow the caramelized sugar to solidify and cool. Afterward, students were permitted to eat their work and report any findings they had on flavor and texture.

Results to Date

After completing the activity with an introductory agricultural mechanic's course at New Mexico State University, students found that utilizing a small handheld torch to caramelize sugar served as a beneficial precursor to soldering copper piping. At the beginning of the activity, the instructor demonstrated how to caramelize sugar properly, allowing students to visualize their expectations. Students reported that they enjoyed using the Butane Micro-Torch as it was easy to use, and the small size of the torch allowed for better control of the flame when caramelizing the sugar. As the sugars were caramelized, students found that brown sugar did not melt quickly and had an unpleasant taste due to the presence of molasses. Students also reported that the Turbinado sugar took longer to melt and was more susceptible to burning. If students accidentally burned their sugar, the caramelized layer was carefully removed without disturbing the crème brûlée mixture below, and a new layer of sugar was poured.

Using this activity to practice and teach soldering skills can assist in developing student knowledge, teaching, or reinforcing various aspects of agricultural mechanics and applying concepts to future careers. Additionally, this activity allowed students to visualize the caramelization process, which helped them connect to the supplemental soldering activity.

Advice to Others

This activity would be best used as part of an introductory soldering lesson in an introductory agricultural mechanics course at the secondary or post-secondary levels. The activity can be used as an activating strategy or hands-on instructional activity. Due to the nature of the activity, we recommend that to connect the cross-disciplines of food science and agricultural mechanics, a lesson on the chemistry of crème brûlée may be taught to touch on food safety and production (FoodCrumbles, 2020). This step would serve to expose pre-service agricultural educators to food science-related topics (Albritton & Roberts, 2020), and it is only recommended for implementation should a program have proper facilities and equipment to allow for food production.

We recommend using only pure cane sugar and powdered sugar in this activity based on students' feedback. This is because cane sugar and powdered sugar best replicate the process of soldering, does not burn as easily, and has a pleasant taste. Brown sugar has an unpleasant taste compared to other sugars used, and Turbinado sugar takes longer to melt and burns faster. We also recommend presenting a short lecture on soldering and plumbing topics before the commencement of the activity, which can help students connect the importance of this activity to real-world processes. Finally, we also recommend allowing students to practice soldering copper tubing to reinforce the concepts learned from this activity.

Resources Needed

This activity requires access to a Butane Micro-Torch (\$14.99), which can be purchased at a local hardware store (i.e., Harbor Freight). A small container of Butane gas (\$2.23) is also recommended for purchase. For the crème brûlée mixture, ingredients include eggs (18 ct. - \$2.97), whipping cream (1 pt. - \$4.58), milk (1 gallon- \$2.49), vanilla extract (1 fl oz. - \$5.84), and several types of sugar (\$1.62 each), which can be bought at a grocery store (i.e., Walmart). Ceramic ramekin dishes are highly recommended for purchase for this activity (8 pk- \$1.48). The total cost of materials for this activity is approximately \$36.20.

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