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Jeremy L. Hsu

Sarah Ahles

Lilian W. Senger

Anuradha Prakash

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## Exploring Pathways to Food Science Careers in Southern California: A Case Study in Food Science Career Development

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## ORIGINAL ARTICLE

## Food Science Education

# Exploring pathways to food science careers in Southern California: A case study in food science career development

Jeremy L. Hsu  | Sarah Ahles | Lilian W. Senger<sup>#</sup>  | Anuradha Prakash<sup>#</sup>

Schmid College of Science and Technology, Chapman University, Orange, California, USA

**Correspondence**

Jeremy L. Hsu, Schmid College of Science and Technology, Chapman University, Orange, CA 92866, USA.  
Email: [hsu@chapman.edu](mailto:hsu@chapman.edu)

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Southern California Institute of Food Technology Section

**Abstract**

Southern California is a diverse region that is home to a high concentration of food science companies, with an increasing demand for additional food scientists and technologists to join this workforce. Despite this abundance of food science companies and the high demand for jobs, there is currently a shortage in the number of qualified food scientists and technologists in the region. This shortage is also observed within higher education, with declining enrollments in the food science graduate and undergraduate programs across Southern California. Here, we conduct a case study to explore the factors that influence students from Southern California to pursue or not pursue careers in food science. We surveyed both undergraduate and graduate students currently enrolled in food science as well as industry professionals in the region to determine sources of knowledge about the discipline, and motivations and barriers for pursuing careers in food science. We also surveyed high school educators in the region to gain additional perspectives on how food science is being introduced at the secondary level, if at all. Our results demonstrate that many students and high school educators are not knowledgeable about career options within food science and that students who are pursuing food science largely report similar motivations for pursuing the discipline as those currently working in the food science industry. We conclude by discussing implications for the food science education community within Southern California and beyond.

**KEYWORDS**

food science career development, food science education, Southern California, student interest

<sup>#</sup>Lilian W. Senger and Anuradha Prakash contributed equally to this work.

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## 1 | INTRODUCTION

Demand for careers in food science in the United States is expected to increase over the next decade, with consistent increases in salaries and job satisfaction (2022 IFT Compensation & Career Path Report, 2022; Bureau of Labor Statistics, 2023; Positive Trends for Science of Food Salaries, 2020). However, despite these positive projections for the field, there have been declining levels of applications and enrollment in food science undergraduate and graduate programs, worrying trends that have led to challenges in filling vacancies in food science (Academic Knowledge Base, 2018; Little, 2022). These trends have led to multiple efforts to spark students' interest in food science, including efforts to produce more food science curriculum (Barrett et al., 2020), summer programs focusing on food science research (Roberts et al., 2010), and professional development for teachers focusing on food science (Hendrix et al., 2021; Kahnke et al., 2006).

Despite these efforts, there have only been a few studies to examine the factors that cause students to pursue or not pursue food science. For instance, the Institute of Food Technologists (IFT)—the largest and most prominent professional society for food scientists and technologists in the United States—published the Food Science Academic Knowledge Base in 2018 and 2023, reports that summarized surveys of students and academic data at 16 (2018) and 24 (2023) food science-based undergraduate and graduate programs in the United States (Academic Knowledge Base, 2018; Academic Knowledge Base, 2023). These reports identified that undergraduate students in food science programs largely credit family members or friends, media (including social media and television), and the influence of faculty members in food science, as the most important influences in their decision to pursue food science. Similarly, graduate students in food science cite the influence of faculty members in their graduate and undergraduate programs, as well as their own work experiences, as being highly influential in their decision to pursue food science (Academic Knowledge Base, 2018; Academic Knowledge Base, 2023). IFT's most recent annual survey of its members—professionals in the food science discipline—and other food scientists examined food science careers but did not explore factors that influenced industry professionals to pursue the discipline, instead focusing on professional priorities and compensation (2022 IFT Compensation & Career Path Report, 2022). These studies are also limited in scope. For instance, the 2018 Academic Knowledge Base report focused solely on students enrolled in a limited number of food science programs in the United States including only two in California. Similarly, IFT's Compensation and Career Path Report highlights the voices of professionals cur-

rently in the food science industry but does not include the voices of students or educators. Given these limitations, we conducted a case study to answer the following questions:

- What are the factors that influence students' decisions to pursue (or not pursue) food science in Southern California?
- What factors do industry professionals in Southern California cite for influencing their career choices, and how do these factors align with students' reasons?
- How familiar are high school educators and guidance counselors in Southern California with the discipline of food science?

### 1.1 | Southern California food science ecosystem

We focus on the broader Southern California food science ecosystem for several reasons. First, California is home to the largest number of food and beverage manufacturing plants in the United States, with major food science industries and most of the state's food processors located within the Southern California region (USDA ERS—Manufacturing, 2023). This region is also highly populated and culturally diverse, with nearly two-thirds of California's 39 million people residing in the region. The state, along with the Pacific Northwest region, also reported the largest percent increase in compensation for food science jobs in the last five years out of any region in the United States, indicating a growing demand for food science positions (2022 IFT Compensation & Career Path Report, 2022). Second, the state and region support many undergraduate and graduate food science programs. Indeed, the state has the highest number of IFT Higher Education Review Board-approved undergraduate programs in the US (IFT Approved Undergraduate Programs, n.d.) as well as graduate programs listed on the IFT database (Institute of Food Technology, n.d.). While these lists are not comprehensive, they demonstrate the large number of colleges and universities in the region that offer food science undergraduate and graduate programs (Table 1). In this regard, California differs from many other states, many of which only have a single institution (typically a land-grant institution) that hosts a food science program. In contrast, Southern California has multiple institutions that offer food science, none of which are land-grant universities (Table 1).

However, despite the abundance of food science jobs as well as the concentration of food science programs, the Southern California Institute of Food Technology Section (SCIFTS) has reported that there remains a large

**TABLE 1** List of institutions in Southern California included in survey which offer food science and affiliated programs, along with their food science enrollments in fall 2022. We also listed if an institution offered a bachelor's degree in food science (undergraduate) or a master's in food science (graduate), as well as their Carnegie Classification.

Institution	Level of food science programs available (number of students)	Carnegie Classification
California Polytechnic State University, San Luis Obispo	Undergraduate (196); graduate (9)	Master's Colleges and Universities: Larger Programs
California State Polytechnic University, Pomona	Undergraduate (162); graduate (9)	Master's Colleges and Universities: Larger Programs
California State University, Long Beach	Undergraduate (45)	Doctoral Universities: High Research Activity (R2)
California State University, Los Angeles	Undergraduate (33)	Master's Colleges and Universities: Larger Programs
Chapman University	Graduate (46)	Doctoral Universities: High Research Activity (R2)
San Diego State University	Undergraduate* (296)	Doctoral Universities: High Research Activity (R2)

\*The San Diego State University program is a foods and nutrition degree that incorporates food science and nutrition.

demand for qualified food scientists in the area, with enrollment in food science programs decreasing in the past 5 years, mirroring national trends (personal communications, SCIFTS). This demand can be evidenced in a 2020 report by the Los Angeles County Economic Development Corporation, which identified food science and agriculture as one of the fields where there was the greatest disparity between the number of job openings requiring a bachelor's degree in the field and the percent of the workers in the field with a bachelor's degree, suggesting a large demand for food scientists who hold undergraduate or graduate degrees in this area (Los Angeles County Economic Development Corporation, 2020). Thus, we focus on this geographic region as a case study to explore why there may be a decline in the number of students pursuing food science degrees despite the robust nature of the food science industry and educational programs in the area. Finally, we note that we focused on Southern California for practical reasons as well. Not only are the authors each located within this region, but most of the author team is active within SCIFTS, which has an extensive network of food science professionals and educators in the region. Thus, we draw upon this network to reach a diverse set of people involved in food science in Southern California.

## 2 | METHODS

### 2.1 | Survey development

We first developed a survey for undergraduate and graduate students in food science following an iterative process. The survey consisted of largely open-ended questions,

which were designed *de novo* to capture students' interest in pursuing food science careers, motivations for pursuing the field, factors that shaped their journeys into food science, and information they identified as helpful to make future career decisions. To ensure the validity of the questions, the survey was iteratively refined through discussions with members of the research team who were not otherwise involved in instrument development. We opted to use one instrument for surveying both undergraduate and graduate students in food science, given that most of our survey questions are broadly applicable to students in both groups. A second survey was developed for high school educators, and a third survey for food science industry professionals, following the same procedure. All survey instruments are included in [Supporting information](#).

### 2.2 | Survey distribution

The first survey was sent to undergraduates and graduate students enrolled in six institutions of higher learning that offer food science programs in Southern California (Table 1). Program administrators at each of the six universities were asked to distribute the survey link to students in their food science program. The second survey, for food science industry professionals, was sent through the SCIFTS listserv. Finally, we contacted high school science teachers in Southern California using convenience sampling. This work was approved by the Chapman University Institutional Review Board and informed consent was obtained for all participants.

## 2.3 | Survey analyses

For the student and industry professional surveys, we conducted thematic analyses as per Peel (2020) by first having two of the authors (JLH and SA) independently read through all survey responses and develop codebooks of emergent themes. Then, the two researchers met to discuss and come up with a consensus codebook. Given the relatively small sample size, the two researchers independently coded all survey responses and met to resolve any disagreements through open discussion (Chinh et al., 2019). Codes that were found in fewer than 5% of the responses were excluded from further analysis. We also compared the responses for the undergraduate and graduate students and determined that there was no difference in code frequency for any of the questions (Fisher's exact test with post-hoc Bonferroni correction). Thus, we grouped the responses for these students together to provide an overview of student perceptions toward food science. Similarly, for questions that were shared between the student and industry professional surveys, we compared the results by investigating if the frequency of codes between these two groups differed (Fisher's exact test with post-hoc Bonferroni correction). Finally, given the paucity of respondents to the high school educator survey, no codebook was created; instead, the two researchers independently read all responses and iteratively discussed observations and themes from the responses.

## 3 | RESULTS

### 3.1 | Overview of responses

We received 176 responses for the student survey. We filtered out responses that were largely incomplete, as well as any respondents who indicated that they were not currently enrolled as an undergraduate or graduate student. After this filtering, 146 responses (83.0%) remained in our dataset and were included in our analyses. In contrast, 41 people completed the industry professional survey, with a complete dataset of 38 responses after filtering (92.7%). Finally, only 17 people responded to the high school educator survey, of which we retained 14 responses (82.4%).

### 3.2 | Demographic breakdown

The plurality of students who completed the survey were Hispanic (37.9%), followed by non-Hispanic White (31.0%), Asian or Asian American (26.7%), and Black (3.4%). The remainder of respondents declined to provide responses. Approximately three-quarters of respondents (72.4%) were

females, with 21.6% males. The remaining 6% declined to provide a response or were nonbinary, genderfluid, or transgender/genderqueer. Nearly 40% (38.5%) of respondents indicated that they were first-generation college students. Nearly three-quarters of respondents (74%) were undergraduate students, with the rest being master's students in food science. We did not ask students to identify their institution, so thus are, unable to report on the breakdown of respondents by institution.

The plurality of respondents to the industry professionals survey (46.7%) identified as non-Hispanic White, while 26.7% identified as Hispanic. Over 10% (13.4%) were Asian American, with the remainder of respondents declining to respond. A total of 70% identified as females and 26.7% as males; no respondents were identified as nonbinary. Approximately a third (30%) of respondents indicated that they were the first in their family to attend college. Finally, for the high school educator survey the majority (63.6%) were identified as females, with nearly the majority being non-Hispanic White (63.6%), followed by 9% each identifying as Asian Americans and Hispanic.

### 3.3 | Student survey results

Students cited a range of different reasons for why they pursued food science (Table 2). The plurality of students indicated a specific passion or general interest in the discipline, while others highlighted product development or the breadth of the discipline as reasons they were interested in pursuing food science. Unsurprisingly, those who indicated that they did not wish to pursue food science primarily stated that this was because they had a career goal outside of the discipline. Students also provided a range of responses when queried about how they found out about the discipline (Table 3). Classes appear to be a major influence, as are social media and friends, more traditional media (e.g., books), and the influence of cooking. Finally, students also identified multiple areas that they wish they had more information about to inform their career decisions (Table 4). Nearly a quarter of students indicated that they wished they had access and exposure to explore a wider breadth of careers, with other students indicating that they wished they knew more information on job requirements, salaries, and availability of jobs in food science.

### 3.4 | Industry professional survey results

Over three-fourths (75.8%) of industry professionals indicated that they had majored in food science or food technology in college, with another 9.1% indicating



**TABLE 2** List of reasons students and industry professionals provided when queried why they wish to pursue or not pursue food science as a career.

Code name	Code description	Sample quote	Percent of student respondents (%)	Percent of industry respondents (%)
Interest	Cites specific passion or interest in food science	“I am pursuing a career in food science as I am passionate about food and finding new ways to manufacture goods.”	20.5	43.3
Product development	Specifically discusses interest driven by product development	“I’m interested into developing new products, or optimize existing formulas. And I’m interested in quality as well”	6.8	6.7
Inertia	Highlights how they feel like it is easier to pursue a career in a field that they have already spent time	“I have already invested in food science. It’s easier to remain in his career than learn a new career.”	6.2	0
Breadth of discipline	Discusses how the discipline of food science provides many different avenues to pursue and/or has varied career options	“There are countless paths and sectors to pursue in food science such as working with flavors, colors, product development, nutrition, etc. Food feeds the world, so the ability to be creative in curating innovative and healthy products seems enticing.”	5.5	0
Finances	Discusses how they were drawn to the field due to financial considerations (e.g., high salary) or the stability of jobs in the discipline	“Stability/job security and financial”	0*	13.3*

An asterisk indicates a difference in frequency between the student and industry responses (Fisher’s exact test with post-hoc Bonferroni correction).

food-related majors (including nutrition, food engineering, and nutritional sciences). The only other major that represented over 5% of industry professionals was business (6.1%).

When asked why they entered the profession, only three codes were seen in over 5% of respondents (Table 2). Nearly half of respondents indicated that they were drawn to food science due to having an interest in the field, while 13.3% cited how the salary and stability of jobs in the discipline were major factors in their choices to pursue food science as a career. These responses largely aligned with the student responses, with the financial draw being the only code that was different in frequency from the student responses ( $p < 0.01$ , Fisher’s exact test with post-hoc Bonferroni correction). Similarly, industry professionals indicated a range of reasons for how they heard about the discipline, ranging from the influence of family and faculty to finding about the discipline themselves (Table 3). Finally, industry professionals provided a range of skills

that they thought should be emphasized in undergraduate and graduate food science programs (Table 5) including critical thinking, specific disciplinary skills from chemistry, biology and computer science, and communication skills.

### 3.5 | High school educator survey results

Nearly half (42.9%) of respondents indicated that they lead or participate in a food science or food-related activity (such as agriculture) in their classes, citing activities such as growing food in a garden, studying feeding of populations, discussing dairy and beef production, exploring the ethics of genetically modified organisms for food, and/or highlighting the process of determining food safety. However, despite this, the high school educators largely report that their students are not knowledgeable about food science. When asked, not a single respondent thought

**TABLE 3** List of reasons students and industry professionals indicated how they found out about food science.

Code name	Code definition	Sample quote	Percent of student respondents (%)	Percent of industry respondents (%)
Interest	Discusses general interest and how this led them to discover the field	“Becoming more interested in health and exercise”	26.5*	0*
Classes or food science programs	Discusses specific experiences in classes (whether high school or college), including co-curricular activities like career fairs	“High school agriculture classes”	22.4	13.3
Social media and friends	Cites finding out through a social media platform or through interactions with a peer	“Found out about it through an article on food science on Twitter”	18.4	10
Self-search	Mentions only general relying on self, or specific actions they took without ascribing to others	“I went to my local library and got a food science book. Since then, I said I wanted to do something related to food”	16.3	23.3
Media	States seeing a brochure, pamphlet, video, website, or other multimedia that showcased food science that sparked interest	“I had no idea Food Science existed until touring [university] campus and seeing a pamphlet for the program. I was instantly intrigued, went to an informational session and a tour of the lab that day and I was hooked. I committed to [university] and majoring in Food Science that day and never looked back.”	12.2	6.7
Cooking/culinary	Attributes route of exposure to interest/background in cooking or culinary	“All my life I have always loved cooking and baking. As a young child, I would watch cooking videos and I stumbled across a channel where there were 3 levels of chef- amateur, home cook, and expert. And at the end of the cooking process, a food scientist would breakdown each individual chef's food and explain the processes. Ever since then, I was every interested in learning about food science.”	12.2	0
Faculty or counselor	Mentions specific faculty or guidance counselor/advisor outreach, whether in class or outside of class	“Faculty advertised it in class”	9.2	10
Helping others	Cites a desire to help other people with food	“I wanted to help others make good food choices”	8.2	0
Job experience	Describes how a previous job allowed to learn about food science	“I worked in a kitchen were [food research and development] was done”	6.1	13.3
Family	Cites the influence of family members in food or food-related industries	“My dad was a food scientist”	2.0	20

An asterisk indicates a difference in frequency between the student and industry responses (Fisher's exact test with post-hoc Bonferroni correction).



**TABLE 4** Student responses for the type of information they wish they had to inform their career decisions better.

Code name	Code definition	Sample quote	Percent of respondents (%)
Exposure to career paths	Mentions getting access to explore a variety of different career options	“Exposure to the possible career paths in classes and internships”	22.6
Availability of jobs	Information regarding the number of job openings and the odds of securing positions in the field	“Job availability and accessibility”	8.9
Logistics regarding career	Discusses wishing to have structural information regarding positions in the discipline, e.g., requirements, job duties, etc.	“Information on specific roles and the typical experience needed for those roles”	7.5
Salary	Cites wanting to know more about compensation (and associated benefits) for careers in food science	“more salary information”	6.2
Graduate program info	Discusses wanting more information about graduate programs in food science in terms of length, acceptance rate, accessibility, cost, etc.	“Having known the difficulty of acceptance into post undergraduate/graduate school for doctoral level education.”	5.5

students were “moderately” or “extremely” aware of food science, with 82% of respondents indicating that they thought their students were not at all aware or only slightly aware of food science as a discipline. Finally, when asked what resources would be helpful to better familiarize students with food science, respondents provided a range of responses. Several respondents indicated that having access to videos relating to food science would be beneficial. For instance, one respondent wrote that having “more short videos about [food science] and why it matters” would be helpful, with others citing getting access to documentaries or films about food science. Other respondents highlighted how having access to instructional materials or labs that promote food science and that were aligned to Next Generation Science Standards (NGSS) would facilitate them sharing more about the discipline with their students.

## 4 | DISCUSSION

Our work provides one of the first explorations that we are aware of examining how students, industry professionals, and high school educators perceive food science and complements the general IFT surveys. For instance, we are not aware of any other studies that have specifically explored the factors that spark students’ interest in and knowledge of food science, nor of any case studies that have examined these perspectives across multiple stakeholders in food science in a unique region that offers plentiful educational and job opportunities in food science yet does not matriculate enough students. In addition, our work builds upon

the results of the IFT surveys (e.g., Academic Knowledge Base and Career and Compensation Reports) by providing a more in-depth examination of how various stakeholders in one region view food science and allow us to compare the perspectives between stakeholders to identify potential strategies to increase student knowledge of and interest in food science as a discipline.

### 4.1 | Student knowledge of food science is driven by both formal education and informal mechanisms

Our survey found that the plurality of students indicated that they first heard about food science through classes or food science programs, highlighting the importance of introducing food science and technology in both disciplinary and professional development courses in K-12 and college classes (Table 3). For instance, one respondent indicated that they first heard about food science “through a career development course at [college]... the course showed different fields within food science and nutrition; I was able to research more about food science and decided that was my path.” In contrast, other respondents indicated that they learned about food science through more disciplinary courses (e.g., “high school agricultural classes”) that discussed elements of food science. Another student wrote that they “took culinary art classes and wanted to relate it with science,” indicating how interest in culinary arts and cooking classes can also spark knowledge of and interest in food science. Similarly, another 10% of respondents also credited faculty or

**TABLE 5** List of skills identified by industry professionals as important for success that should be taught in undergraduate and graduate food science programs.

Code name	Code definition	Sample quote	Percent of respondents (%)
Critical thinking/ problem-solving	Process and think critically about data and information, and solve problems	“How to be a critical thinker”	30.0
Specific disciplinary skills	Use key skills from associated disciplines like chemistry, computer science, and biology	“Chemistry, Process Engineering, Product Development, Quality, Statistical Process Control (Statistics in general)”	23.3
Communication	Communicate key findings orally or through writing	“Be able to communicate well. If you can’t present your ideas well [it] doesn’t matter how smart you are”	16.7
Collaboration	Work well in teams	“Teamwork”	16.7
Business skills	Possess competencies related to business, e.g., management, finances, etc.	“Business acumen”	16.7
Specific food science techniques	Cited specific techniques and competencies within food science	“Master food analysis and testing methods and be familiar with the policy of food industry development”	13.3
Culinary skills	Ability to cook	“Solid culinary foundation to be able to articulate meaningful concepts using functional ingredients/technologies”	6.7
Adaptability	Ability to pivot and be flexible	“[Able to handle] last minute pivots/scope change”	6.7

guidance counselors for providing them their first knowledge or awareness of food science.

Others credited more informal mechanisms. For example, nearly one-fifth of respondents indicated that they heard about food science through social media (e.g., Twitter) or through friends and peers, with another 12% indicating the influence of more traditional media. Others cited informal outreach programs: “I found out [about food science] at a career fair at [the local university] when I was in middle school,” one student wrote, highlighting the importance of such informal outreach opportunities.

Over a fourth of students replied to this question by asking how they first heard about the discipline, by discussing their general interest in the discipline, and not providing specific details on the source of their knowledge. For example, one respondent wrote, “no one event or person in particular influenced me... I’ve just always been interested.” These responses indicate that there are some students who may not explicitly remember where they first heard about the discipline, and further work is needed to investigate what factors may have shaped such students’ interest in food science over time. In addition, the sources of knowledge for food science listed by students largely align with those identified by industry pro-

professionals in Southern California (Table 3). However, we highlight two areas that may be different. First, none of the industry professionals replied to the question regarding how they first heard about food science by indicating that they always had an interest, in contrast with the fourth of students who stated general interest as a response to the question. However, we speculate that this discrepancy is likely an artifact of how students and industry professionals interpreted the question and reflected on their sources of knowledge. Given that industry professionals have likely been involved in the discipline for longer than students, it is possible that they have reflected more on their journeys and career paths and thus were more likely to provide specific responses as compared to students. We also note that almost half of industry professionals indicated a general interest in food science when queried for their reasons for pursuing food science (Table 2), again suggesting that this difference in code frequency is likely an artifact of the level of reflection by students and industry professionals. Second, a fifth of industry professionals cited family as their initial source of knowledge of food science, while very few students indicated family as a source of knowledge. While the differences were not significant, it is possible that those students in food science with family who are familiar with

the discipline may have a higher likelihood of persisting in the field and pursuing a career in food science, given work in other science, technology, engineering, and math (STEM) fields that have demonstrated that having family members in a related discipline providing support can increase students' persistence in STEM (Foltz et al., 2014; Morganson et al., 2015).

Intriguingly, there were some differences between our data and the results of IFT's Academic Knowledge Base. For instance, the IFT survey from 2018 found that family members and family friends, media, and faculty members were the top three influences for undergraduate students in food science, with similar influences for graduate students (*Academic Knowledge Base*, 2018). While our survey identified that media and faculty members were common sources of knowledge for learning about food science for the first time, very few students identified family members as a source of knowledge for food science. This contrast may be due to the differences in how the questions were asked in our survey as compared to those of the IFT Academic Knowledge Base. Our survey asked for students' sources of knowledge, rather than influence on their interest in food science, so it is possible that family members could be a large influence on our respondents' decisions to pursue food science, but not necessarily the initial source of information for students about food science as a discipline. In other words, a student who heard about food science on social media, then talked to their family about the career and received words of encouragement, would reply to our survey, indicating that their initial source of knowledge was social media but indicate family as a major influence on the IFT Academic Knowledge Base survey. Alternatively, it is possible that food science students in Southern California may have fewer familial influences than students across the 16 schools included in the IFT Academic Knowledge Base survey, which only included one school from Southern California in 2018 and two in 2023.

#### **4.2 | Students and industry professionals identify similar motivations for pursuing food science, though with some differences**

Our results also found that students and industry professionals were largely aligned on their reasons for why they pursued food science. For instance, the plurality of respondents in both groups indicated that they chose the career out of a passion or interest for the discipline (Table 2), with a similar percentage also explicitly highlighting interest in product development, one sub-field of food science. However, there were also differences in perceptions. For instance, 6% of students stated that they were drawn to

food science due to the breadth of the field, specifically citing the range of possible subfields and careers within the area. No industry professionals mentioned the breadth of the discipline, perhaps because many industry professionals are already working in a specialized, niche area of the discipline and may not perceive the same breadth of the discipline as a motivating factor for their careers. In addition, over an eighth of industry professionals (13.3%) indicated that they were drawn to food science due to financial reasons, citing high compensation for jobs in the discipline, and the job security they feel with the increasing demand for food scientists. In contrast, no students mentioned financial reasons as their motivation for pursuing food science. This suggests that additional outreach to students who are considering food science as a career about the state of jobs in the field and providing more information on salary and compensation in food science careers may be beneficial and could lead to additional students deciding to pursue food science as a career. Indeed, we note that more information on the availability of jobs and information on the compensation of jobs in the field were the second and fourth most requested information, respectively, when students were queried about what information they wished they had to inform their career decisions better (Table 4). The most common response students provided to this question was additional exposure to career paths in food science, suggesting that additional efforts by undergraduate and graduate food science programs to showcase the different career options in food science may be beneficial.

#### **4.3 | Student responses indicate that outcome expectations play a large role in their decisions to pursue food science**

We draw upon social cognitive career theory (SCCT) to further situate these results, where students are requesting additional information about career paths, job availability, and compensation. SCCT states that students' choice of careers is influenced by a complex network of psychological and social factors, including their goals, outcome expectations, and their self-efficacy beliefs (Cardoso et al., 2013; Lent et al., 1994; Lindley, 2005). These three factors interplay with others that can influence a student's choice of career. For instance, under SCCT, a student's learning experience can impact both self-efficacy (their confidence in their ability to succeed in the field) as well as their interests; in turn, self-efficacy and interests shape a student's outcome expectations, or their expectations of what will happen if they pursue a given career (Cardoso et al., 2013). These outcome expectations and a student's self-efficacy can have a direct influence on a student's goals, actions,

and performance, thus shaping how likely a student is to pursue food science as a discipline (Navarro et al., 2007).

First, we explore students' outcome expectations for food science. Multiple students provided statements indicating positive outcome expectations for food science as a career. "As someone who [went] back to school for a career change because they felt stuck in their current career, I was scared I might feel stuck again, but with food science, there are so many different options within the field that I'm confident I have made a choice that will continue to challenge me so that I never feel stuck or bored in my career," one student wrote, indicating that they had enough knowledge of jobs in the discipline that they felt positively about finding an engaging job. Similarly, another student indicated how their outcome expectations shifted from negative to positive after learning more about careers in the field. "Initially I was hesitant if I wanted to pursue a food science career as I wasn't fully understanding career paths and what that would look like," they wrote. "However, after actually seeing facilities and better understanding what people do on the daily basis in their career, I understand it more and can see myself doing this kind of work." This response highlights how programs and outreach efforts that provide students with greater information on job availability and experiences in the food science workforce (such as field trips, presentations, and social media outreach, etc.) can shape students' outcome expectations as well as increase their self-efficacy, thus, leading to a higher likelihood of choosing food science as a career.

In contrast, some students indicated negative outcome expectations. "I don't know if I'm passionate about the subject enough to decide if this is the career I want," one student wrote, indicating that they were still deciding whether to pursue food science as a career following their education. "It interests me, but if a higher-paying job comes along, I will most likely turn to that, even if it doesn't involve food science." Similarly, another student writes, "I do not know what kind of career opportunities it would open up. I would also want to know the need for people in this field." These quotes further reinforce how sharing information about the increase in demand for food science jobs, as well as the steady increase in salary levels of those jobs, may be helpful in influencing these students to pursue food science as careers.

In addition to outcome expectations, self-efficacy also plays a major factor in shaping students' career decisions, which was evidenced in our responses as well. "I'm interested in [food science as a career] but I'm afraid I won't get to do it since I am not the best when it comes to chemistry," one student wrote, indicating a low self-confidence in one of the core disciplines that food science draws upon. In contrast, another student stated that "[food science] has been my area [of] studying and I would feel the most confi-

dent in that type of career," indicating that they have high confidence in their ability to succeed in a career in food science given their current educational studies in food science. Given the large influence of self-efficacy in career decisions, with higher self-efficacy correlated with greater persistence in STEM fields, additional work is needed to investigate the factors that shape students' self-efficacy in food science and explore potential interventions that can increase self-efficacy (Brown, 2002; Lent et al., 1994; Trujillo & Tanner, 2014). We also highlight how there may be differences in self-efficacy between students from different demographic backgrounds in STEM (MacPhee et al., 2013). While our sample size was too small to examine differences among students in different demographic groups, we urge the food science education community to continue exploring ways to support students from underrepresented backgrounds and promote a diverse community in food science education and in the food science workforce.

#### 4.4 | Industry professionals largely have food science educational backgrounds

Our survey identified that over three-fourths of the surveyed food science industry professionals in Southern California had earned food science undergraduate degrees, and that another 10% of these professionals possessed an undergraduate degree in a food-related major such as nutrition. These results largely align with past work in the United States and beyond. For instance, a survey of over 3000 European food scientists identified that the majority of industry professionals in food science obtained undergraduate or graduate degrees in food science (Oreopoulou et al., 2015). Similarly, the IFT's Compensation and Career Path Report also indicates that the majority of respondents possess their highest degree in food science or technology (2022 IFT Compensation & Career Path Report, 2022). These results indicate that there may be opportunities to continue expanding the food science pipeline by expanding outreach efforts and programs to allied fields such as chemistry and biology, particularly at colleges and universities that do not offer food science programs.

#### 4.5 | Food science professionals highlight different skills that food science education programs should emphasize

Our survey queried food science industry professionals on the skills important for success that they thought should be taught in undergraduate and graduate food science programs. The plurality of respondents indicated that critical thinking and problem-solving were



important, followed by specific disciplinary skills (e.g., skills and concepts from associated disciplines like chemistry, computer science and biology), communication, collaboration, business skills, and specific food science techniques (Table 5). These skills largely align with past efforts to determine the skills and competencies needed for success in food science. For instance, the IFT has provided a consensus list of standards and essential learning outcomes for undergraduate food science programs through the IFT's Higher Education Review Board (Santau et al., 2020). These guidelines include food science communication (including both oral and written communication); critical thinking and problem solving; and professionalism and leadership as standards for undergraduate food science programs. Thus, the skills listed by our respondents largely overlap with these standards. Similarly, other studies that have examined what food science educators and industry professionals think are important outside the United States have also identified that communication, business skills, teamwork, and knowledge of disciplinary skills are essential competencies for food science (Flynn et al., 2013; Mayor et al., 2015; Metcalfe et al., 2020; Weston et al., 2017, 2020). Interestingly, past work has found major variation in the skills that food science industry professionals identify as important based on geographic region, suggesting that more work is needed to explore if our results—and the standards listed by IFT's HERB—are representative of what food science communities in other parts of the United States identify as the most critical skills for food science students and professionals to develop (Flynn et al., 2013). We also acknowledge that the makeup of the food science job types in a region (e.g., research and development, quality assurance, etc.) may also influence the skills that respondents identify as most important.

#### 4.6 | High school educators indicate low student knowledge of food science and a need for additional resources

Our results indicate that high school educators felt like most students were not aware (or only minimally aware) of food science as a discipline, despite nearly half of the surveyed educators indicating that they had incorporated an activity or lesson related to food science in their classes. Many of these educators also requested additional access to videos relating to food science, as well as food science curricular activities aligned with the NGSS. These results indicate an urgent need for the food science education community to continue raising awareness of current resources for K-12 educators and develop additional resources for primary and secondary education. For instance, we note that the IFT currently hosts a page

that compiles both curricular activities and videos for K-12 teachers, listing classroom resources by grade level and videos by topic area and the NGSS domains they cover (K-12 Teaching Resources, n.d.). Similarly, there are multiple peer-reviewed papers that provide templates of successful programs or curricular activities that promote knowledge of and interest in food science in K-12 students or provide professional development training relating to food science for K-12 educators (Craig & Alleman, 2016; Hendrix et al., 2021; Macbeth et al., 2021; Wickware et al., 2017). However, it is possible that many educators are not aware of these resources, suggesting that there may be opportunities for IFT to enhance its outreach to K-12 educators and work with the food science education community to spark further development of videos and curriculum for K-12 students relating to food science.

## 5 | LIMITATIONS

We acknowledge several limitations of our work. First, we recognize that our work is limited in sample size, particularly for the high school educators, and that our sampling may not be representative of all Southern California students interested in food science or industry professionals. We also note that our sampling is not longitudinal in nature and thus only provides a snapshot of how our respondents perceived food science at one timepoint (in 2023). We also did not survey faculty in food science. However, despite these limitations, our work provides a first snapshot of how various stakeholders in food science perceive the discipline in Southern California, leading to new insights into how students and industry professionals view food science and informing future efforts at promoting food science in the region.

### 5.1 | Implications for the food science community

We provide several recommendations for the food science community, particularly educators in Southern California, based on our work. Our results indicate that this region does not lack food science programs or job opportunities, but that many students identify a lack of information as a barrier to pursuing careers in food science. Thus, we urge the food science community to continue developing resources that allow high school, undergraduate, and graduate students to explore careers in the discipline. Many students indicated that they would benefit from additional information regarding careers in food science. Communicating additional information about the demand for jobs in this region, along with sharing information regarding the

recent increases in average salary in food science in the area, may lead to more students choosing to pursue food science as a career. Future work is needed to identify the best modalities to communicate such information. Second, we urge the food science education community to continue investigating the factors that shape students' knowledge of and interest in food science. Our case study was limited to one geographic region and drew upon a limited number of respondents, and efforts that survey students nationally, combined with more in-depth tools like interviews and focus groups, may gain additional insight into the factors that motivate students to pursue food science and help identify any barriers that hinder participation in food science. Finally, we highlight the urgent need to improve outreach to K-12 educators and develop additional resources, particularly curriculum that is aligned with NGSS standards. This need is highlighted by our results that indicated most instructors appeared to be unfamiliar with current food science education resources and the fact that most of our high school educators stated that their students were largely unaware of food science as a discipline, suggesting key opportunities for the food science community to further support K-12 educators and spark interest in food science in students in primary and secondary schools.

#### AUTHOR CONTRIBUTIONS

**Jeremy L. Hsu:** Investigation; writing—original draft; methodology; formal analysis; writing—review and editing; supervision. **Sarah Ahles:** Investigation; writing—review and editing; formal analysis. **Lilian W. Senger:** Conceptualization; funding acquisition; writing—review and editing; supervision. **Anuradha Prakash:** Conceptualization; funding acquisition; writing—review and editing; supervision.

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#### CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

#### ORCID

Jeremy L. Hsu  <https://orcid.org/0000-0001-5600-2345>

Lilian W. Senger  <https://orcid.org/0000-0003-3606-8595>

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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