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Introducing an Undergraduate Degree of Cosmetic Science and Formulation Design within a College of Pharmacy

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Introducing an Undergraduate Degree of Cosmetic Science and Formulation Design within a College of Pharmacy

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Abstract

As a unique and versatile undergraduate degree program, a Bachelor of Science in Pharmaceutical Sciences (BSPS) is offered by a number of colleges/schools of pharmacy. These provide a bachelor's degree concentrated in pharmaceutical sciences, and can be a non-Doctor of Pharmacy option, possibly before progressing to graduate degree studies. Recently implemented at the University of Toledo College of Pharmacy and Pharmaceutical Sciences (UTCPPS), one such BSPS major is Cosmetic Science and Formulation Design. This new undergraduate major was created to serve the needs of the cosmetic and personal care industry, with a great need identified for well-trained new professionals with basic knowledge in the sciences and business. This Cosmetic Science and Formulation Design major was added to four other BSPS majors at UTCPPS. Introduced in 2013, this major is the only functioning undergraduate degree in Cosmetic Science and Formulation Design in the United States. Preliminary job placement data provides promising evidence that this undergraduate major has helped graduates launch a career in the cosmetic and personal care, or pharmaceutical industries. Based on our experience from the past three years, we believe that this cosmetic science major has been worth its resource investment. We hope others designing new undergraduate pharmaceutical sciences programs might integrate advice from this experience into their impending programs.

Keywords: pharmacy education, bachelor of science in pharmaceutical sciences, cosmetic science

INTRODUCTION

Bachelor of Science in Pharmaceutical Sciences (BSPS) degree programs are typically four-year, non-licensure, undergraduate degrees designed for students who wish to pursue careers related to the pharmaceutical industry, biomedical industry, forensic science, pharmacy administration or healthcare administration. It also prepares students to enter graduate (masters or doctor of philosophy) education within pharmaceutical science or pharmacy administration, or to obtain some pre-requisites for entry into a professional degree program, including a Doctor of Pharmacy (Pharm.D.) program. A prior article had discussed the importance of and need for BSPS degree programs for those who wish to pursue a career in the pharmaceutical industry.¹

In September 2015, we undertook an environmental scan of colleges/schools of pharmacy in the United States to describe the number of non-pharmacist-focused BSPS degree programs. Using a list of 138 colleges/schools of pharmacy (fully-accredited and pre-candidate status) distributed by the American Association of Colleges of Pharmacy (AACP),² we reviewed each institutions' website information. We

searched for descriptions of undergraduate pharmaceutical sciences programs. We found that seven institutions (5%) offered one general BSPS degree option, while six institutions (4%) offered a bachelor's degree that majored in a specific pharmaceutical sciences discipline, such as toxicology, pharmaceuticals, or pharmacology. Table 1 provides a list of the institutions identified. Of note, one institution offered three majors, while only our College offered a spectrum of five different majors within its BSPS program.

A COSMETIC SCIENCE AND FORMULATION DESIGN MAJOR

There appears to be a great need in the United States cosmetic and personal care industry for well-trained professionals to enter the workforce with basic knowledge in sciences as well as business. In particular, there is a need for graduates who have science-based training (often referred to as 'technical training'), as well as those who understand the regulatory environment, can apply it with formulating ingredients into products, and have an understanding of how businesses operate. To serve this need from the cosmetic and personal care industry, UTCPPS created a novel undergraduate major, in addition to our four existing BSPS majors. While most BSPS majors at the University of Toledo College of Pharmacy and Pharmaceutical Sciences (UTCPS) have 20 years of history, here we describe this as a more recent example of the considerations in implementing a BSPS major. This new Cosmetic Science and Formulation Design major was introduced in 2013 and is, at the time of writing, the only

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functioning undergraduate Cosmetic Science degree major in the United States (US).

Need in the Industry

An overview of this industry. A sense of how common this industry's consumer influence is can be described with its products. The variety of consumer health and beauty products from the cosmetic and personal care products industry include perfume, sunscreen, toothpaste, and hair, as well as skin care products, makeup, and antiperspirants. These products are staples among US consumers of all ages. Based on revenue generated in 2015,³ the US cosmetic and personal care industry was worth \$61 billion-dollars. Of note, this industry contributes a substantial number of jobs to total employment in the US; in 2013, 3.6 million jobs in the US were supported by this industry (i.e., 2 percent of total US employment).⁴

Moreover, the number of jobs in the cosmetic and personal care industry continues to grow. Consumer products within this industry are considered durable to economic pressures. In recent history, this industry continued to sell products even in uncertain economic times. The great recession that started in 2007 caused a large economy-wide reduction in US employment, affecting the US pharmaceutical and automotive industries among many others. In contrast to the experience of the overall US economy, employment in the cosmetic and personal care industry increased during this recession.⁴ Products made by this industry have become integral parts of our lives and we have come to need them no matter how much or little money we are making. This certainly has developed a robust need for cosmetic chemists.

Shortage of workers. Statistics also show that North American chemical companies face workforce turnover issues.⁵ Similar to other industries in the US economy, chemical companies, including the cosmetic and personal care industry, face a shortage of experienced workers and will need to replace a significant number of retiring baby boomers in the coming years. Intensifying these workforce challenges is the so-called "missing middle" of workers ages 35 to 54.⁵ To replace retiring workers, new recruits would best have specialized knowledge and skills. While on-the-job training can be an option for companies, many prefer hiring specially trained graduates; for the types of jobs they offer, this can save time and money for these employers (email communication, JM Chandler, President, ACT Solutions Corp, March 2014). In short, there is a substantial need for new professionals who are well trained and can start working in the industry quickly after graduation.

Industry-focused training. The majority of chemists in the cosmetic and personal care industry have a bachelor's degree in chemistry, biology, or chemical engineering.⁶ Additionally,

when we reviewed job descriptions for new openings in the cosmetic and personal care industry on job search engines, such as LinkedIn.com, Monster.com or Indeed.com, the majority of entry-level job postings only required a bachelor's degree in a scientific field, such as chemistry, biology or chemical engineering and 0-3 years of experience, depending on the type of job. However, these existing degree majors do not provide graduates with formulation training and skills, such as how to formulate products like a shampoo from its individual ingredients. Therefore, these recruits would need either: (a) on-the-job training, which places a cost on the employer and a burden on senior staff and co-workers, or (b) an advanced degree that focuses on cosmetic chemistry and formulation skills (email communication, JM Chandler, President, ACT Solutions Corp, March 2014). As a bachelor's degree is sufficient to fulfill entry-level positions, companies are looking for employees with this type of degree, and not graduate-level training.

In summary, we discovered there was a gap in supply and demand (as shown in Figure 1) as more students with an undergraduate degree could have started working in the industry if there were a major specifically designed for them that could prepare them for multiple facets of this specific industry.

Cosmetic Science Majors in the United States

The idea to create an undergraduate major in cosmetic science at UTCPPS was sparked by a first-year undergraduate student interested in studying cosmetic science. This was communicated to Kenneth S. Alexander (KSA), then Professor and Director of the BSPS in Pharmaceutics major; he began exploring programs in cosmetic science offered in the United States.

Four cosmetic science programs existed across the United States in KSA's review. All four currently provide only graduate-level training, with only two housed in colleges/schools of pharmacy (personal communication, KS Alexander, May 2016). The first was a Master of Science in Cosmetic Science at Fairleigh Dickinson University from their School of Natural Sciences.⁷ The second program was a Master of Science in Pharmaceutical Science with emphasis on cosmetic science at the University of Cincinnati from their College of Pharmacy.⁸ The third program, which previously had an undergraduate major in cosmetic science, now only offers a Master in Pharmaceutics with a specialization in Cosmetic Science at Long Island University from their College of Pharmacy and Health Sciences.⁹ Fourth, there was a Master of Business and Science (MBS) Personal Care Science concentration offered at Rutgers University Graduate School-New Brunswick.¹⁰ In addition to these institutions, a few other

US-based programs may offer elective coursework in cosmetic science, but KSA found no other cosmetic science-specific degree programs (personal communication, KS Alexander, May 2016). In addition, the authors could not locate any doctoral-level programs that were specialized in cosmetic science.

Description of our BSPS Major

Curriculum. The Cosmetic Science and Formulation Design curriculum at UTCPPS was designed to prepare students for the industry's current needs. Input came from faculty at the College, and the cosmetic science professional community, including the Society of Cosmetic Chemists (SCC). KSA and GB (co-author) went to regional SCC chapter meetings and proposed a curriculum to attending members; this aided in identifying industry needs with practical relevance. With the SCC's comments and recommendations, KSA and GB finalized a curriculum. Topics offered in courses at other schools were considered when identifying content to be taught, as well as inviting speakers. KSA's added training as an education specialist proved immensely helpful as these faculty developed an educationally relevant curriculum.

At UTCPPS, coursework in the first two years is the same for all BSPS and pre-Doctor of Pharmacy (PharmD) students. As a result, a listing of the courses in students' final two years of bachelor degree study for the Cosmetic Science and Formulation Design major (Table 2) is provided. In this undergraduate major, students are required to take a variety of science courses, including chemistry, pharmacology, pharmaceuticals, microbiology, analytical methods, and cosmetic science, towards broadening students' scientific knowledge. Importantly, required business and economics courses provide a unique feature to this undergraduate major; these were specifically requested by our professional cosmetic industry partners/stakeholders within SCC. Additionally, students who intend to pursue a career in marketing and/or sales have an option to minor in business administration, international business and/or professional sales.

Faculty and invited speakers. Our BSPS major is noteworthy in that it includes one full-time faculty, a few volunteer adjunct faculty members with prior cosmetic industry experience, and about 10-15 invited speakers for all coursework offered over a two-year period, of which many are currently senior administrators within the cosmetic and personal care industry. Speakers are invited based on their practical expertise and how well that fits different lectures' content. For example, when students learn about silicones as important ingredients in numerous types of cosmetics and personal care products, we invite a speaker from a silicone supplier who talks about various aspects of silicones. In preparation for these guest

lectures, GB & KSA have been networking and have identified potential guest speakers throughout the years at professional meetings, conferences, and webinars, on social media and via publications in peer-reviewed journals (e.g. Journal of Cosmetic Science, Cosmetics and Toiletries Magazine). From these instructors' cumulative expertise and contributions, this BSPS major is industry-focused and should remain current.

Formulation training. Another notable and unique feature of this major is that students have two years of formulation training during their four years of undergraduate studies. That is, there are four semesters spent by students in a pharmaceuticals/cosmetics science laboratory creating various pharmaceutical and cosmetic product formulations. Key factors that have made us confident to place a strong emphasis on formulation training were reviewing job listings and speaking with recruiters. When reviewing job descriptions/duties for entry-level openings, we found that formulation skills and experience were quite often listed as a main requirement. Even for regulatory affairs positions, knowledge of ingredients and formulations was essential. Recruiters confirmed these findings.

Our laboratories were designed to teach students about many of the emerging technologies used by cosmetic chemists and to teach them how to operate instruments used in product quality testing and claim substantiation. For example, when students formulate a moisturizing product in the laboratory, they learn how to use and operate a Novameter[®], Tewameter[®] and Corneometer[®]. These widely used instruments can provide evidence to substantiate moisturizing claims.

Internship. After finding that formulation skills and experience were important requirements for entry-level positions, we included a 400-hour internship into the Cosmetic Science and Formulation Design curriculum, similar to our other BSPS majors. Students are required to complete their internship following their junior year. Previous students have completed their internships at various cosmetic science companies, including raw ingredient suppliers and/or distributors, finished goods manufacturers, and contract manufacturers. These companies have provided students with real-world experiences, while interns worked on projects that were of interest for those companies. Upon completing an internship, students are required to summarize their experience in a written report. This report, in addition to feedback from internship sites, contributes to each student's grade for their internship experience.

Additionally, these internships have been excellent opportunities for students to prove themselves at these companies, and for the employers to evaluate these students

as potential employees. Similar to many co-op programs, some of our students have been hired by their internship company following graduation. Most recently, two of our fourth-year students received job offers from their internship sites eight months before graduation. This is a rare situation in the cosmetic and personal care industry, as companies usually only offer positions to graduates.

Positions of Graduates

As the wide variety of courses taught during the four years provided students with basic skills and knowledge in multiple scientific areas, they had a wide variety of jobs available to choose from after graduation. While this undergraduate major only began in 2013, the first three cohorts of graduates were tracked in; they had the necessary general BSPS coursework, and so only specific cosmetic and formulation coursework remained to be completed.

Three cohorts have now graduated for a total of 13 students. We have experienced significant growth over the years. There were only three students in the first graduating class. However, in four years this number had tripled, and now we have nine students currently in their fourth-year in this major. As this major grows, we are also recruiting more broadly to students statewide, which we hope will increase the number of students applying to UTCPPS because of this specific major. Most of our students still decide on their major between their second- and third-years in the college. It should be emphasized that the structure of this college of pharmacy, by having 2 general years before students specialize in a pharmaceutical sciences major, allows students to take their time and explore the majors we offer and make their decision by the end of their third semester in the college. There are always students that choose UTCPPS due to its PharmD program, but as they learn about the BSPS majors offered in the College, some undergraduate students decide to switch and apply to one of these majors instead. We consider this a positive situation as we are retaining more students in our College, and attracting some students that are not interested in pursuing a clinical PharmD.

As noted in Table 3, the majority of students that earned a bachelor's degree in this major now work either in the cosmetic and personal care industry or pharmaceutical industry. Graduates fulfilled a variety of positions ranging from product formulators (i.e., cosmetic chemists) to marketing manager to quality operations professional. Employers have included both smaller and larger companies (also in Table 3). These company business profiles represent various aspects of this industry, ranging from finished goods manufacturers to contract manufacturers to raw material suppliers; many of these companies are also among industry leaders.

Lessons Learned and Future Plans

Although this undergraduate major only began in 2013, we have already gained valuable experience and learned important lessons.

Tracking our graduates' first career positions. For us, a highly-valued outcome of education is that we see our graduates' career placement successes. Additionally, tracking students' internship placement and post-graduation employment has helped us to better understand current needs within this industry. These outcomes have fostered our continued engagement with this industry. By facilitating industry-focused education for our students, including industry-expert guest speakers throughout this major and networking at cosmetic science professional meetings, the education-to-employment cycle is complete. Successful job placement confirms need for this newly created undergraduate major.

Importance of internships. According to survey responses from our students, their internship experiences have substantially enhanced their knowledge and skillset, and also provided them with insight into an actual company. This internship component could be seen as similar to the substantial PharmD experiential component. We hope to continue expanding the types and quality of internship sites for our students. As more and more companies learn about this BSPS major and experience our students, we have seen an increasing number of inquiries for future interns from companies in a number of states.

In a prior AACP report, internships had been recommended in pharmaceutical sciences degree programs.¹¹ Of note, our BSPS program (all majors) has an internship requirement of 400-hours, usually completed over a summer term; this experiential component appears highly valued by students and employers. Internships have a conversion rate (i.e., where interns are employed by their internship employer) of greater than 50%.¹² Paid internships are more noticeably higher than unpaid sites.¹³ (We use both, with mostly paid sites beyond the University, while unpaid positions exist at the University and a few non-University sites.) Our approach at engaging with pharmaceutical as well as cosmetic and personal care industry stakeholders has been very helpful in this effort.

Importance of professional associations and networking. Our College supports and encourages student participation at associated industry events and conferences, such as SCC meetings. These are valuable networking opportunities for students where they can meet with industry representatives. This exposure has also enabled students to present their research and/or internship projects to participants at regional and national conferences. These conference and travel expenses, as well as faculty's time commitment to prepare

students for these experiences, should be factored into planning a BSPS program.

Advisory Board input is critical. At the annual meeting of our BSPS Pharmaceutical Sciences Advisory Board, we are informed of current changes within industries by employers representing diverse areas of all majors in a BSPS program; these employers give advice for directions to move forward in helping us better prepare students for their industrial work environments. To maintain an industry-focused curriculum that continues to be current, we regularly refine our majors. We remove less helpful coursework and insert additional content (and guest speakers) as germane topics are uncovered.

Dealing with students' uncertainty in choosing this 'new' major. A challenge we experienced (and we understand that many other new programs will face) is a hesitation from students to select this major. When this new major was initiated, there were no data on internship placement and job placement, which only adds more uncertainty to knowing future career prospects. Being the only US school to offer this major made it even more challenging. Now with three classes graduated, we have very promising data to share with students.

Allocating resources when budgets are tight. Any new program requires resources. Our College has dedicated a faculty member to this cosmetic science major, and we had to set up a teaching wet lab with all the ingredients, packaging supplies, other consumables and instruments needed for product formulation and testing. These resource needs have not been inconsequential.

We endeavor to keep working with other departments and colleges within our institution, to keep this major's curriculum current and varied. One of our future plans is to offer a wider selection of elective courses, including more courses from other colleges, so students could have the ability to better tailor their coursework to the direction of another specific area in which they are interested. For example, students interested in makeup products might take an art class and learn about color theory in more detail. To earn elective hours, students might also join a faculty's research group and learn more about special ingredients, techniques and instruments, which they might not otherwise see or experience.

It is noteworthy that graduates from this major, as opposed to our other BSPS majors and a prior literature report,¹ appear focused on a career in this area. No current students or graduates have applied to this PharmD major. Lack of PharmD applications from these students may suggest that this major

may not appear to be a "backup plan" in case students were not successful with admission to our PharmD program. We mention this because prior literature can be interpreted to suggest that colleges/schools of pharmacy, that offer both BSPS and PharmD programs, might use a BSPS program as an alternate plan or holding pen for students interested in becoming a pharmacist but not yet successful in admission to a PharmD program.¹ This has not happened in our BSPS Cosmetic Science and Formulation Design major as yet, which seems to confirm our student's intrinsic motivation. This indicates that they did not choose this major as a consolation after not being admitted into our PharmD program. As well, students that have entered this major have been determined; they have finished the major promptly and have found jobs quickly after graduation.

MOVING FORWARD

Our experience with developing and implementing a BSPS cosmetic science major illustrates a notable approach that integrates industry employers and representatives to dovetail into an undergraduate degree major, producing graduates that are prepared for industry careers. Based on this experience, we believe it is worth exploring a specific industry's needs and determine whether the school/college provides graduates that are a good match for those needs. Tailoring, modifying the curriculum, teaching new skills, and including industrial experts may be needed to move a major towards a better suited program. As well, colleges/schools could assess their own faculty's areas of expertise to potentially align new BSPS majors within their existing framework. Courses in our BSPS majors are often taught by research-intensive faculty members, who actively work within various fields such as drug discovery, pharmacology, healthcare outcomes, drug design and product development. Offering BSPS majors has created an environment for research-oriented science faculty to engage, teach, and thrive within their expertise. Successful research projects have resulted in presentations and publications; adding to the professional contributions and reputation of this College. In addition to peer-reviewed publications and conference presentations, research has resulted in patents, grants, and industry-sponsored projects. All of these can generate additional revenue for a college/school of pharmacy.

One idea for how the academy could facilitate success of new BSPS majors can be collaborations between programs/fields. For instance, we regularly have students who double major in Cosmetic Science and Formulation Design as well as Pharmaceutics. These areas are closely related and are very similar in terms of knowledge and skillset requirements. Additionally, might multiple colleges/schools of pharmacy

collaborate to provide similar BSPS majors (i.e., might they combine resources and energy for this purpose)?

CONCLUSION

BSPS programs develop graduates with an undergraduate degree focused specifically on the pharmaceutical sciences. In 2013, UTCPPS created a novel BSPS major, Cosmetic Science and Formulation Design, as an additional option among four other BSPS majors. A need was recognized to supply more well-trained new professionals with bachelor's degrees with practical, focused training for the pharmaceutical as well as cosmetic and personal care industry. The majority of our graduates from this major have been employed in the cosmetic and personal care industry, as well as others in the pharmaceutical industry. They have accepted various positions, from cosmetic chemists and formulators to quality control personnel to technical marketing personnel. Our experiences have helped us establish more relationships with the industry and further strengthen this major. Of note, working in partnership with industry stakeholders has served us well with implementing and continuing to offer relevant content; this also with our other BSPS majors. Within all of our BSPS majors, experiential coursework through internships has proven very helpful to students, graduates, and employers. Cosmetic science appears to be a promising, related field for expansion by colleges/schools of pharmacy. In addition, educators are encouraged to examine industry needs and the potential to align focused areas of training with faculty expertise.

Author contributions: GB & MJP conceived of this manuscript. After interviewing KSA, GB wrote the initial draft. Meanwhile, MJB searched colleges/schools of pharmacy for undergraduate pharmaceutical sciences programs. MJP and MJB critically revised drafts of this manuscript. All authors accept responsibility for this manuscript content.

Disclosures: None.

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Figure 1. Summary of Gaps in Supply and Demand of Cosmetic Chemists in the United States

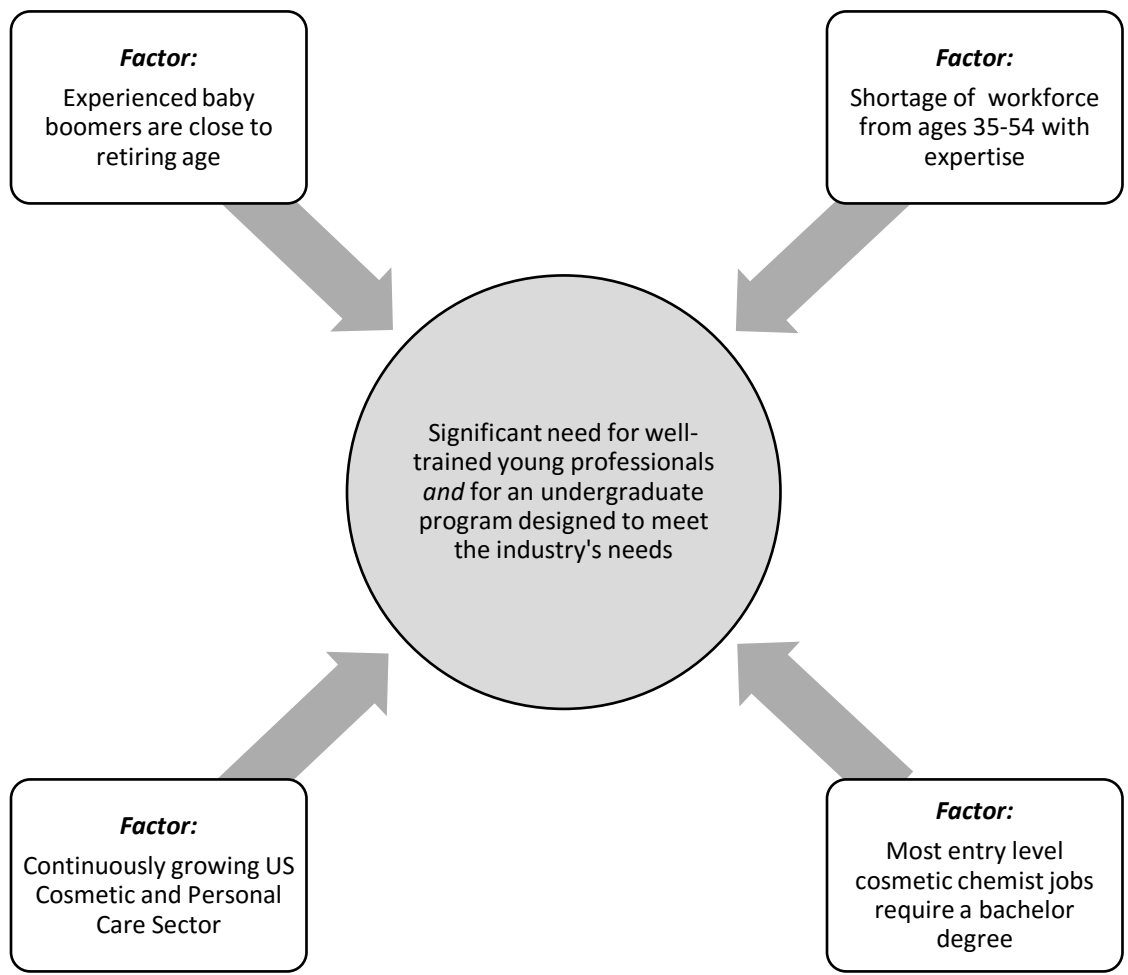


Table 1. Colleges/Schools of Pharmacy in the United States with a Bachelor of Science in Pharmaceutical Science Degree Program

Institution	General BPS	BSPS specific to one science discipline ^a
Albany College		2
Campbell University	1	
Massachusetts College of Pharmacy and Health Sciences (MCPHS)	1	2
Ohio State University		1
Purdue University	1	
St. John's University		1
SUNY- University at Buffalo	1	
University of Georgia	1	
University of Louisiana- Monroe		1
University of Michigan	1	
University of Rhode Island	1	
University of Toledo		5
University of Wisconsin-Madison		1

BSPS= Bachelor of Science in Pharmaceutical Science

a= including pharmacology, toxicology, pharmaceuticals, medicinal chemistry, pharmacy administration, cosmetic science

Table 2. Summary of the BSPS Cosmetic Science and Formulation Design Professional Curriculum at UTCPPS

THIRD YEAR	
Fall Semester (16 credit hours)	Spring Semester (13 credit hours)
Pharmaceutical Calculations2	Pharmaceutical Technology II..... 4
Pharmaceutical Technology I4	Cosmetic Raw Materials 2
Pharmacology I3	Physiological Chemistry II..... 3
Physiological Chemistry I3	Microbiology & Immunology..... 3
Techniques in Pharm. & Med. Chem.2	Microbiology & Immunology Lab 1
Techniques in Pharm. & Med. Chem. Lab.....1	
Intro to Cosmetic Science11	
Summer Semester (6 credit hours)	
Cosmetic Science and Formulation Design Internship ..6	
FOURTH YEAR	
Fall Semester (12 credit hours)	Spring Semester (14 credit hours)
Toxicokinetics 3	Cosmetic Science II 2
Cosmetic Science I..... 2	Cosmetic Science Laboratory II..... 1
Cosmetic Science Laboratory I 1	Principles of Marketing 3
Microeconomics..... 3	Cosmetic Science Electives..... 5
Introduction to Business..... 3	Macroeconomics 3

Table 3. Positions Filled by Graduates and Employers for Each Position (n=13)

Positions filled by our graduates	Number of graduates in each position	Employers for these positions
Cosmetic chemist/Formulator	8	ACT Solutions Corp., DE
		Sigan America, IL
		Amway, MI
		Reforma Group, MI
		Accupack Midwest, OH
		Limited Brands, OH
		Aring’s Compound Corner Pharmacy, OH
		Product Quest Manufacturing, FL
Quality operations professional	1	Pfizer, MI
Marketing manager	1	Active Concepts, LLC., NC
Graduate student (for Ph.D.)	1	Pharmaceutical Sciences program, Washington State University, WA
Currently seeking employment	1	-
Other	1	Private investor, MI