Securing the Future of Nutritional Sciences Through Integrative Graduate Education

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ABSTRACT The new millennium has ushered in unprecedented opportunities for research and discovery in the nutritional sciences. These have arisen from major advancements in the social and biological sciences, notably genetics, genomic technologies, computational statistics, and behavioral sciences. The most exciting academic challenges and employment opportunities for nutritional sciences graduates interface with other disciplines, and doctoral training programs in the nutritional sciences must respond to the wealth of these emerging opportunities. The American Society for Nutritional Sciences (ASNS) Graduate Nutrition Education Committee suggests that three major challenges face the nutritional sciences: (a) to train doctoral students to be full and active participants in interdisciplinary research and discovery, and (b) to achieve this goal while maintaining nutrition’s unique academic identity and (c) fostering a cohesive academic community. The committee proposes that these objectives are best engaged at the level of graduate education and that the future of ASNS will be secured by strengthening graduate nutrition programs. This manuscript reviews educational strategies that address these challenges and advocates that ASNS actively engage graduate doctoral programs in nutritional sciences.

KEY WORDS: • American Society for Nutritional Sciences • nutrition • graduate education • integrative science • interdisciplinary education

In April 2001, the Long-Range-Planning Committee of the American Society for Nutritional Sciences (ASNS) published an article in the Journal of Nutrition entitled, “Nutrition: A Reservoir of Integrative Science.” This paper outlined some challenges facing nutrition as a discipline, and ASNS as a society, as nutrition defines its image and positions itself to participate fully in the post-human genome-sequencing era (1). The article also discussed the role that nutrition graduate training programs might play in shaping the future discipline. Under the leadership of Dr. Lindsay Allen, past president of ASNS (2000–2001), the ASNS Graduate Nutrition Education Committee (GNEC) began to address emerging challenges faced by nutritional sciences graduate training programs as they prepare doctoral students for highly competitive interdisciplinary research and employment opportunities. During the past 18 months, the GNEC hosted two small workshops with faculty members from academic nutrition programs and professional educators to help in this process.

Integrative science: Issues and opportunities for graduate nutrition training

Most biological and biomedical disciplines have restructured or redefined their graduate programs in light of the increasing opportunities that are afforded by integrative and interdisciplinary research (2), particularly programs that interface biological, mathematical, and computational disciplines (3–5). Nutritional sciences training programs have not usually participated in these activities (6,7) and this trend should be reversed. Theoretical and methodological advances in genetics and social and behavioral sciences are providing the knowledge and tools necessary for understanding the synergistic relationships among nutrient intake, metabolism, and human behavior, as well as for developing and evaluating intervention programs. Effective mining of these resources will require the integration of knowledge and research methodologies from many disciplines, including those with a limited historical relationship to nutrition.

Nutritional sciences training programs must prepare graduates to be full participants in the new frontiers of nutrition research and discovery. Many exciting academic challenges and employment opportunities occur at the interface with other disciplines. In the near future, for example, Dietary Reference Intakes (DRI) will be tailored to individual genotype for optimal health, disease prevention, and management. Intervention research, drawing on theories and methods from nutritional anthropology, communication science, and health psychology, is being used to translate biological science to improved health and nutrition. These realities place new educational demands that may not be met by traditional nutritional sciences programs.

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Challenges facing graduate nutritional sciences education

The GNEC proposes that three major challenges face nutritional sciences graduate training programs: (a) to prepare doctoral students to be full and active participants in interdisciplinary research and discovery, and (b) to achieve this objective while maintaining nutrition’s unique academic identity and (c) fostering a cohesive academic community.

Academic diversity is both the greatest strength and the greatest weakness of integrative science programs, including nutritional sciences. Individual nutritional sciences training programs tend to be unique: they reside in medical colleges, schools of public health, and land grant and private universities. They may be jointly administered or affiliated with programs or departments of toxicology, biochemistry, animal sciences, food sciences, medicine, and social and behavioral sciences. Academic faculty in these programs can be expert in many disciplines, including economics, biochemistry, genetics, physiology, immunology, epidemiology, sociology, anthropology, psychology, and health communications. This diversity of faculty and training programs stimulates a dynamic intellectual environment that facilitates innovation and multidisciplinary research and also “individualizes” scientific expertise. Although this diversity in training is essential to address many complex questions, it can have an adverse impact on cohesiveness among academic faculty and impair communication within and among academic programs. Because academic diversity in the nutritional sciences is likely to increase, issues related to academic cohesiveness must be addressed now, or nutrition as a discipline will not effectively capitalize on benefits afforded by integrative science.

Why should ASNS be involved in graduate education?

Strong and vibrant academic societies actively define and support their core knowledge base. Societies provide clarity, uniqueness, and definition to their discipline; engender a spirit of commonality, purpose, and mission among their membership; promote research and discovery; and ensure continuity within the discipline for subsequent generations. This engagement requires coordination with relevant academic units. Historically, however, ASNS has not had robust interactions with academic nutritional science programs.

The GNEC believes that ASNS could play an effective role in maintaining core nutrition knowledge and facilitating the expansion and creation of new knowledge without rigidly defining curriculum or adopting policies that frustrate innovation. ASNS could give much needed definition to the core of nutrition knowledge, serve as a clearinghouse for efficient assimilation and dissemination of educational tools, act as a liaison between academic institutions and industry and/or government (e.g., via sponsoring internships), and encourage innovative teaching solutions.

Identifying a common nutrition knowledge base with overlapping and interfacing disciplines

In the age of disciplinary integration, identifying core knowledge is essential. Translational approaches to education (i.e., “from bench to bedside” or “cell to society”) are encouraged among all biological and social sciences, resulting in the blurring of traditional disciplinary boundaries. Departmental mergers and multidisciplinary umbrella graduate training programs are the norm. Such integration is encouraged and driven by funding agencies. Graduate training programs in nutrition must respond to these new educational demands but in doing so must preserve nutrition’s unique identity. By maintaining a core body of knowledge and expertise, nutritional scientists bring unique strengths to interactions with interface disciplines that are essential for solving the most pressing current public health problems.

Core nutrition knowledge is best maintained and disseminated within nutritional sciences training programs (Fig. 1). Nutrition, although often described as an integrative science, clearly has a unique identity and a distinct core knowledge (Table 1). This minimal core maintains nutrition’s academic uniqueness, provides a degree of commonality and cohesion among all nutritional scientists, and secures the future of the discipline. However, the foundation of nutrition knowledge significantly overlaps with knowledge bases of other biological, physical, and social sciences (Figure 1). Finally, nutrition knowledge interfaces with additional disciplines (Figure 1) which represents the new frontiers of nutrition research and discovery. Graduate education in nutrition must be comprehensive in core nutrition knowledge, have selective depth in overlapping disciplinary knowledge, and provide opportunities for exposure to appropriate interface disciplines.

Graduate students in nutrition must also gain an appreciation for the integration and application of nutrition from the cellular and molecular level to the community. This concept is illustrated in Figure 2, which depicts the field of nutrition as three overlapping peaks of knowledge or research foci at the molecular/cellular, organism/metabolism, and population/community levels. All nutrition graduate students should possess an awareness of the breadth of nutrition, which includes being able to identify key knowledge, issues, societies, and proficient individuals. Furthermore, all graduate students should develop competency in integrative nutritional biochemistry (metabolism), primarily at the organism level, but with understanding of underlying molecular mechanisms and community- and population-based nutrition interventions. Last, graduate students should develop proficiency—an understanding of specific theories, experimental techniques, and ancillary (interfacing) disciplines—in one or more areas of specialization.
Teaching nutrition in the context of interdisciplinary science

Graduate students trained in nutrition establish careers in diverse areas, including academic teaching and research, basic research in governmental settings, public policy and intervention, health care or product development, and marketing in the food industry. Thus, identifying a common doctoral nutritional sciences curriculum that prepares students for the many potential career options, while capitalizing on advances in the field, has become increasingly difficult. The GNEC identified some current approaches of nutrition programs, with the goal to consider approaches that could be applied at most institu-
Developing a minimal foundation in nutrition for incoming graduate students. Most graduate nutrition programs require all entering doctoral students to have a sufficient foundation in knowledge of nutritional sciences—a critical baseline of knowledge—especially among students lacking undergraduate degrees in nutrition or dietetics. This foundation, if needed, can be achieved by requiring attendance at an undergraduate introductory nutrition course before advanced graduate courses. Alternatively, it can be achieved through “mezzanine” courses that focus in specific areas of nutrition including clinical nutrition, experimental nutrition, nutritional biochemistry, and nutrition through the life cycle. Self-directed independent, intensive studies are also effective. The GNEC recommends these approaches and encourages training programs to require incoming students to master core nutrition knowledge before initiating graduate studies. Training programs could also institute a 1- to 2-week intensive “boot camp” before classes begin, in which instructors test students’ knowledge and assist with integration and application of information. ASNS could aid these efforts by developing and offering a standardized examination to test baseline nutrition knowledge. The examination could be coupled with this boot camp or incorporated as part of the written and/or oral qualifying examination administered during the graduate program.

Teaching core nutrition knowledge. Historically, core nutrition knowledge was taught through required specialized courses without attempts to integrate this knowledge within the discipline. Although this approach was effective in disseminating information from faculty to students—and is still valuable—it fails to foster integration across courses and among disciplines. This approach also requires an extensive and highly structured required curriculum that leaves little flexibility. The GNEC identified noteworthy approaches currently used to teach core nutrition knowledge in the context of integration, as detailed here.

Comprehensive nutrition courses. These “molecule to human” or “cell to community” courses teach most elements of core nutrition knowledge, biological and social, in the context of a single nutrient, such as vitamin A. The several faculty members within a program have expertise ranging from molecular biology to epidemiology, thus illustrating the breadth of nutrition as a discipline. Introducing a nutrient in this manner helps establish a paradigm that students can apply to other nutrients and nutritional problems. Alternatively, expert guest lecturers in traditional nutritional sciences courses can integrate a nutrition topic from the molecular to the community level, via either in-person lecturing or distance education technology. Seminar series or courses that include literature reviews and discussions of nutrients or nutritional problems from perspectives of nutritional biochemistry, nutritional epidemiology, and interventions and policy also achieve this objective.

Integrative core macro- and micronutrient courses. Existing courses are adapted to include integrative approaches a number of ways, several of which are discussed below.

Incorporate the Institute of Medicine books on DRI (8–12) and the 2001 DRI text on minerals into existing courses. These books both provide up-to-date public health recommendations and demonstrate how biochemical, molecular, clinical, and epidemiological approaches are combined to establish nutrient requirements and set safe intakes.

Incorporate active learning techniques into existing courses. Case study and problem-based approaches readily lend themselves to integrative and interdisciplinary topics and require greater student involvement, which is a major advantage.

Utilize grant writing or professional development courses. Courses cover grant writing and professional development including ethics, research design, peer review, and consulting. These courses often serve as a “capstone” integrative experience and typically involve faculty with a wide range of expertise.

Develop theme topics that carry through the core curriculum. Core nutrition courses can be integrated by development of theme questions or topics. The theme could relate to a policy issue or a clinical condition such as dietary modulation of cancer risk. Creating these segues between courses requires faculty to function as teams, a process that enables appreciation of linkages and integration of the information, and presents nutrition knowledge as a continuum.

Approaches to teaching overlapping and interface disciplines

Mastering core nutrition is not sufficient for interdisciplinary training. Students should also establish expertise in overlapping and interfacing disciplines by taking courses in these disciplines and formally interacting with graduate students from other training programs. Some nutritional sciences programs require students to minor in one or more overlapping or interface disciplines; others have formal requirements for courses outside the primary department.

Modular courses, with non-nutrition faculty, provide another mechanism whereby interdisciplinary experiences can be achieved. Students select from various modules focused on different topics. Modular courses also facilitate enrollment of graduate students from related departments into nutrition courses.

Tools and technologies

Nutrition graduates can be full participants in new frontiers of nutrition research and discovery only if they are familiar with state-of-the-art methodologies including genomic, pro-
Articulating the value of a PhD in nutrition

Academic disciplines are justified, sustained, and renewed by the knowledge base they represent and support. Nutrition as a discipline is distinguished by both its unique knowledge base and its mission to apply this knowledge to human health and disease. Furthermore, nutrition as a set of research problems and solutions is positioned to benefit from interdisciplinary approaches. Historically, this discipline can boast of many important basic science discoveries that have led to unparalleled achievements in public health, as well as having had a positive impact on global economies and improved the quality of life for millions of individuals. However, a graduate degree in nutrition is not a prerequisite for a successful career in nutrition, many fundamental discoveries in nutrition do not originate from nutritional sciences laboratories, and many scientists who make substantive contributions to nutrition knowledge or prevention programs do not consider themselves nutritional scientists. Why then should graduate students who are interested in health- or nutrition-related sciences choose nutritional science programs? A doctoral degree in nutrition can only be as valuable as our training programs are effective in enabling our graduates to compete for interdisciplinary career opportunities. The GNEC anticipates that, through the implementation of this initiative, a coherent articulation of the inherent value of a doctoral degree in nutrition will emerge.

Recommendations for involvement of ASNS in graduate nutrition education

To achieve the goals outlined, the GNEC recommends that ASNS become actively involved in graduate education by:

- Identifying core nutrition knowledge and gaps in training, as outlined herein.
- Identifying and sharing innovative approaches to teaching nutrition. The GNEC could highlight effective innovative teaching methods through workshops at the annual Experimental Biology meetings or through publications in the Journal of Nutrition or ASNS Nutrition Notes.
- Serving as an educational resource.
- ASNS could maintain a collection of case studies and recorded expert guest lectures on nutrition topics that are available to ASNS members. Distance education technology could facilitate these efforts.
- ASNS could assist graduate programs by providing standardized tests to assess individual competency in nutrition, as done by the American Chemical Society.
- Sponsoring research internships. ASNS could facilitate internship programs that allow interested students to include industry experience as part of graduate education.
- Sponsoring teaching and research workshops and short courses at Experimental Biology meetings.

Conclusions and future of the initiative

The GNEC recommends that training programs in nutrition capitalize on the unique strengths that distinguish nutrition as a discipline and offer this training in the context of an interdisciplinary approach. This recommendation is not meant to "homogenize" these doctoral training programs but rather to help unify the field and stimulate new approaches to graduate nutrition teaching. The further refinement and success of this initiative depend on the full support and participation of the ASNS membership, and the future direction and implementation of this initiative will be guided by a continuing dialog among the GNEC and all nutrition training programs. The GNEC encourages all nutrition programs to formally review this report, discuss its potential impact on training, and provide detailed comments and recommendations to the GNEC. The GNEC encourages nutritional sciences faculty to participate in future workshops.

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