



# Nursing is STEM

C O A L I T I O N

Student and Exchange Visitor Program (SEVP)  
U.S. Immigration and Customs Enforcement  
500 12th Street SW, Stop 5600,  
Washington, DC 20536–5600

Attention: STEM CIP Code Nomination

On behalf of the members of the Nursing is STEM Coalition, a diverse network of prominent universities, esteemed nursing leaders, professional organizations, and dedicated nursing educators, we are advocating for the inclusion of nursing (CIP Codes 51.38XX) as a STEM designated field on the Department of Homeland Security (DHS) STEM Designated Program List. The following petition outlines how nursing integrates science, technology, engineering, and mathematics and how it aligns with the Department of Homeland Security definition of a STEM field, one that “engages students in research, innovation or development of new technologies using engineering, mathematics, computer science or natural sciences (including physical, biological, and agricultural sciences.”

Over the past century the profession of nursing drastically changed. The way in which nurses provide care has evolved from hospital-based care and expanded into all facets of society. What was once thought of as a technical job evolved into a rich profession with its own body of research, innovations, and evidence-based practices. As our world becomes increasingly complex with the emergence of new technologies in healthcare, nurses play an integral role in the design and implementation of these technologies to promote health and wellbeing. Twenty-first century nurses address health issues with innovation and research, work in virtual spaces, and continually reinvent themselves to problem-solve across dynamic health environments.

The American Association of Colleges of Nursing reported that for the first time in 20 years, enrollment in entry-level baccalaureate nursing programs declined. In addition, nursing schools continue to reject qualified applicants due to the shortage of faculty, facilities to support training, and budget cuts. The U.S. Bureau of Labor Statistics projects approximately 200,000 openings for nurses each year through 2031. By uniformly designating nursing as a STEM profession, the body of STEM research will be enriched by the unique knowledge of the nursing profession, unlock funding for professional nursing to address challenges in nursing education, diminish the perception that women are not pursuing rigorous math and science fields, and allow international students educated in the U.S. to both apply their nursing education and help alleviate the nursing shortage crisis. A recent study demonstrated that foreign-born nurses and other health professionals are making significant contributions to closing gaps in care. Foreign-born healthcare professionals (majority who are nurses and advanced practice nurses) worked

more hours per year, were more likely to work less desirable shifts, reside in medically underserved areas/populations, work in skilled nursing/home health settings, and speak languages other than English when compared to U.S.-born healthcare professionals.

### ***Nursing integration of Science, Technology, Engineering, and Mathematics:***

The American Association of Colleges of Nurses (AACN) recently adopted an updated *Essentials* series that provides “the educational framework for the preparation of nurses at four-year colleges and universities” (AACN, 2021). These updated *Essentials* articulate core educational competencies and required learning outcomes for our modern day, professional nursing workforce. Threaded throughout the nursing *Essentials* is a strong foundation of STEM topics. Several nursing prerequisite courses (see Appendix A) are from the STEM field such as chemistry, biochemistry, physiology, and microbiology. The professional nursing curriculum is deeply aligned with the goal of STEM education, emphasizing collaborative and creative problem solving to promote the health and wellbeing of individuals, communities, and our planet. The following outline describes just a few examples of how STEM principles are engrained at the core of a nursing education:

### **Science:**

Nursing education encompasses its own scientific discipline, Nursing Science, which focuses on evidence-based practice, nursing theories, and research methodologies. Nurses learn to critically appraise research findings and apply scientific evidence to promote and improve patient outcomes. The following outlines additional fields of science standardized within nursing education:

- **Biological Sciences:** Nursing education programs require understanding of anatomy, physiology, and microbiology; essential for nurses to comprehend how the human body functions and responds to illness or injury. This knowledge helps nurses assess patients, interpret symptoms, and plan appropriate care.
- **Chemistry:** Knowledge of chemistry is necessary for understanding medication administration, including drug interactions, chemical compositions of medications, pharmacodynamics, and pharmacokinetics. Nurses need to comprehend the chemical properties of substances they handle and administer to ensure patient safety. Educational coursework in General Chemistry, Organic Chemistry, Biochemistry, and Pharmacology are critical within nursing education.
- **Physics:** Physics principles are applied when understanding mechanical ventilation, monitoring medical equipment, and patient positioning to prevent complications such as pressure ulcers or musculoskeletal injury. Concepts such as gravity, force, and pressure are essential to provide safe patient care.
- **Psychological Sciences:** Nursing education incorporates psychology to understand human behavior and therapeutic communication. This requisite knowledge aids a nurse’s ability to provide holistic care, addressing not just physical but psychological needs.
- **Social Sciences:** Understanding sociology and anthropology helps nurses recognize the influence of culture, socioeconomic status, and societal factors on health beliefs and practices. The knowledge promotes nurses providing health promotion and culturally competent care.
- **Health Sciences:** Nursing education includes courses in public health, epidemiology, and biostatistics to prepare nurses for roles in health promotion across the lifespan, disease prevention, and population health management.
- **Nutritional Science:** Nursing students learn about nutrition and its role on the body. Understanding nutritional principles help nurses assess dietary intake, identify nutritional deficiencies, and provide appropriate nutritional education. Nurses learn age-specific

nutritional requirements, such as breastfeeding guidelines for newborns, nutritional needs during pregnancy, and dietary considerations for older adults. Nurses learn about nutrition-related diseases such as diabetes, cardiovascular disease, and obesity, as well as the role of nutrition in wound healing, immune function, and recovery from illness or surgery.

### **Technology:**

Technology plays a significant role in nursing education, enhancing teaching methods, facilitating learning experiences, and preparing nurses for the increasingly technology-driven healthcare environment. Examples of technology utilization in nursing education:

- **Simulation:** Nursing education today “can no longer afford to consider simulation as merely an ‘add-on’. Simulation today includes role play, standardized patients, virtual simulation, and computerized mannequins...simulation allows students to learn skills, develop clinical reasoning abilities, and to become competent in caring for patients/families in a safe environment”. High-fidelity mannequins mimic physiological responses and allow students to practice clinical skills, critical thinking, and decision making without risking patient safety. Simulation also serves as a safe and highly realistic method for testing clinical innovations created by collaborative teams of nursing students, biomedical engineers, software engineers, or computer scientists.
- **Virtual Reality (VR) and Augmented Reality (AR):** VR and AR offer immersive learning experiences for nursing students. They simulate clinical environments, procedures, and patient interactions, allowing students to practice skills and gain confidence.
- **Electronic Health Records (EHRs):** Nursing students learn to navigate EHR systems, integral to modern healthcare practice. Training in EHRs familiarizes students with documentation processes and patient data management, preparing them for clinical practice in settings where EHRs are used.
- **Telehealth and Telemedicine:** With growing emphasis on telehealth services, nursing education includes training in telehealth technology and remote patient monitoring. Students learn to conduct virtual assessments, communicate with patients remotely, and utilize telehealth for healthcare delivery.
- **Innovations in Healthcare Technology:** Nurses play an active role in the development and integration of healthcare technology. Development of technologies such as wearable health devices help ensure patient safety and monitoring.
- **Informatics:** Nursing informatics is a specialized field within nursing that focuses on integrating nursing science with information management and analytical sciences to identify, define, manage, and communicate data, information, knowledge, and wisdom in nursing practice. Technology plays a crucial role in nursing informatics, enabling nurses to effectively manage and utilize healthcare information to improve patient care outcomes.

### **Engineering:**

Emerging areas exist where engineering principles intersect within nursing practice and education. Examples include:

- **Biomedical Engineering:** Biomedical engineering focuses on the application of engineering principles to healthcare and nursing. Nursing students benefit from learning about medical device use and design and biomedical imaging. This knowledge helps nurses utilize medical equipment, interpret imaging results, and collaborate with biomedical engineers to improve patient care.
- **Healthcare Technology Management:** Healthcare technology management involves the maintenance, repair, and management of medical equipment and technology

systems within healthcare settings. Nursing education includes coursework on healthcare technology use, troubleshooting, and safety elements.

- **Systems Thinking and Process Improvement:** Nursing students learn principles including system thinking and process improvement to analyze complex healthcare systems, identify areas for improvement, and implement evidence-based interventions. These skills facilitate quality improvement to enhance patient safety, reduce healthcare costs, and optimize healthcare workflows.

### **Mathematics:**

Mathematics is at the core of nursing education and practice, ensuring nurses provide safe, informing decision-making, and improving patient outcomes. Nurses utilize mathematical models to analyze health data, predict health trends, and evaluate the effectiveness of interventions. Examples include:

- **Medication Dosage Calculations:** Nurses must accurately calculate accurate, safe medication dosages based on patient weight, age, and other factors. This involves arithmetic and understanding ratios and proportions. This also includes understanding of metric and household conversions. Nursing education programs require students to demonstrate proficiency in medication calculation exams to progress in their education.
- **Intravenous (IV) Fluid Administration:** Nurses calculate IV fluid administration rates based upon patient's condition, fluid resuscitation needs, and prescribed infusion rates. requires understanding volume calculations and time-based calculations.
- **Concepts in pharmacology:** Medication administration is a tremendous nursing responsibility. Having a strong grasp of pharmacokinetics is fundamental to safe medication administration. This includes an understanding of math to calculate time intervals for dosing medications based on plasma concentration. The algebraic concept of exponential decay is essential for understanding a drug's half life as it is eliminated from the body.
- **Patient monitoring:** Nurses monitor and collect numerical data. This includes vital signs, bloodwork, a patient's fluid intake and output, a patient's range of motion, arterial pressure measurements, glucose levels, among many others. They must interpret this data accurately, understanding concepts like ranges and data trends. They must critically evaluate the accuracy of numerical data and closely monitor trends to promote health.
- **Statistical Analysis:** In nursing research and evidence-based practice, statistical analysis is often used to analyze data and draw conclusions. Nurses need to understand statistical concepts like mean, median, mode, standard deviation and significance testing.
- **Healthcare Economics:** Nurses need to understand financial concepts when it comes to managing resources efficiently within healthcare settings such as budgeting, cost-effective analysis, and resource allocation.
- **Patient Education:** Nurses educate patients about their health conditions, treatment plans, and medications. This involves numerical concepts like blood glucose levels, blood pressure interpretation, dosage regimens/calculations, and nutritional supplementation.

***Engagement of students in research, innovation or development of new technologies using engineering, mathematics, computer science or natural sciences:***

Nursing students' engagement in research, innovation, and development of new technologies using engineering, mathematics, and science prepares students for the evolving healthcare landscape. Courses and programs specific to innovation in healthcare are becoming the standard at nursing schools and healthcare institutions around the country. Nursing innovation focuses on creating new methods, ideas, products, or services to improve patient care, health care outcomes, and nursing practices through the application of scientific principles, technological advancements, engineering solutions, and mathematical analyses.

The American Nurses Association (ANA) lists nursing programs leading in innovation and the list grows year after year. This is because worldwide organizations that focus on health and healthcare, including the ANA, the World Health Organization and the National Academies of Science, Engineering and Medicine, have determined that nurses' acquisition of innovation education and skills is essential to the nursing profession. The International Council of Nurses defines nursing innovation specifically with STEM in mind, stating it as "the process of developing new approaches, technologies and ways of working".

Here's some examples of how nursing students are involved in such endeavors:

1. **Interdisciplinary Research Opportunities:** Nursing students collaborate with students and faculty from engineering, mathematics, and science disciplines on research projects that address healthcare challenges and improve the future of healthcare. Interdisciplinary research teams explore topics such as medical device design, healthcare informatics, biomechanics, and data analytics to develop innovative solutions for improving patient care.
2. **Undergraduate Research Programs:** Nursing programs frequently offer undergraduate research opportunities that allow students to participate in hands-on research experiences. Students conduct research projects related to nursing practice, healthcare technology, patient safety, or health outcomes, leveraging engineering, mathematics, and science (examples above) to advance knowledge and innovation in nursing.
3. **Capstone Projects and Design Challenges:** Nursing students can participate in capstone projects or design challenges that involve developing new technologies or innovative solutions to address healthcare needs. Collaborative projects with engineering or science students can provide opportunities for nursing students to contribute their clinical expertise while learning from peers with complementary skills in technology and innovation.
4. **Hackathons and Innovation Competitions:** Nursing students can participate in hackathons, innovation competitions, or healthcare-focused design challenges where multidisciplinary teams work together to solve real-world healthcare problems. These events provide a platform for nursing students to collaborate with engineers, mathematicians, and scientists to ideate, prototype, and pitch innovative solutions that have the potential to transform healthcare delivery.
5. **Internships and Externships:** Nursing students can pursue internships or externships with healthcare technology companies, research institutions, or healthcare organizations involved in innovation and technology development. These experiential learning opportunities allow students to gain firsthand experience in applying engineering, mathematics, and science concepts to healthcare challenges while working alongside professionals in the field.

Engaging nursing students in research, innovation, and the development of new technologies using engineering, mathematics, and science, cultivates interdisciplinary collaboration, creativity, and problem-solving skills in their future careers. These experiences enrich students'

learning experiences and contribute to advancements in nursing practice, healthcare delivery, and patient outcomes.

Thank you for your time and consideration. We look forward to the opportunity to further discuss the transformative impact of this designation on the global nursing community.

Sincerely,

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