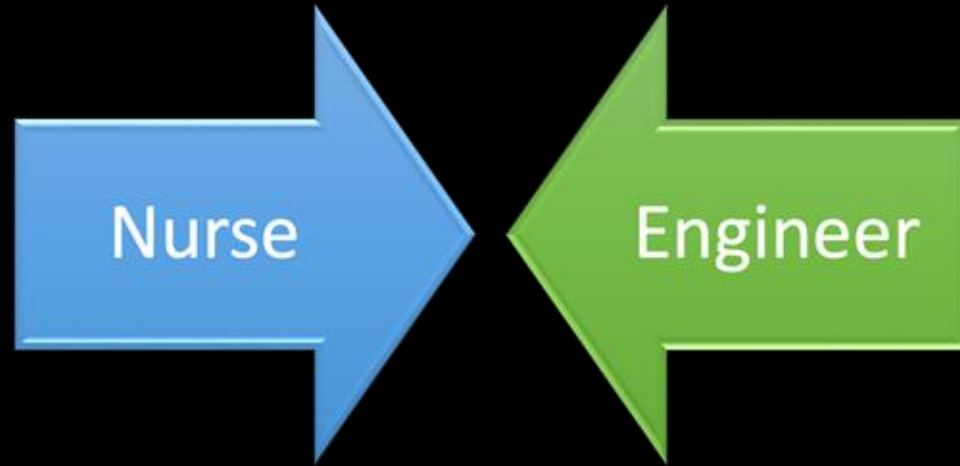


Exploring the Nurse Engineer

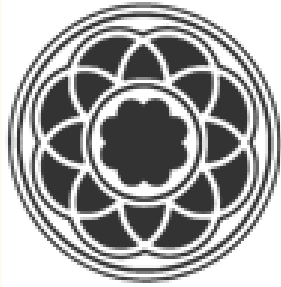
A Growing Interdisciplinary Profession You Didn't Know About



Kenneth Cheng MSN, BE, RN, CHRN

Garett Craig MS, BME, BSN, RN

Kelly Landsman MN, BME, BS, RN, PHN



PACIFIC
LUTHERAN
UNIVERSITY

PLU
SCHOOL OF
NURSING

None of the planners or presenters for this educational activity have relevant financial relationships to disclose with ineligible companies.

Criteria for successful completion to receive nursing contact hours: Attendance of at least 90% of this educational activity, the completion of an evaluation form.

Pacific Lutheran University Center for Continued Nursing Learning (PLU CCNL) is approved as a provider of nursing continuing professional development by the Montana Nurses Association (MNA), an accredited approver with distinction by the American Nurses Credentialing Center's Commission on Accreditation (ANCC).

Presentation Overview

- **Ken's Journey**
 - What is Engineering?
 - Why Nurse Engineer?
 - Application
- **Kelly's Journey**
 - What is Nursing?
 - Uniting Nursing & Engineering
 - Take Action
- **Garett's Journey**
 - The Nurse Engineer
 - Application
 - The Future

Presenter Introductions

Kenneth Cheng MSN, BE, RN, CHRN

- Naval Architect and Boeing aerospace test & evaluation engineer
- Hyperbaric and wound care nursing, wilderness EMT and ski patroller
- Clinical Program Manager and consultant for medical simulation, medical education software
- Military medical research on traumatic brain injuries

Garett Craig MS, BME, BSN, RN

- Biomedical Engineering and Nursing
- Artificial Heart Engineer (LVADs), Application Consultant (Neurosurgery), Medical Device Design (Startup Community), Space Safety Challenges

Kelly Landsman MN, BME, BS, RN, PHN

- Biomedical Engineering - Research & Development, manufacturing, innovation medical devices
- Nursing - Cardiac and surgical staff nurse

What is Engineering?

“Engineering is the profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practice is **applied** with judgment to develop ways to **utilize**, economically, the materials and forces of nature for the **benefit of mankind.**” (1)

- Engineers solve problems to meet human needs
- We solve problems through a systematic process
- We re-evaluate the solution and refine it as the problem evolves

Sound familiar?

Nurses were consistently voted the most trustworthy profession for 21 years in the Gallup Poll

- High ethical standards
- High quality standards in their work
- Honesty
- Service to the public

The Ipsos Veracity Index is an annual poll that has measured the trustworthiness of professions in Britain since 1983. This year's Index found that 85 per cent of people surveyed trust engineers to tell the truth, placing them fourth overall behind nurses, airline pilots and librarians. The figure is down slightly from last year's 87 per cent, which made engineers the second most trusted profession.

Related content

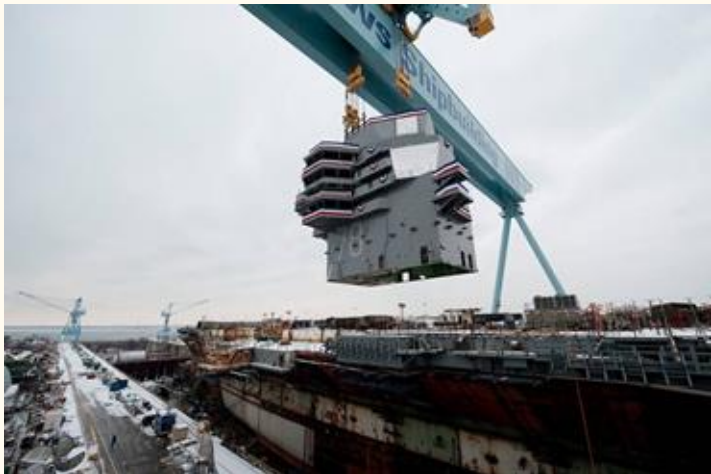
- [Engineers are Britain's second most trusted profession](#)
- [Engineers rated one of UK's most trusted professions](#)

Engineers have recorded similar levels of trust in previous years, including a score of 89 per cent in 2020. The Institution of Engineering and Technology (IET) worked with the 2023 Ipsos Veracity Index to include engineering for the sixth year running.



Why did I choose Engineering? Why does this relate to nursing?

- Problem solving
- Analytical and structured thinking (critical thinking)
- Contributing positively to society (helping others)
- We make the world a better place
- Broad opportunities within the profession
- Change the world with new ideas and technology



E-DIV

Electrical Division is the largest division in Engineering Department, home to electrician's mates and interior communications electricians. Imagine providing the communication and electrical systems needed to conduct the business and recreation activities of a small city. Add to this the alarms and indicating systems of a large factory and the control system that provides steering to one of the largest ocean-going vessels ever built. This is the relentless task of E Division. Maintaining equipment in nearly every compartment on board keeps the many E electricians busy. The Aft E's Gyrocompass Shop operates and maintains the gyro, telephone, underwater log, wind indicating, steering, and main E's switchboard systems. E Shop TWD maintains the numerous internal communication and sound-powered phone systems, alarms and indicating circuits, shaft tachometers, fuel consoles, and the list control indicating system. The talented electrician mates maintain non-propulsion electrical systems including navigational lights, small boats, laundry and galley, general power, and lighting systems. The Motor Rewind Shop provides both extensive in-helm and on-site underway support to the entire strike group, repairing and rewinding motors and transformers needed to restore to service to vital equipment.

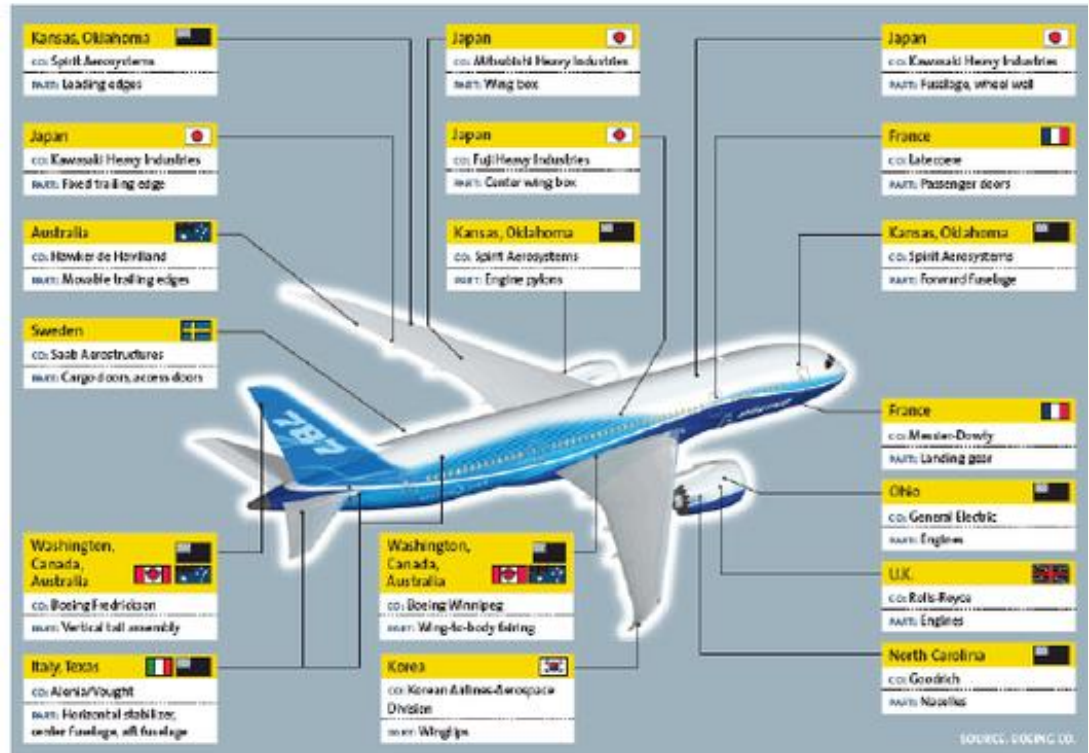
The Aviation and Brigsance, and Flight Deck Lighting Shops support the air wing by maintaining flight deck aircraft electrical servicing stations, fueling stations, aircraft elevators, and flight deck lighting. Additionally, these service the 400 Hz system that provides power to combat systems. The General Services and Tool Issue shops ensure all spaces have uninterrupted electrical power, lighting, and safe equipment to conduct business in support of the Carl Vinson mission. Finally, the Battery Shop ensures that the Rapid Hull Inflatable Boats (RHIB), Captain's gig, and Admiral's barge are ready to be deployed for either search and rescue missions or recreation. Additionally, the shop ensures all underway replenishment stations and crewbars are ready to receive supplies that keep the galley lines moving and weapons magazines full.



Engineering: The REAL world
Boeing Structural Components Laboratory,
Seattle WA



Engineering involves collaboration between multiple disciplines across many nationalities for the purpose of creating new technology with the safety of its users in mind



Engineering: A Field of Applied Science

Fundamental science is the observation and understanding of the natural universe around us.

- Biology
- Physics
- Chemistry
- Mathematics
- Anatomy

Applied science is the utilization of fundamental scientific knowledge and principles to develop **practical applications**.

- Engineering
- Medicine
- Nursing??
- Architecture
- Computer Science
- Meteorology
- Forensics

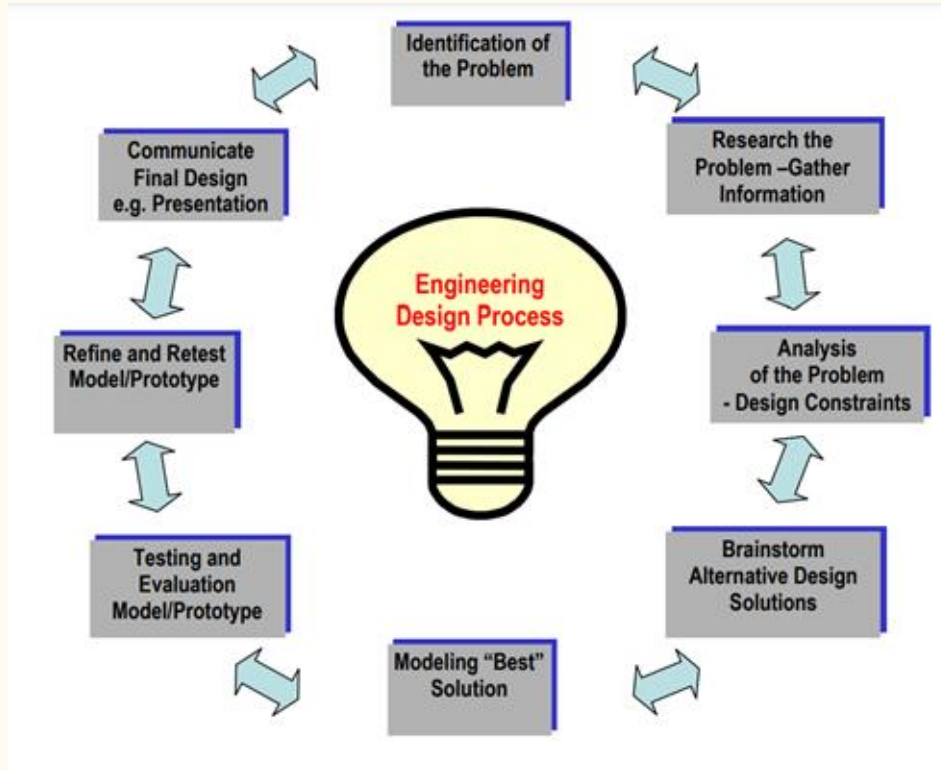
Engineering Education: Fundamental vs. Applied Sciences

- Physics I, II, III
- Calculus I, II, III
- Chemistry I, II
- Differential Equations
- Naval Science I, II, III
- Basic Ship Systems
- Engineering Economics
- Engineering Analysis & Statistics
- Introduction to Engineering
- Electrical Engineering I, II
- Fluid Dynamics
- Thermodynamics
- Solid Mechanics
- Propulsion
- Materials Science
- Engineering Chemistry
- Environmental Science
- Navigation
- Naval Architecture
- Ship Design

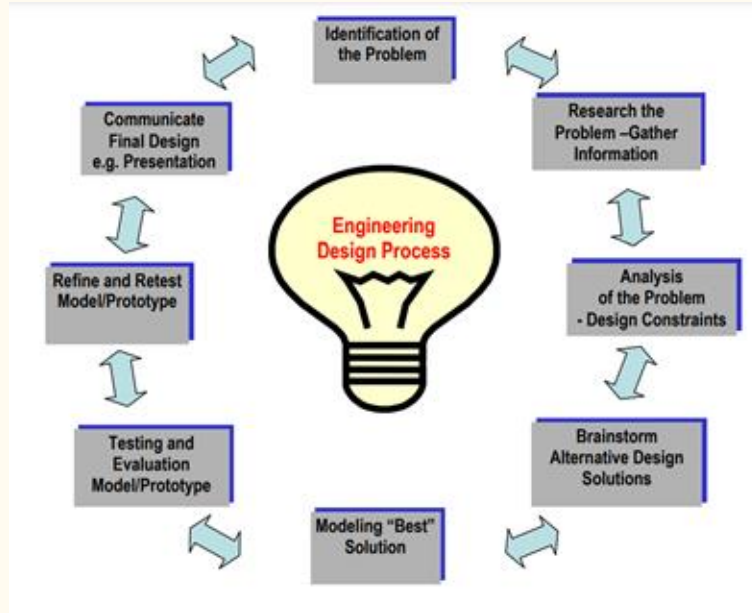
The Engineering Process/Method

“Scientists discover the world that exists; engineers create the world that never was.”

-Theodore Von Karman



Nursing and Engineering processes are continuous cycles with critical thinking at its core



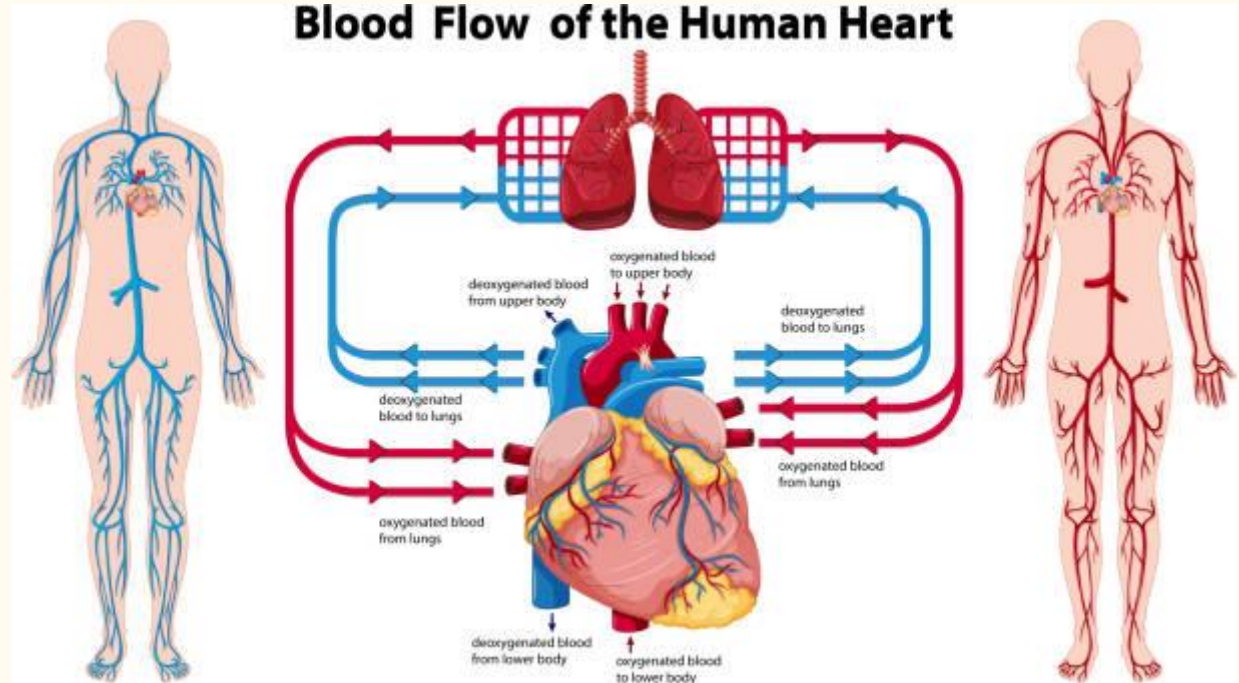
Problem solve much?

- The study of human anatomy & physiology is the study of a complex engineering system
- The methods which nurses and engineers problem solve are similar and can be synergistic in many healthcare situations

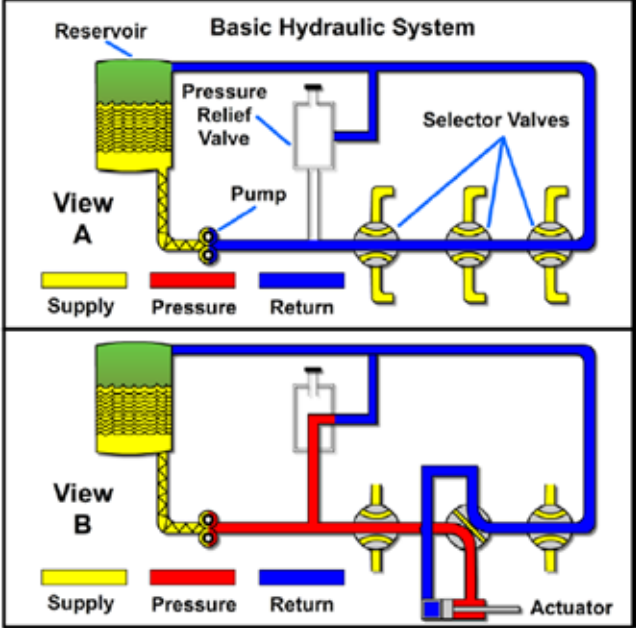
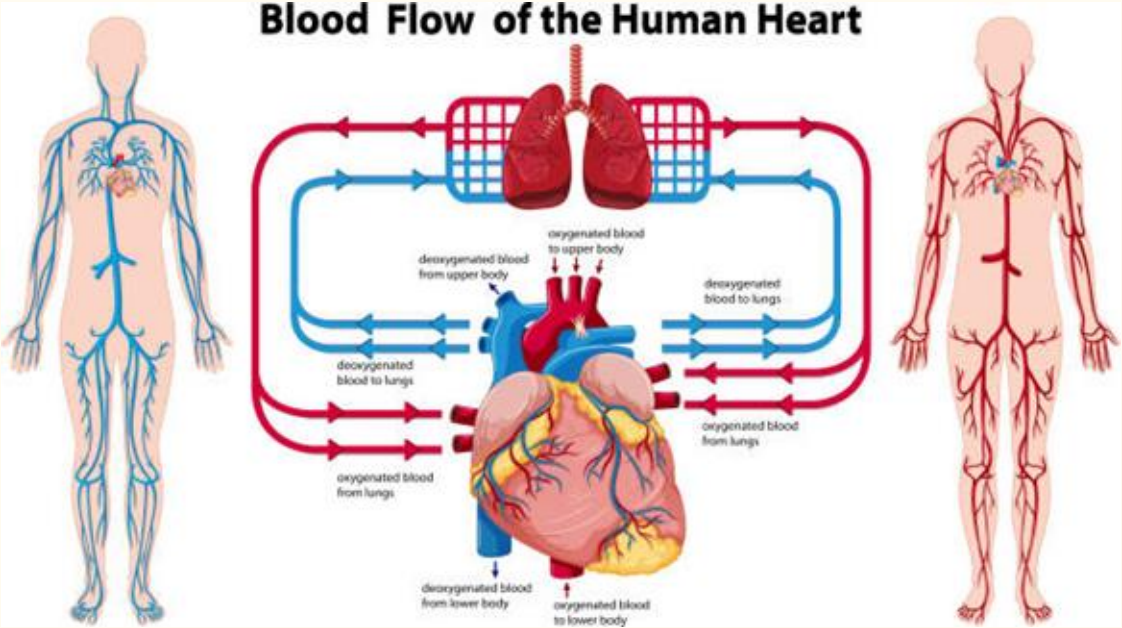


Nurses: You are already working as engineers

- Understanding of fundamental Sciences
- Analyze problems
- Break down complex systems into subsystems
- Critical thinkers
- Innovate new solutions



Thinking like an engineer



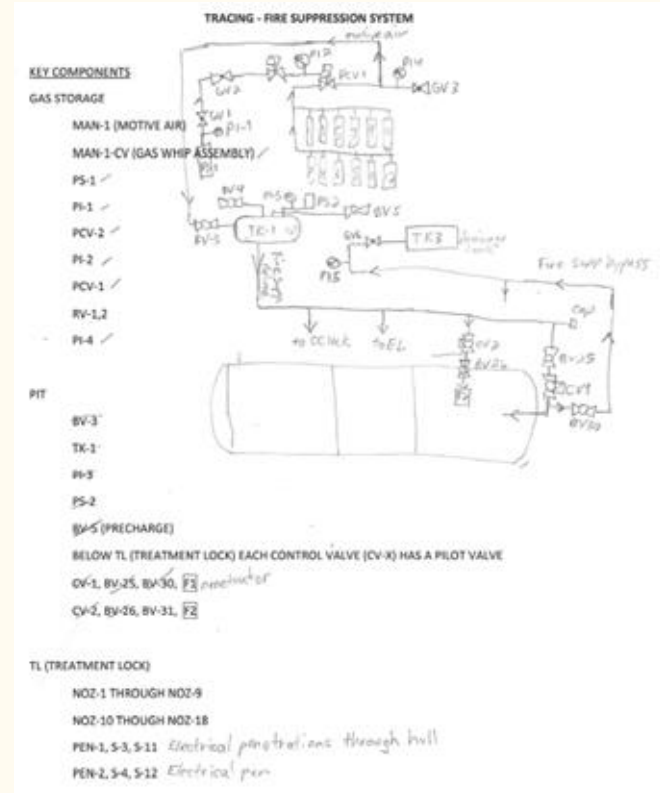
Engineering applied in Nursing



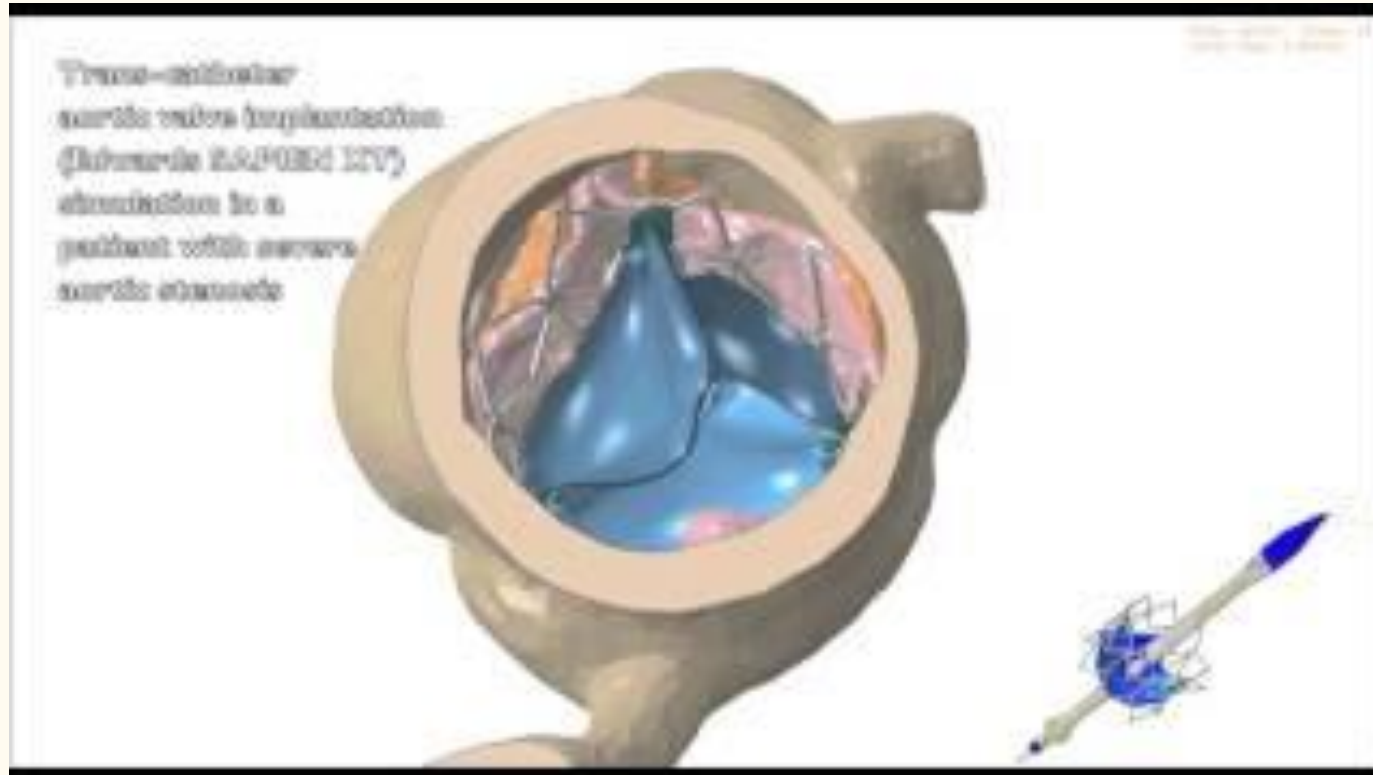
Virginia Mason Franciscan Health Center for Hyperbaric Medicine Seattle, WA



Physics, Chemistry, Diving, Hydraulics meets Nursing



Engineering meets medicine: Computational Fluid Dynamics Modelling in Cardiology (2016)



Medical Simulation in Healthcare



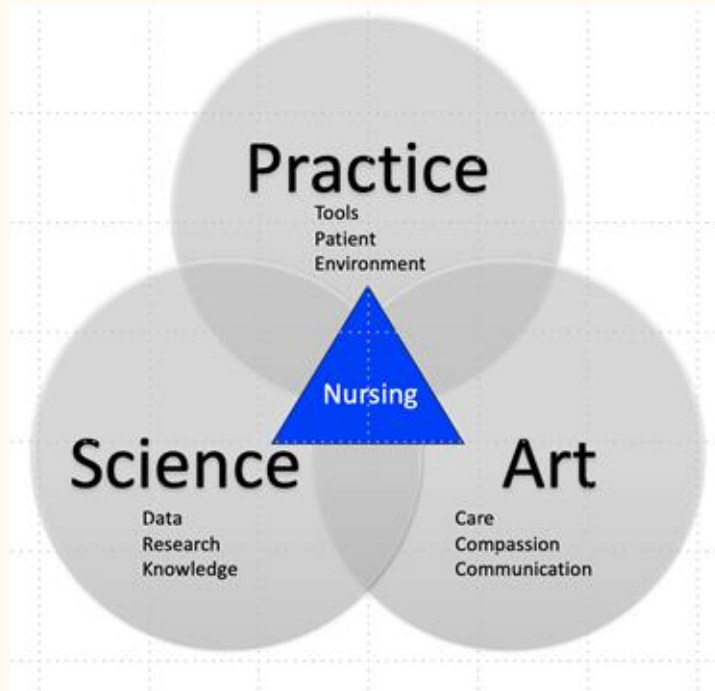
IMSH: International Meeting for Simulation In Healthcare

Every year the Society for Simulation in Healthcare (SSiH), hosts the International Meeting for Simulation in Healthcare (IMSH) in a major city of the United States. Dedicated to [healthcare simulation research](#) and learning, the event provides an opportunity for "Simulation Champions" from around the world to come together to network with peers, learn from experts, and see the latest [medical simulators](#) like those from Laerdal, CAE Healthcare or Gaumard.



What is Nursing?

“protection, promotion, and optimization of health and abilities; prevention of illness and injury; facilitation of healing; alleviation of suffering through the diagnosis and treatment of human response; and advocacy in the care of individuals, families, groups, communities, and populations” (ANA, 2021, pg.1)



Meet people where they are and
use evidence based practice

Engineering view of Healthcare

Some stated causes of the healthcare crisis in the United States:

- “the structure of the U.S. market for health care services, which has encouraged and supported innovation in medical procedures, drugs, devices, and equipment, **but has been indifferent to, if not discouraged, innovation directed at improving the quality and productivity of care delivery**”
- “**persistent underinvestment** by the health care delivery sector in information/communications technology”
- “the **inability or unwillingness of the health care delivery sector** to take advantage of engineering-based systems-design, -analysis, and -management tools that have transformed other sectors of the American economy”³

Nurses are Everywhere

- Largest portion of the healthcare workforce
- Spend most time with patients
- Work across sites
- Holistic, complex systems thinkers
- Know how work is done
- Select the tech, devices, workflows
- Implement the tech, devices, workflows
- Teach patients
- See issues with use and evaluate unmet needs

Nurses have an
invaluable, unique lens
on healthcare

Nursing Challenges Healthcare

- Inconsistent recognition of nursing as a STEM profession ⁴
- Nursing care is a cost to health systems - “part of room charge” ⁵
- Nursing stereotypes related to gender, religion and subservience ⁶

Yet...

- Nurses make up the largest portion of the healthcare workforce (4 nurses per 1 physician)⁷
- Nurses are a highly trusted profession ⁸
- Nursing care has a direct impact on patient safety ⁹

Engineering Challenges in Healthcare

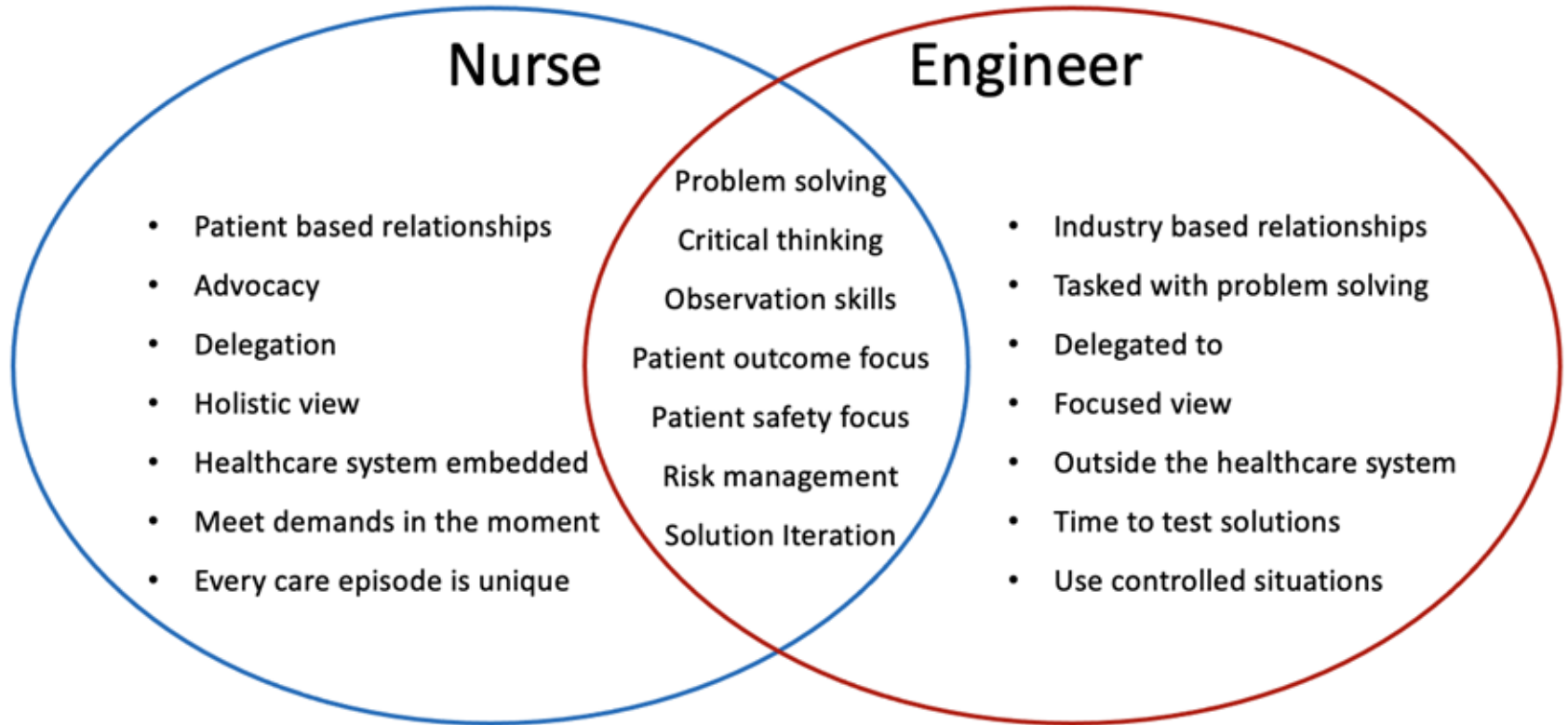
- Limited access to clinical settings
- Limited applications within the delivery system
- Prohibitive regulatory pathways
- Poor implementation
- Stagnation of technology
- Commoditization
- Limited standardization and investment



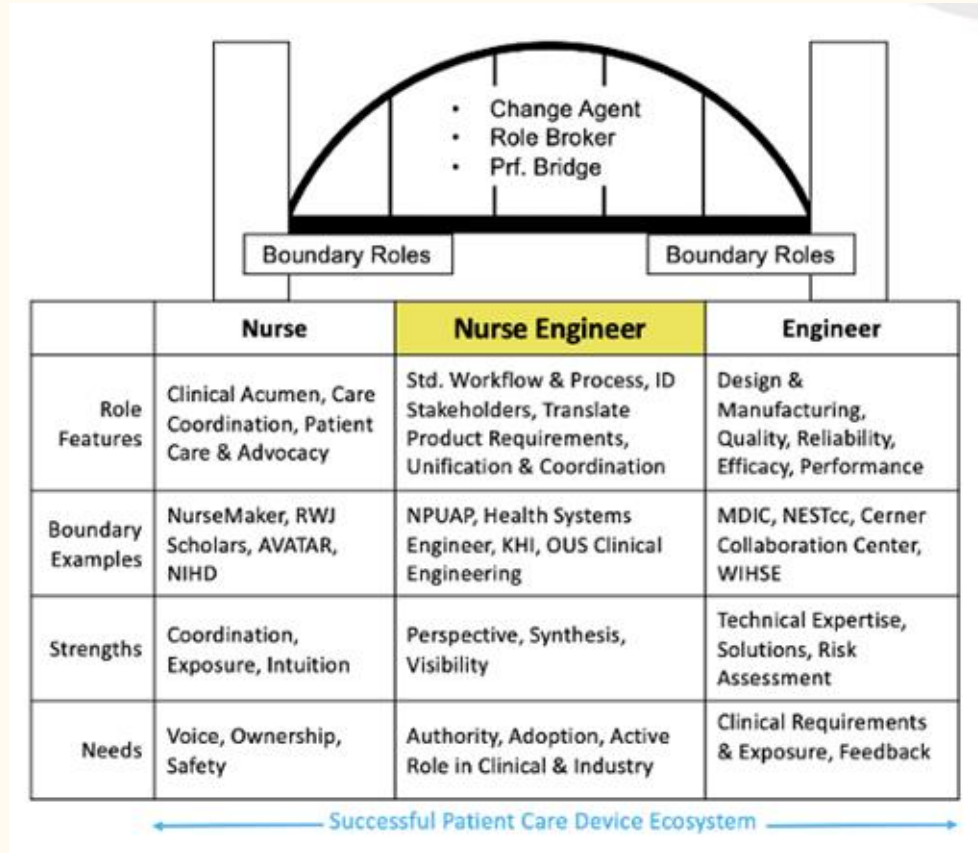
Nursing + Engineering

- Emergence of nurse scientists and nurse researchers ¹⁰
- Emergence of clinical nurse leaders “CNL”¹¹
 - “In the truest use of the role, the CNL doesn't take a patient load; rather, they facilitate care processes and remove barriers that challenge the work environment. “ ¹²
- Emergence of nursing informaticists ¹³
- Human Factors, Health Systems, Biomedical engineering
- Calls for the nurse engineer - multiple publications as far back as 1986 ¹⁴

So Why Nurse Engineering?



Who is the Nurse Engineer?



Who are you in the Nurse Engineer Ecosystem?

- **Driver** = a nursing or engineering professional eager to partner
- **Catalyst** = a person that has combined the professions after specializing in one area first
- **Converger** = a person that is simultaneously trained in nursing and engineering
- **Partners** = people outside of the nursing and engineering professions that are supportive partners



Next Steps

- Explore your personal strengths and interests
- Check out stories of nurse-engineer collaborations
 - AJN Series
 - UMass and UConn centers
 - ANA Innovation
- Chart your course
- Find partners
- Resources are available at **NurseEngineer.com**



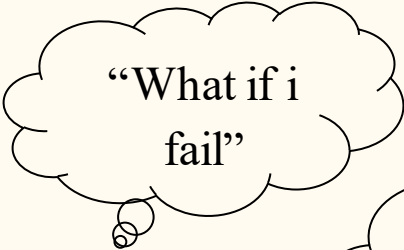
My Start into Nurse Engineering

Never thought I'd be a nurse

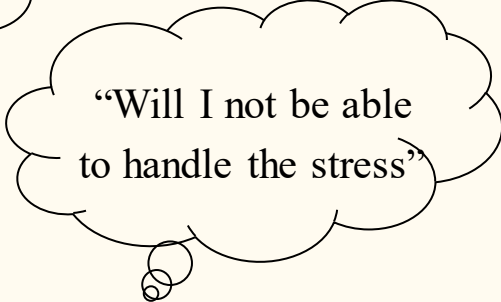
A new Dual Degree option

Initially pursuing Chemical Engineering

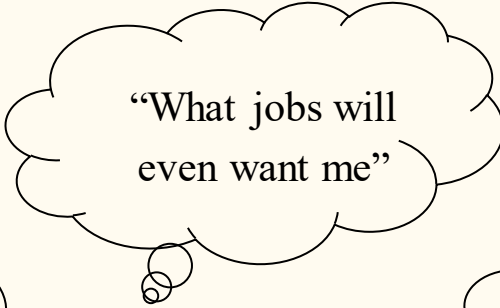
My first question "Would I make a good nurse?"



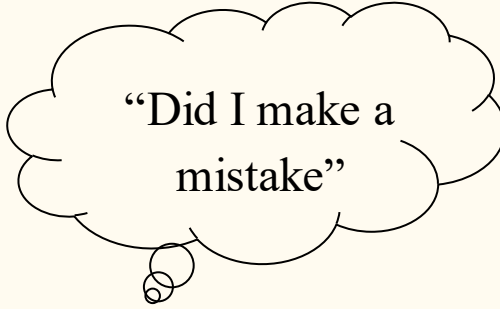
"What if i
fail"



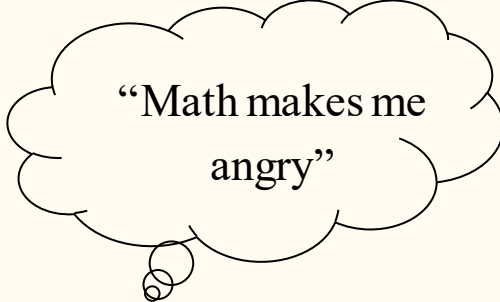
"Will I not be able
to handle the stress"



"What jobs will
even want me"



"Did I make a
mistake"



"Math makes me
angry"

Nurse Engineer Curriculum

- Nursing Classes (Standard / Accelerated)
- Engineering Classes (Standard BME Classes)
- Classes that combined both Degrees (Capstone, Thesis)

Project / Group based work

- * **Nursing gave me the reason to do something**
- * **Engineering gave me the process to solve it**

Engineering	Nursing
Calc I, II, III	Fundamentals
Differential Equations	Nutrition
Linear Algebra	Adult Health
Statistics I, II	Pharmacology
Biology I, II	Genetics
Chemistry I,II	Ethics
Anatomy and Physiology	Behavioral
Biofluid Mechanics	Maternal / Newborn
Thermodynamics	Health Assessment
Programming	Human Development
Physics I, II	Pathophysiology
Electronics	Leadership / Management
Signals and Systems	Pediatrics
Engineering Computation	Critically Ill
Biomaterials	Population Health
Capstone	Ethics in Nursing

Difficulty and Challenges of Nurse Engineer

- Constant translating between both degrees
- Two different thought processes (limited options and time vs unlimited options and time)
- Theoretical vs Practical
- When to let Engineering or Nursing lead in decisions

Careers needing Nurse Engineers

- Consultants
- Hospital Management / Directors
- Clinical Specialists
- Product Managers
- Quality Improvement
- Research
- Marketing
- Space Travel
- Military
- **Huge Potential Fields**
 - Simulation
 - AI in Healthcare
 - Hospital Improvement
 - Bioprinting
 - VR/AR

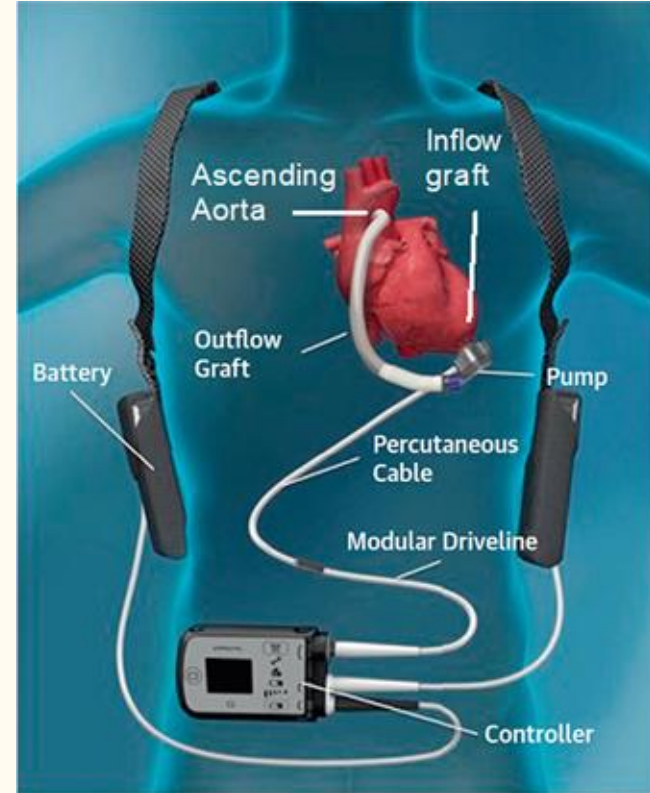
My Career as a Nurse Engineer (So FAR!!)

- LVAD Engineer
- Device Development
- Application Consultant
- Medical Safety Officer



Artificial Heart Engineer

- Supported LVADs in all areas of hospital
- Adult and Pediatrics
- Coordinate care with nurses, doctors, PT and family
- Mostly bedside and in specialities
- Trained to work with 8 different pumps
- Harmonious engineer and nursing relationship



Device Testing and Prototyping

- Creating ET tube to reduce damage and infection
- Testing of materials, dimensions and usability
- Worked with pig, cadaver and simulated tissue models
- Good deal of ISO, validation, IP and materials experience
- Learned how to start a company and get funding



Application Consultant Role

- Two different responsibilities:
 - OR and Case coverage
 - Install, training, sales, inspection
- Work with nurses, doctors, hospital admin, vendors, biomed, sales reps, scrub techs, CT and IT
- Travel to many hospitals and institutions
- Blend of nursing and engineering in one role



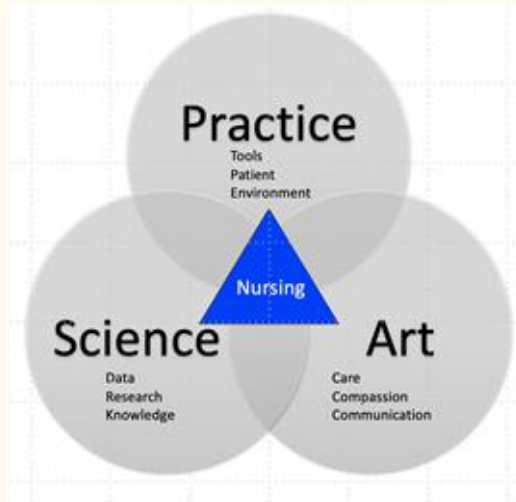
Space Safety Role

- Medical Officer for Mars Analog
- Develop plans on Emergency and Evac situations
- How to handle materials, spills and experiments
- Evaluating how crew handle isolated conditions
- Suit prep, weather risks, environment risks etc



What is Nursing?

“protection, promotion, and optimization of health and abilities; prevention of illness and injury; facilitation of healing; alleviation of suffering through the diagnosis and treatment of human response; and advocacy in the care of individuals, families, groups, communities, and populations” (ANA, 2021, pg.1)



Sources Here for Connecting with Nurse Engineers

Education

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<https://nurseengineer.com/education>

<https://www.duq.edu/academics/colleges-and-schools/nursing/undergraduate-programs/bme/bsn-dual-degree/index.php>

<https://www.umass.edu/engineering/organizations/marieb-center-nursing-and-engineering>

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