# Engaging Student Interest Through Modeling


## Sowmya Anjur, Ph.D.

Science Faculty & Scientific Inquiry and Research Coordinator

Illinois Mathematics and Science Academy


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# Illinois Math and Science Academy

# Science at IMSA

- Typically 100 minute classes twice a week
- Sub disciplines have many electives
- Biology electives
  - Pathophysiology
  - Biology of Behavior
  - Microbes and Disease
  - Cancer Biology

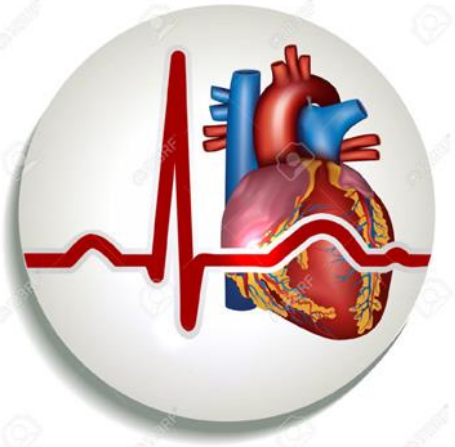
# Pathophysiology

- Focus on development of disease and related changes in organ systems
- Emphasis on learning through modeling
- Integration with other disciplines

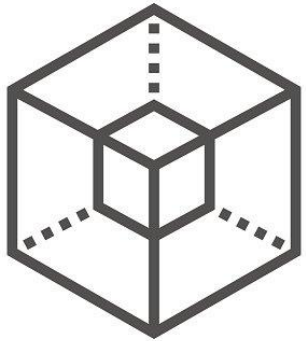
# Pathophysiology Integration

- Biophysical Quantitation
- Applications to Chemistry
- Extrapolation to Clinical Conditions

# Why Modeling?



https://brilliantnurse.com/nclex-heart-anatomy-and-physiology/



https://www.clipartlogo.com/istock/icon-3d-modeling-1723577.html

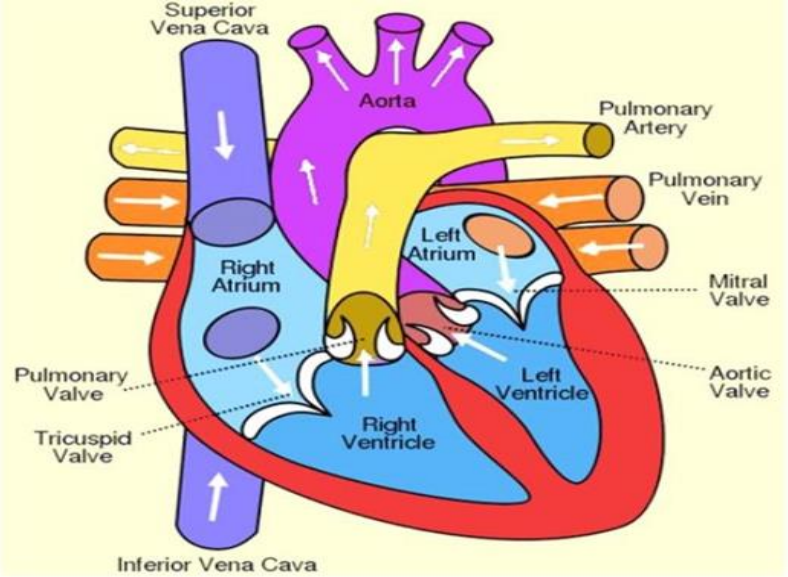
https://www.unicon.net/LTI

# 3-Dimensional Modeling

Creating 3-Dimensional (physical) representations of concepts studied in class

Student engagement increased and so did understanding and articulation on assessments

# The Human Heart – A Marvel of Biomedical Engineering




http://www.todayifoundout.com/index.php/2010/09/how-the-heart-works

# Biomedical Engineering - Engineering or Biology?

https://engineeringselection.com/blog/biggest-challenges-career-engineer/

https://webstockreview.net/image/biology-clipart-clip-art/2303062.html

# NGSS Standards

- **NGSS Science and Engineering Practices standards met by project:**
- **HS-LS1-1** (Systems of specialized cells within organisms help them perform the essential functions of life),
- **HS-LS1-2** (Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system),
- **HS-LS1-3** (Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly).

# NGSS Standards (Continued)

**NGSS Crosscutting Concepts standard met by project:**

- **HS-LS1-1** (Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem)

# UN Sustainable Developmental Goals

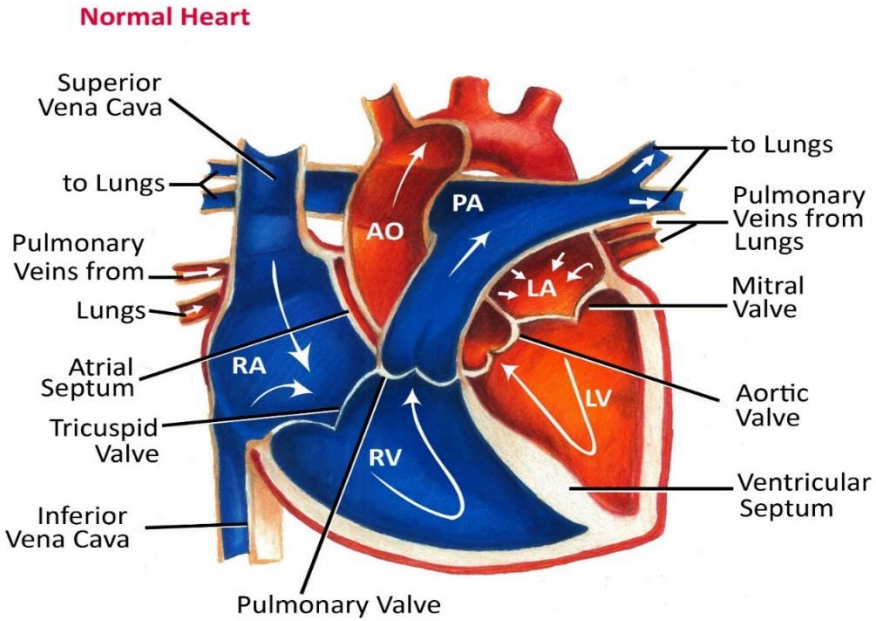
# Introduction to the Human Heart

- Explain basics of the human heart – electrical/mechanical systems, valves, direction of flow.
- Discuss connection between electrical and mechanical systems, why they need to work together.

# Mechanical System of the Heart

- The four chambers of the heart, their names and functions
- The function of the valves and which way they open
- Why the aorta is the biggest blood vessel in the body
- Direction of flow of blood in body
- Role of arteries and veins
- Role of the lungs

# The Human Heart – Mechanical System

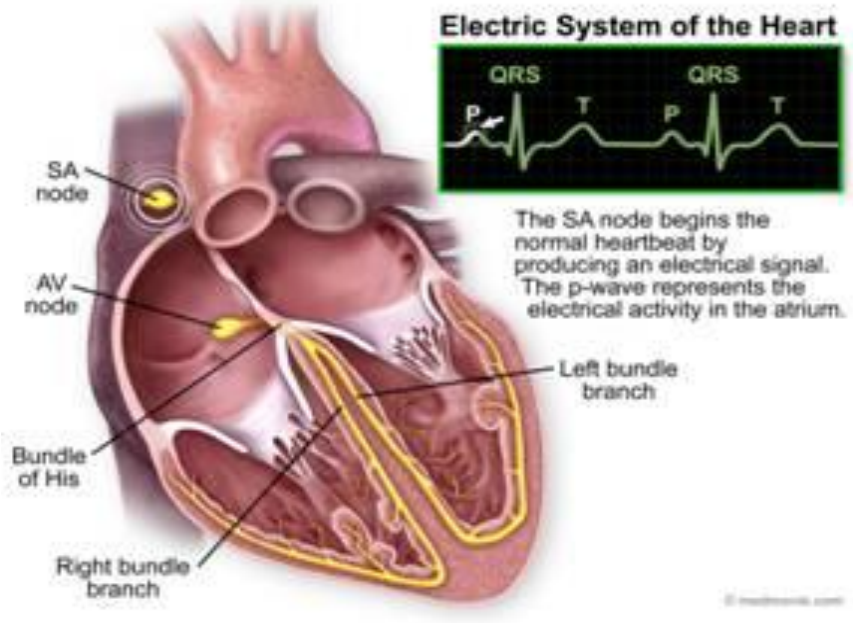



https://pediatricheartspecialists.com/heart-education/14-normal/152-normal-heart-anatomy-and-blood-flow

# Electrical System of the Heart

- The electrical system of the heart – parts and functions of the intrinsic conduction system
- How the electrical and mechanical parts work together and why
- What happens if the electrical system fails – examples
- What happens if the mechanical system fails – examples

# The Human Heart – Electrical System




https://www.hrsonline.orgnt-Resources/The-Normal-Heart/Electrical-System

# Engineering Heart Models

- Brainstorm and come up with a schematic for your heart model
- Show the schematic to me for approval
- Use the given materials to build your heart model
- HINT: The model should be the size of your fist (life- sized)
- Try to represent as many parts as you can, using your creativity and engineering skills
- HAVE FUN!!!!!

# Heart Model Design

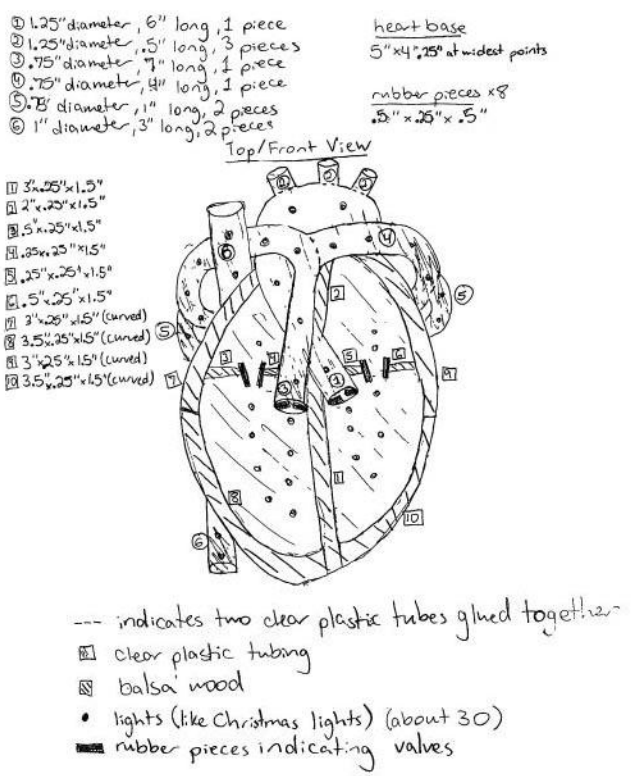



**Figure 5. Design for student heart model from Figure 1.**

# Student Heart Model Examples


# Heart Model Reflection

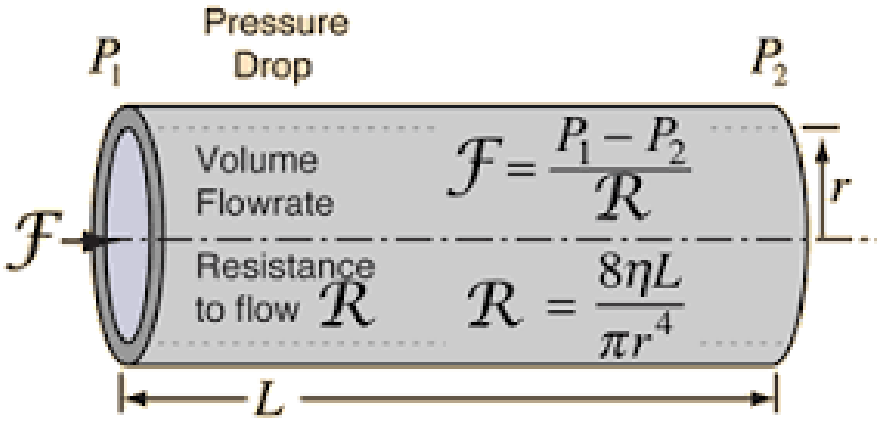
- Model construction
- Troubleshooting
- Availability of Resources
- Comments/Suggestions

# Integrating Biophysics into the Heart Model

Biophysical parameters can easily be introduced into any kind of modeling

Some ideas to do this with the heart model are incorporating resistance, viscosity, thickness and flow into the equation

# Biophysics Applications




http://hyperphysics.phy-astr.gsu.edu/hbase/ppois.html

# Heart model project publication

Anjur, S. 2015. Using Heart Models for Physiology Teaching and Learning. Spectrum (the Illinois Science Teachers Association Journal (Winter 2015 issue), 40(3):33-37

https://ilscience.org/resources/Documents/SPECTRUM/Spectrum-V40N2_2015-Winter.pdf

# Clinical Correlations

https://www.pinterest.com/pin/632333603911421887/

# Clinical Applications – Case Studies

- Case studies
- “Detective” work
- Example: woman fainting due to heat – heat stroke – changes in body - what can be done to prevent damage to tissues
- Encourage students to create case studies for enhanced understanding of pathophysiology

# Any Questions?

# Thank You!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