

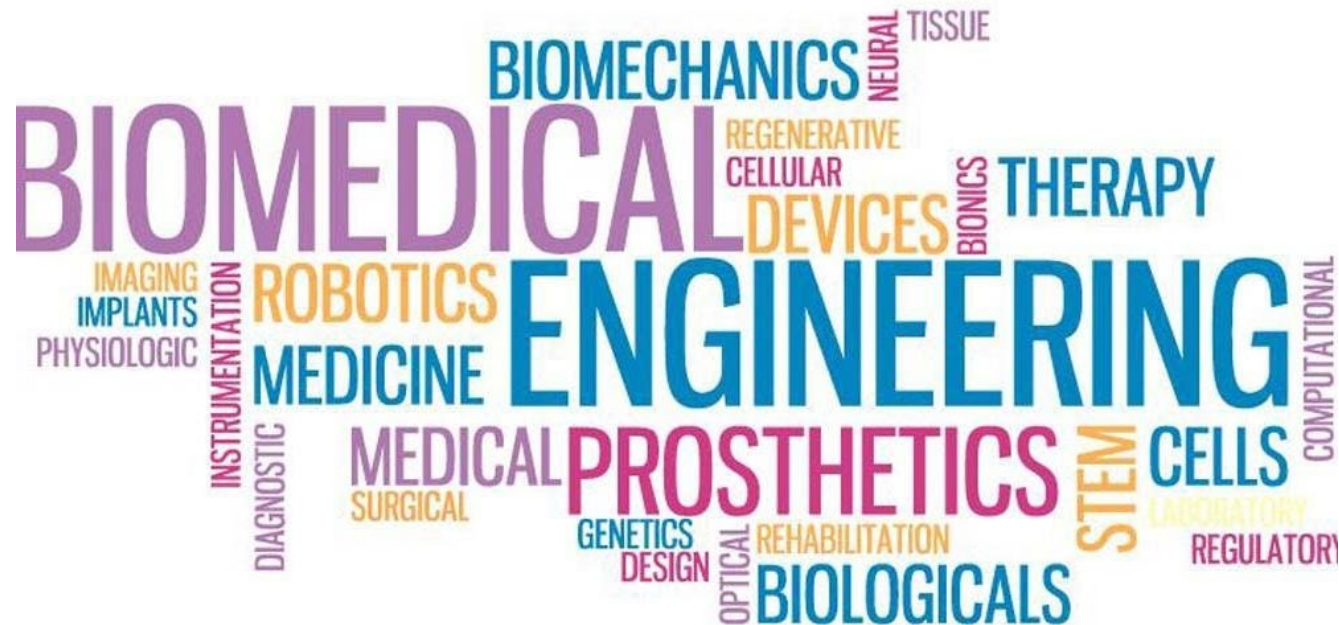


What is Biomedical Engineering?

October 15, 2021

APSC 1001

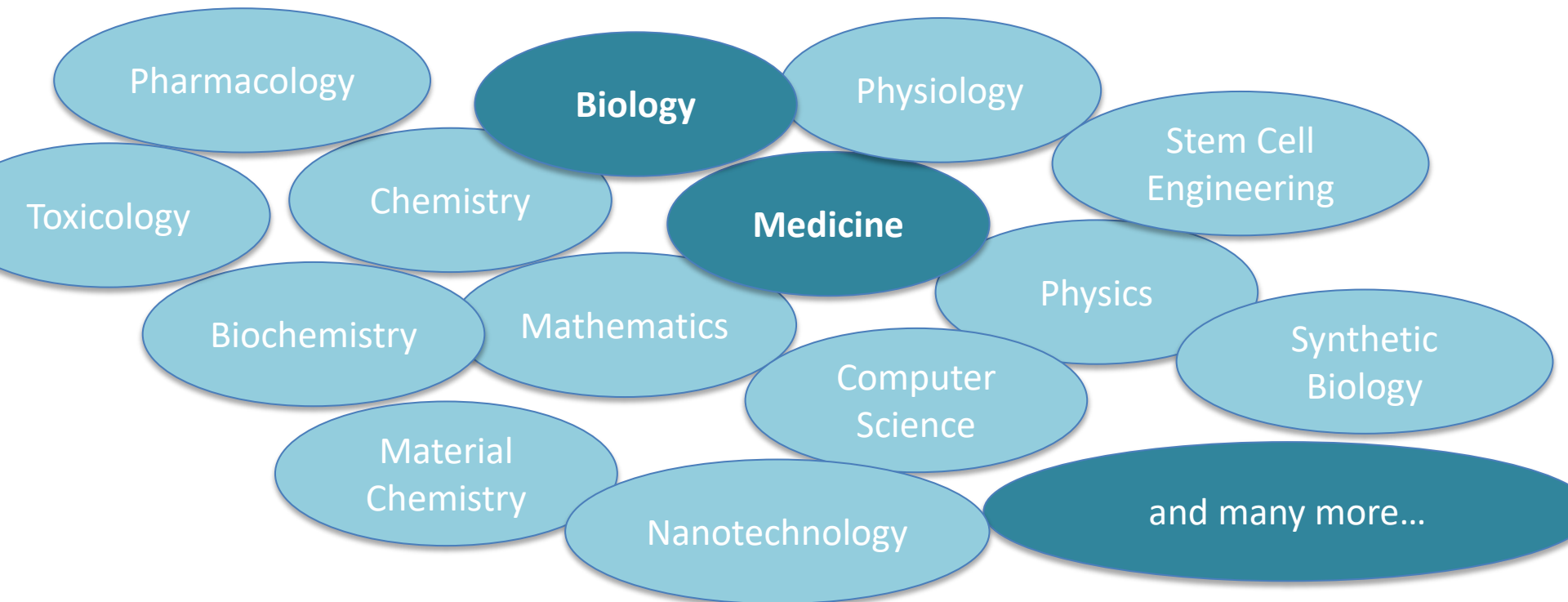
Professor Jason Zara



- What is a Biomedical Engineer?

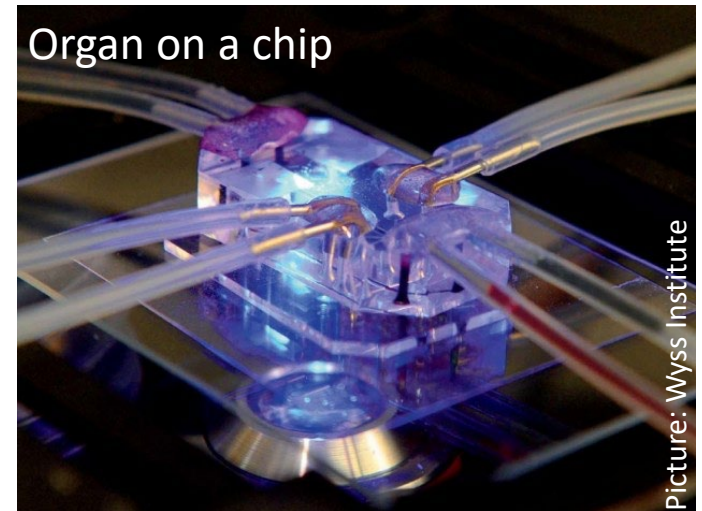
A Biomedical Engineer uses traditional engineering expertise to **analyze and solve problems in biology and medicine**, providing an **overall enhancement of health care**.

- Biomedical engineering is multidisciplinary



• What are Some of the Specialty Areas?

- **Bioinstrumentation**
- **Biomechanics**
- **Therapeutics**
- **Diagnostics**
- **Bioinspired soft robotics/rehabilitation engineering**
- **Tissue engineering/regenerative medicine**
- **Bioinstrumentation**
- **Clinical engineering**
- **Medical imaging**
- **Telemedicine**
- **Bioinformatics**
- **Systems physiology**



Example:

“organs on chips are used to study the toxicity of drugs to reduce animal testing”

Discipline involved: chemistry, pharmacology, toxicology, biology

- Medical imaging

Developing new imaging techniques –
improving resolution and non-invasive
diagnostic ability.

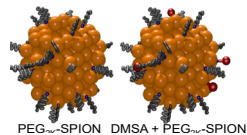
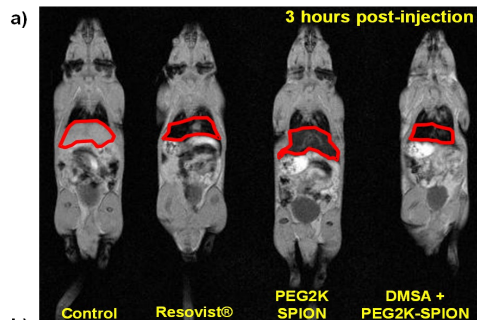
Disciplines involved:

Physics,
Biology,
Computational technology,
Signal analysis,

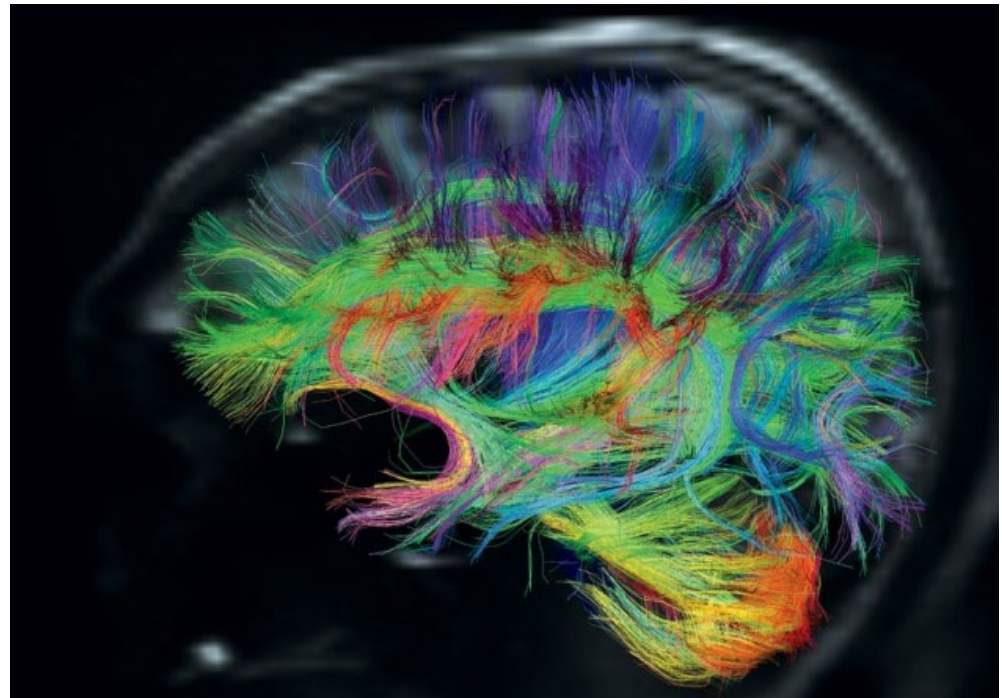
Biomaterials,
Chemistry.

Contrast agents

Journal of Biomedical Nanotechnology, 2015, 11 (1), 126-136



DSI- MRI showing connections between regions of the brain



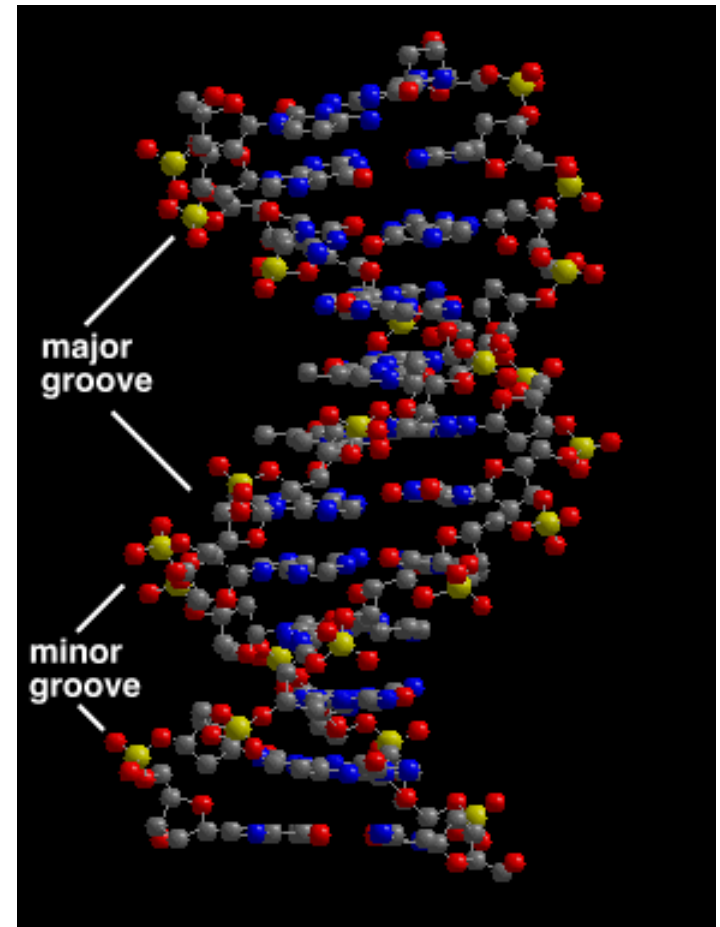
Source: <https://www.nature.com/news/neuroscience-making-connections-1.10260>

- **Mechanics applied to biological or medical problems**
- **Study of motion, material deformation, flow within the body, and transport of chemicals across biological and synthetic media and membranes.**
- **EXAMPLES:** artificial heart and replacement heart valves, the artificial kidney, the artificial hip, function of organs



• Bioinformatics

- Roughly, bioinformatics describes *any use of computers to handle biological information*.
- In practice, the definition used by most people is narrower; bioinformatics to them is a synonym for "computational molecular biology"---*the use of computers to characterize the molecular components of living things*.



• Designing medical devices

The application of electronics and measurement principles to develop devices used in diagnosis and treatment of disease.

e.g. electrocardiogram, cardiac pacemaker, blood pressure measurement, hemoglobin oxygen saturation, kidney dialysis, and ventilators.



Optune Device – FDA approved for treatment of high grade brain tumors

- Delivers low intensity alternating electric fields delivered through transducer arrays to disrupt cancer cell division and growth.

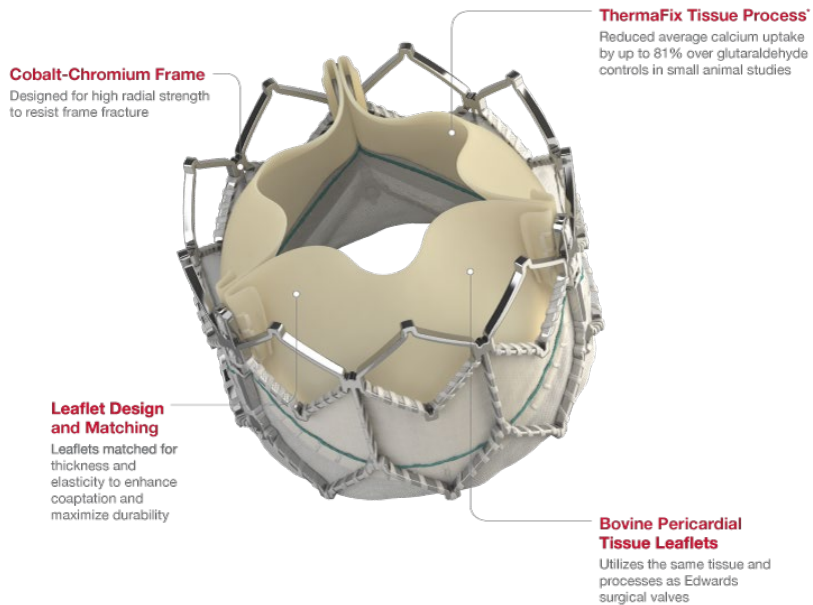


Original Optune® System



Second Generation Optune® System

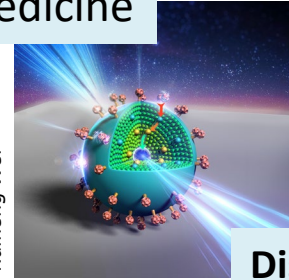
Replacement heart valve



<https://www.edwards.com/devices/heart-valves/sapien-xt-valve>

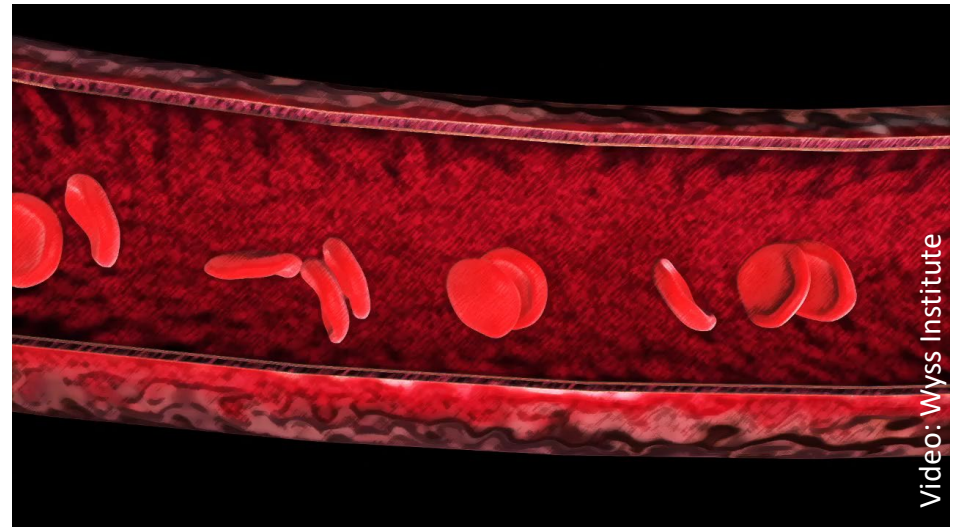
Nanomedicine

Kaiheng Wei



Disciplines involved:

- Biomaterials
- Blood physiology
- Physiology
- Toxicity
- Medicine
- Chemistry



Marosfoi *et al.*, *Stroke*, 2015, 46(12):3507-13.

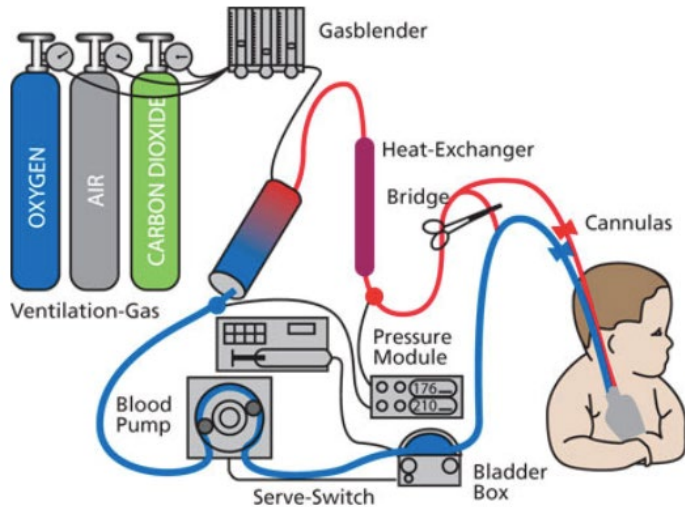
Example:

ECMO: ExtraCorporeal Membrane Oxygenation

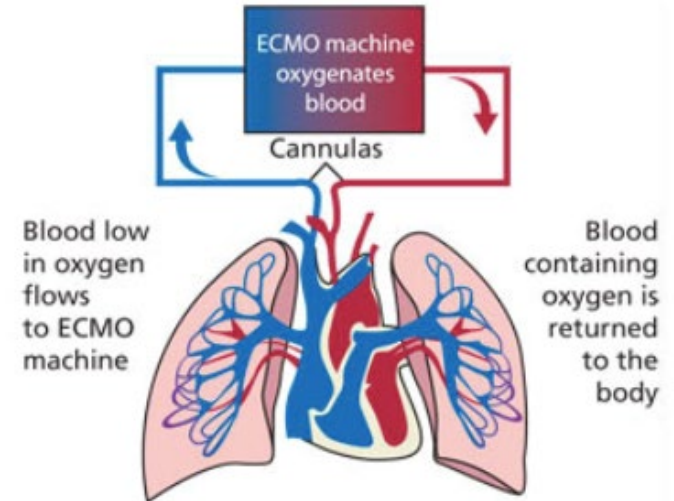
=> Heart/lung failure

Disciplines involved:

- Biomaterials
- Blood physiology
- Medicine
- Physics
- Flow dynamics
- Electronics



www.dellchildrens.net



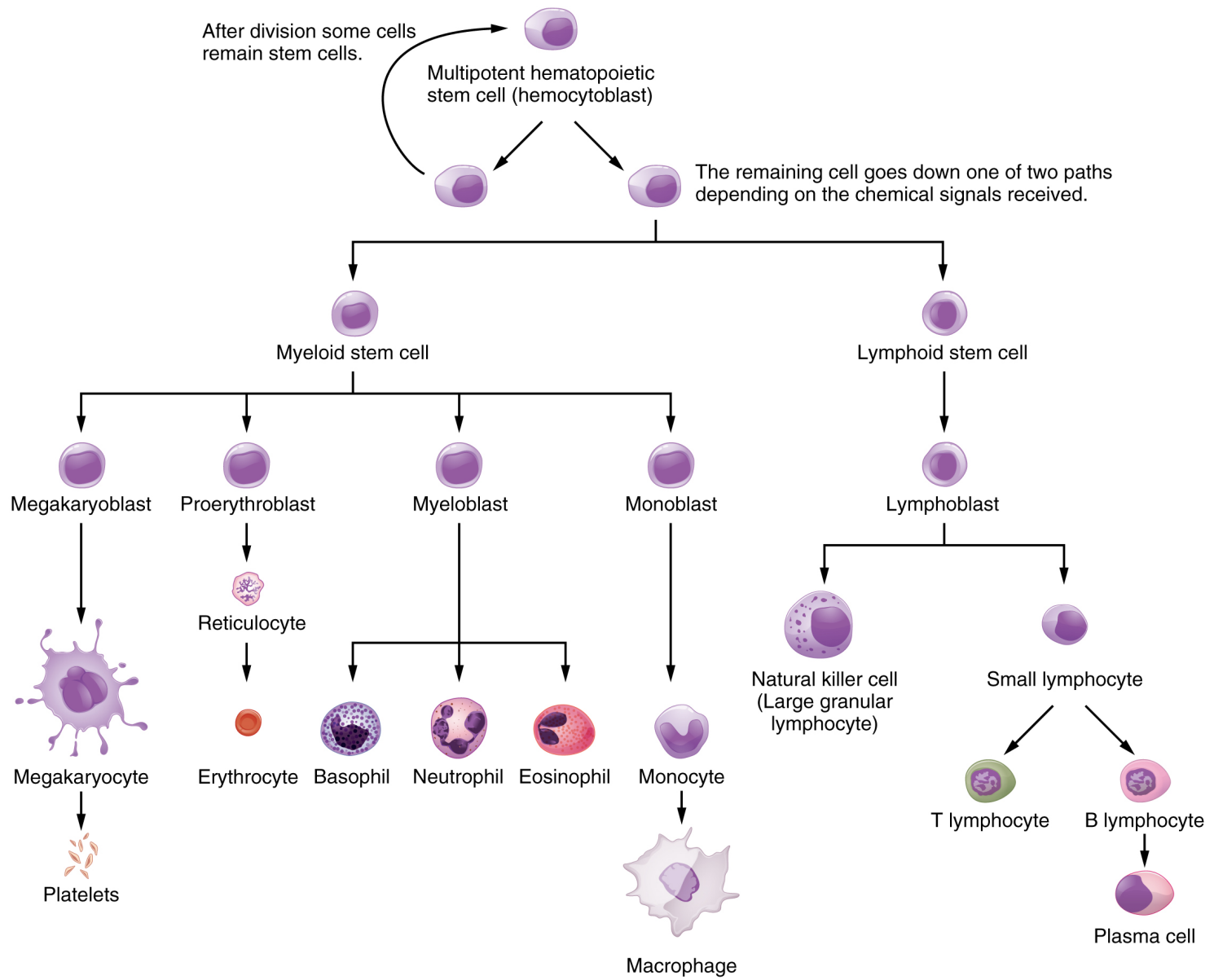
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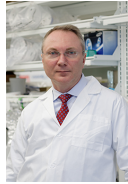
- Tubing connects to patient
- Blood gas monitor
- Pressure monitoring
- Water heater
- ECMO pump
- Artificial lung
- Back-up battery

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• Stem cell engineering



Biomedical Engineering at GWU



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