Welcome to Intro to Biomechanics! Our goal is to avoid the following…

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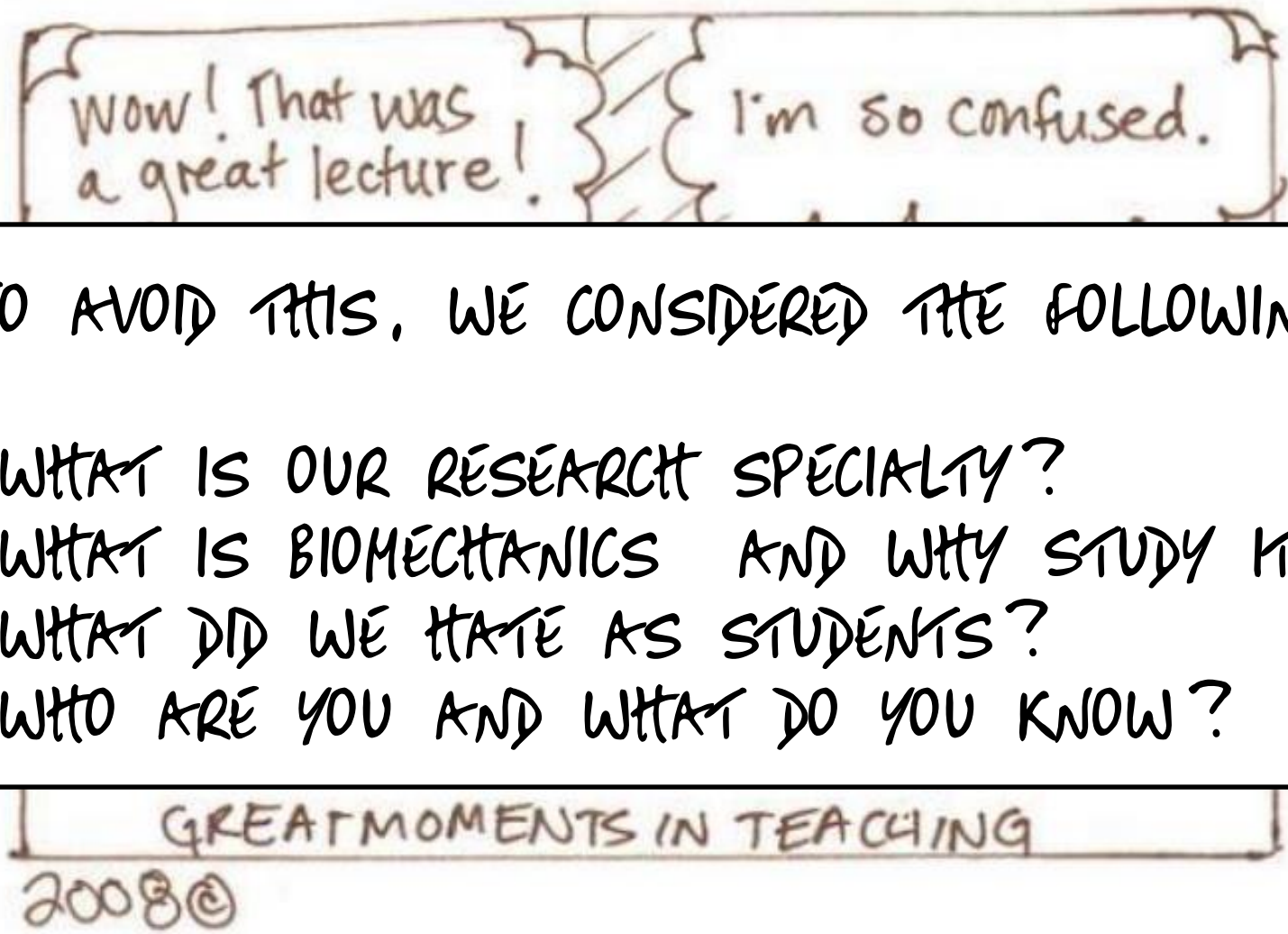
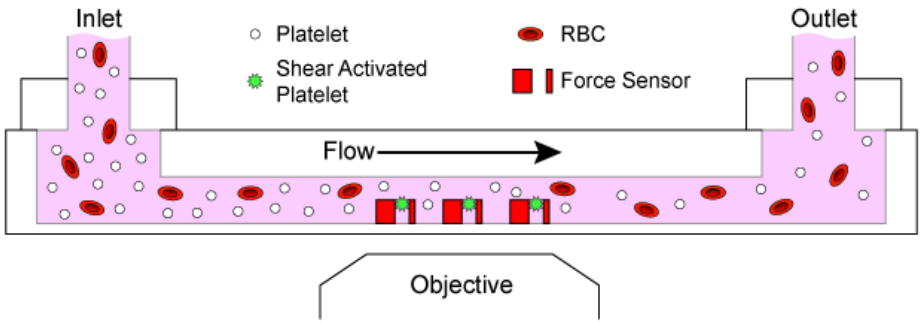
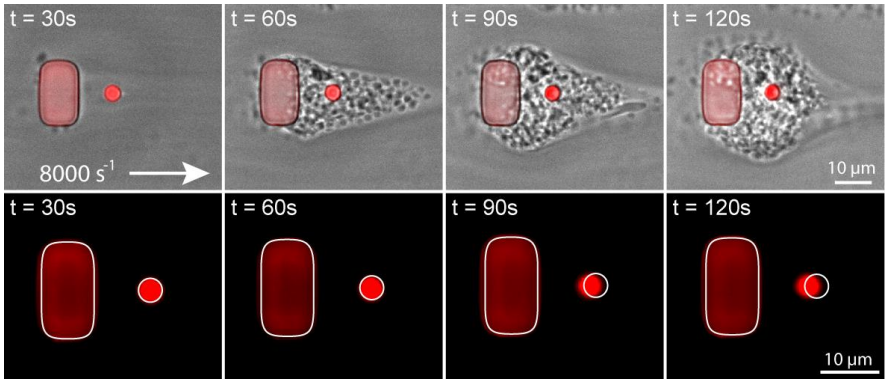
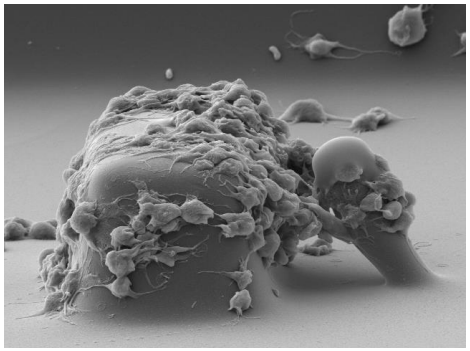


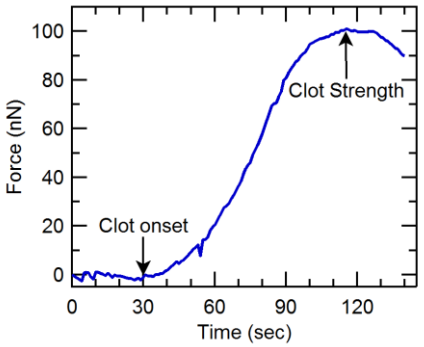
Who are we: Nikita Taparia

- 4th year PhD ME
- **Research interests:** bionantechnology, optics, microfluidics, data science
- **Thesis:** Platelet-VWF biomechanics and point of care blood diagnostic devices.
- I am a huge fan of tennis and I am an online commentator and tennis data analyst.



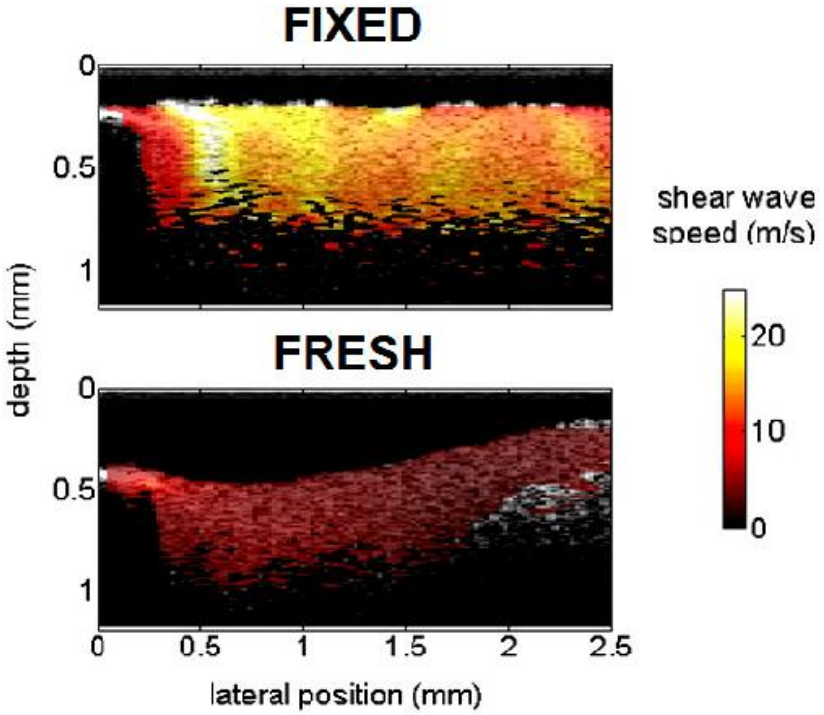


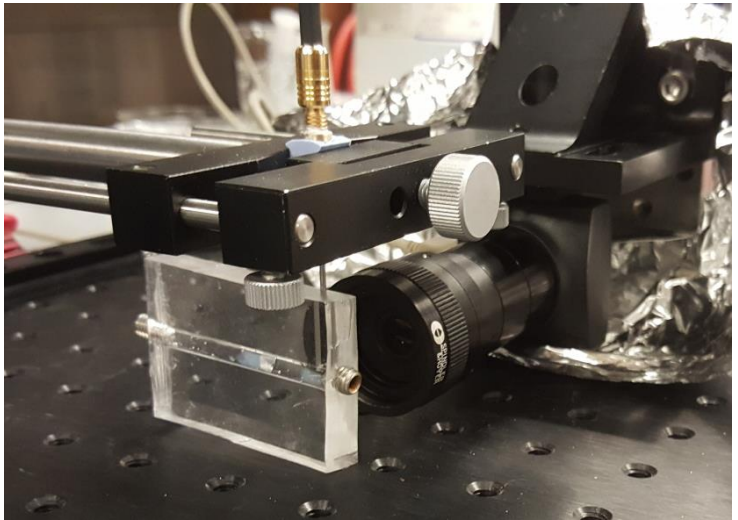




Who are we: Saniel Lim

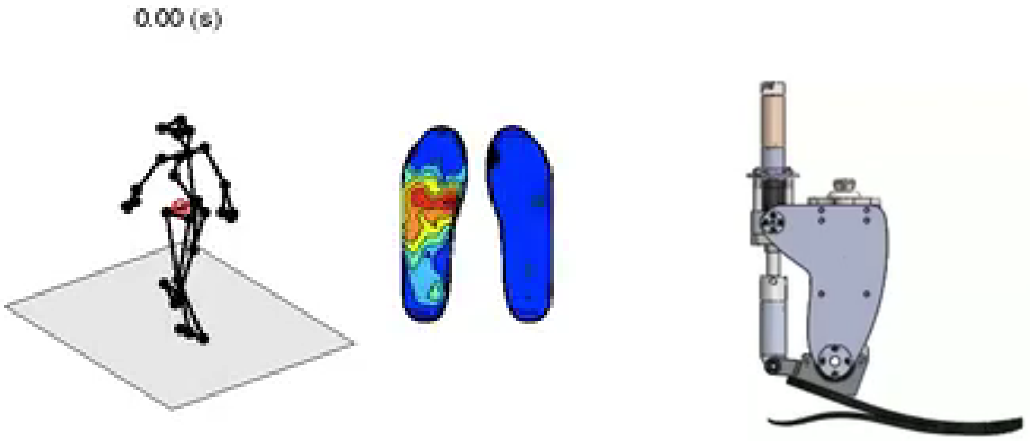
- 3rd year PhD ME
- **Research interests:** biomechanics, ultrasound, optics
- **Thesis:** Real-time monitoring the mechanical property change of a tissue sample during histological preparation
- Got into swimming 10 years ago, playing squash 5 years ago, and now parenting





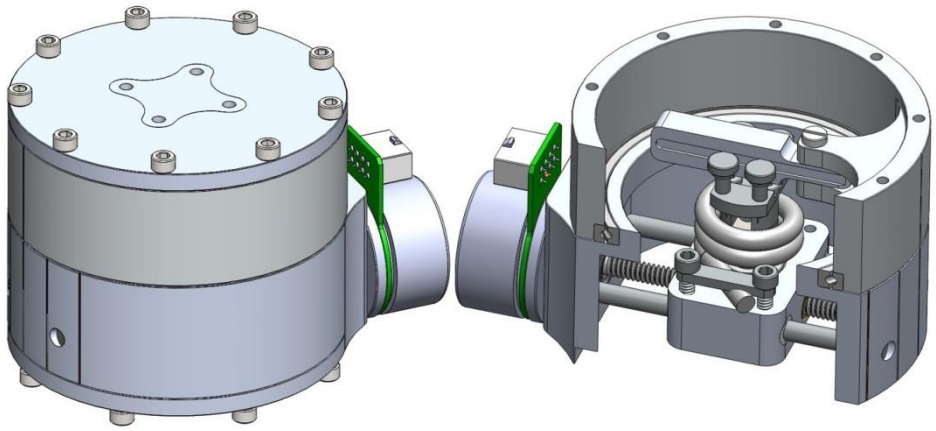
Who are we: Jonathan Realmuto

- 5th year PhD ME
- **Research interests:** biomechatronics, biomechanics, robotics
- **Thesis:** Powered ankle prosthesis with a nonlinear spring and individualized learning control
- I enjoy playing music (esp. drums) and playing Go (AlphaGo anyone?)



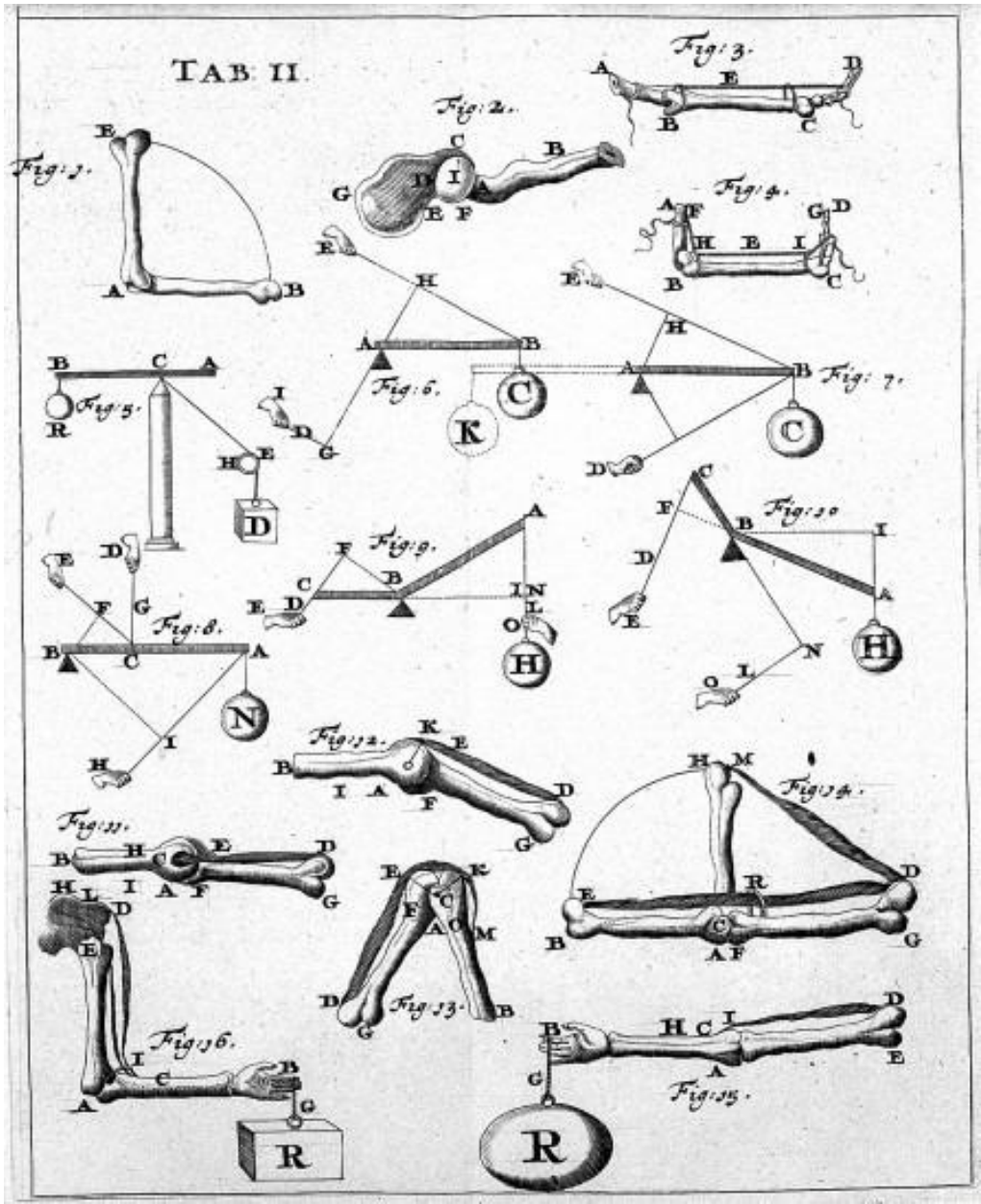
Who are we: Corey Pew

- 4th year PhD ME
- **Research interests:** lower limb prosthetics and biomechanics
  Thesis: My specific research is investigating the benefits of variable stiffness in the transverse plane for lower limb amputees.
- I like triathlons, and am a member of the UW Triathlon team.



What is biomechanics?

"The study of forces acting on and generated within a body and the effects of these forces on the tissues, fluid, or materials used for the diagnosis, treatment, or research purposes."



Why study biomechanics?

How do our bones grow in order to support your weight and deal with loads imposed on them?

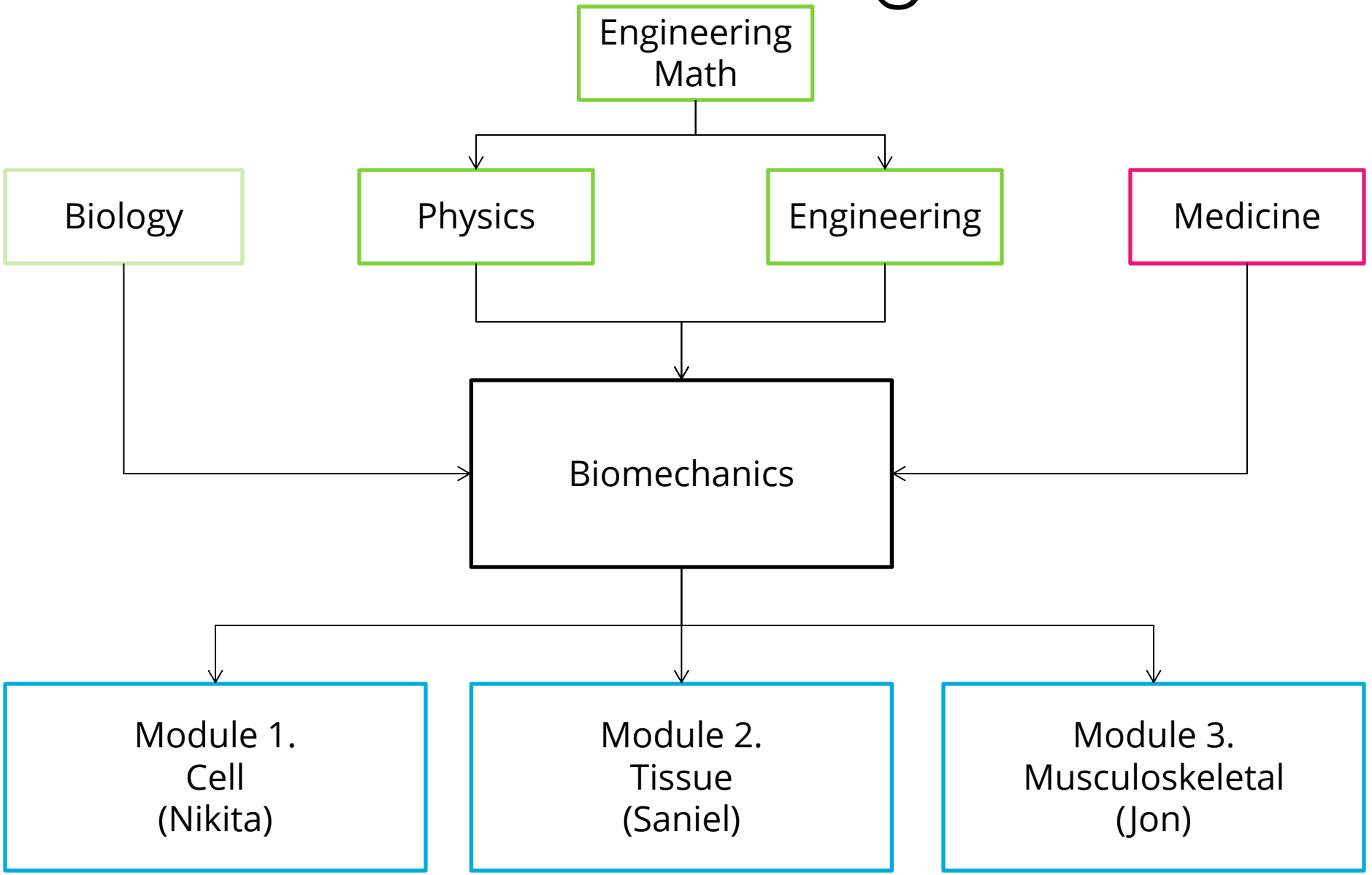
How do our arteries know what size to be in order to deliver just the right amount of blood to the fingers or to the eye?

How do you walk? How do you run? How do you jump?

How does your wound heal? How do you hear? How do your white blood cells catch pathogens?

How does the biomechanics change in disease and dysfunction? For example – malaria or designs of artificial implants.

Course Design



Lectures will include traditional style, group work, and guest lectures.

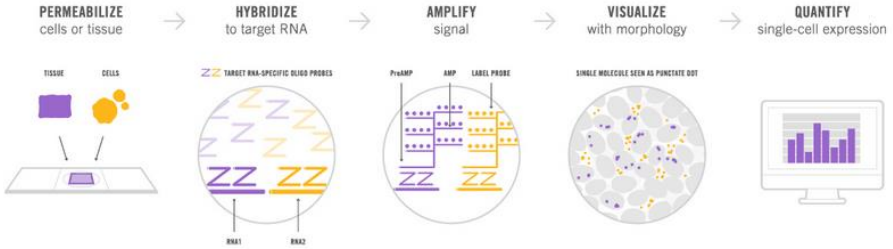
Module 1. Cell Mechanics

Goal: Use fundamentals from solid and statistical mechanics to quantitatively understand a cell's behavior.

Why? Understanding the behavior of a cell from a mechanical standpoint allows us the opportunity to revolutionize health care with new diagnostic techniques, modern medical therapies, and disease modeling

Stasys Medical

Holomic



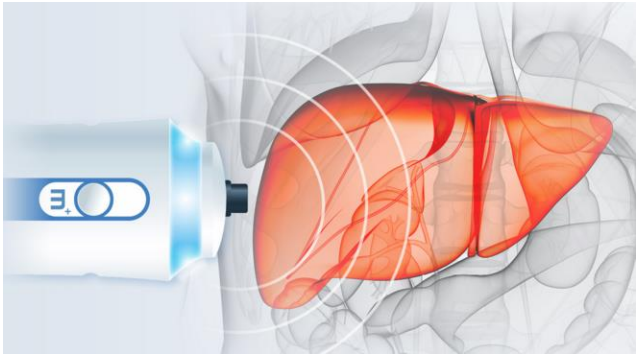
Advanced Cell Diagnostics

Careers in Biomechanics: Graduate studies are a must. Afterwards, you can work in cutting edge research institutes or your research could spin out into a startup.

Module 2. Tissue Mechanics

Goal: To provide modeling of tissue behavior and to introduce recent advances in tissue diagnostic tools

Why? The primary goal of challenging biomechanical problems with engineering mindset is to improve human health. Tissue is highly accessible and easy to measure, so it has served as an excellent source of diagnostic Information



Non-invasive liver diagnosis tool

Tissue testing system

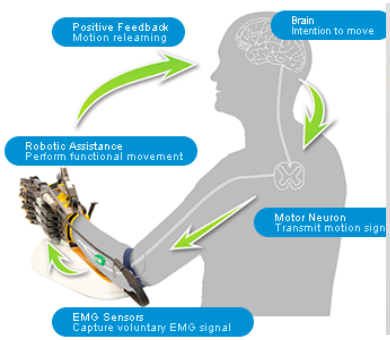
Soft tissue biopsy needle

Careers in Biomechanics: Related fields include medical devices development, biomedical imaging techniques, tissue diagnostics

Module 3. Musculoskeletal Mechanics

Goal: Functional understanding human movement.

Why? As engineers, we seek to design solutions to human problems. With respect to human movement these may include rehabilitation (e.g., rehab-robotics), assistance (e.g., prosthetics/orthotics), monitoring (e.g., diabetes), and augmentation (e.g., exoskeletons).



rehab-robtics


HCi Viocare


MIT Biomechatronics


ESKON

Careers in Biomechanics: Gait analysis research lab, sports companies (Nike, etc.), ergonomics, wearable robotics, sports sciences, researcher

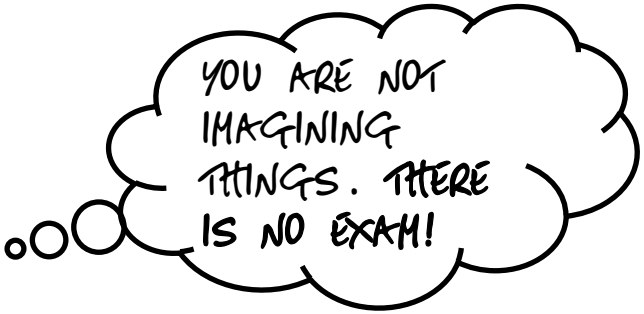
Grading Scheme

Module 1.
Cell
(Nikita)

Module 2.
Tissue
(Saniel)

Module 3.
Musculoskeletal
(Jon)

Intro to Biomechanics



Projects (50%)

Oral Project Proposal (15%)
Oral Project Update (15%)
Final Written Report (35%)
Oral Final Presentation (35%)
Team Assessment (Multiplier)

In Class Work (10%)

Attendance is required
Imagine 1% for each week. Group work on problems and project will be done.

Homework (40%)

9 Assignments – 3 for each module designed to test your ability to use your previous knowledge and apply it towards biomechanics.

Team Assessment

What do you mean by multiplier?

How you work in a team will define most of your industry or academic life. Our goal is to make sure you understand how you perform in a team dynamic.

You will develop your own grading scheme for team assessment. You will submit this assessment about your teammates at the end of module. Only the last one will count – giving you a chance to improve your performance but you will see this grade throughout the quarter.

Your final team project grade is multiplied by your participation grade.

Example

Your team gets 100% on the entire project but your team members believe you performed sub-par, and your evaluation results in 50%. This means you will receive 50% as a final project grade.

*Remember, our goal is to make sure everyone contributes **equitably**.*

Project Format – Conference Style

Phase I (15%)

Oral Project Proposal (3 min)

Due: 4/19

- Develop a Team Assessment. Teams must be interdisciplinary.
- What's your main point? [What are we doing?]
- How does it fit in the big picture? [Why is it important?]
- What's the approach? [How are we doing it?]
- What is our projected timeline?

Phase 2 (15%)

Oral Project Update (3 min)

Due: 5/12

- What are you doing and why is it important?
- What's the approach?
- What are the current challenges?
- What is our updated timeline?

Phase 3 (70%)

Final Written (6 pgs)

Oral (12 min)

- Abstract/References for the written conference proceeding.
- Introduction
- Methods
- Results
- Conclusion

Sample Project Ideas

Cell Mechanics

- Using experimental results from seminal papers – try to justify them with 2-3 known cell mechanics models.
- Design the stiffest and yet lightest cell using tensegrity.
- Design a nanoscale device powered by a molecular motor protein.

Tissue Mechanics

- Choose one soft tissue and review the mechanics based on the results published in clinical journals; lung, liver, articular cartilage, skin, tendon, muscle, etc.
- Using a simulation tool, design a heterogeneous phantom model and evaluate the mechanical properties; strain, speed of sound, etc.
- For hepatic fibrosis, review ultrasound-based techniques

Musculoskeletal Mechanics

- Design a passive dynamic walker and model the device in simulation
- Design an active spoon device that can effectively cancel the tremor vibrations of the hand
- Design a prosthetic lower limb device including the mechanical system and sensor system needed to control the device

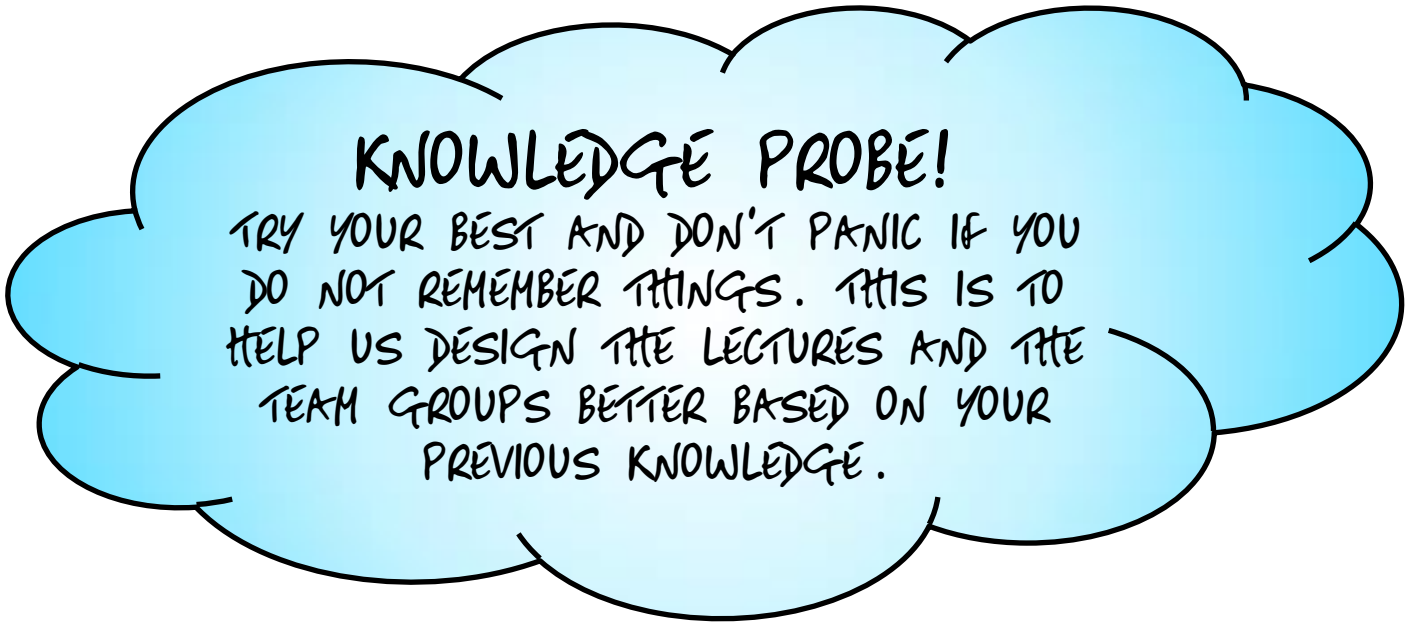
You are not limited to this list but it must be approved!

Who are you and what do you know?

As far as we can tell, this is all we know...

	BioE	ME	EE
Junior	1	8	0
Senior	21	15	1
Graduate	0	3	0

We would like to know more...



Important Emails/Links

http://courses.washington.edu/biome44/

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Saniel – saniel@uw.edu

John – realmuto@uw.edu

Corey – coreypew@uwl.edu

BIOMECHANICS SEMINAR!

Mondays 12:30-1:30