

The Integrated Mechanobiology of Plants and Animals Fall 2023

Course Directors:

Rebecca Wells (Penn)

Guy Genin (WashU)

Tuesdays/Thursday 11:00-12:20 ET; 10:00-11:20 CT

Live lectures in person when the lecturer is at a given site, broadcast via Zoom, recorded and posted

Zoom link: <https://pennteam.zoom.us/j/92759331913?pwd=QXAxZDhRJTdtWGJINWIDOU56MlcxUT09>

Students are expected to be present in class unless they have the permission of the instructor.

Lecture class sessions will include a 20 min discussion period and a 1 hr lecture.

Required work:

1. **Food-for-thought questions** will be distributed after each lecture; you must submit your answers (about 1 paragraph long) the evening before the next class (by 9 pm CT/10 pm ET), and be prepared to participate in a brief discussion at the start of class. (You will be graded based on efforts to think deeply and integrate the course material – there are no right answers.) Submit answers to rgwells@pennteam.upenn.edu.

2. There will be 3 formal **Homework Assignments** on quantitative material; there will be significant support available to complete these.

3. There will be 3 **Journal Club** discussions; these will be held independently at each site. Papers will be distributed in advance, and students are expected to contribute actively to the discussion.

4. The **Final Project** is a combined written and oral presentation of a grant proposal that you develop based on the material you learn in class. Details will be provided closer to the time.

If at all possible and unless they have permission from the instructor, students should attend class in person. At Penn, the class is held in the **CEMB conference room in the LRSM** (corner of 33rd and Spruce; first floor, go to end of left corridor off lobby, enter CEMB suite on the left, and you will find the conference room inside). If necessary, the remote link

is: <https://pennteam.zoom.us/j/92759331913?pwd=QXAxZDhRJTdtWGJINWIDOU56MlcxUT09>

Recorded lectures and other course material will be posted on **Canvas**, as will all course announcements.

Office hours with Penn Instructor (Rebecca Wells) are by appointment: rgwells@pennteam.upenn.edu

Grading:

25% for homework (x3) and food-for-thought submissions

25% for journal club participation and written comments in advance

50% final presentations

Module 1: Introduction to the class and to basic plant and animal cell mechanics

1. 8/29 Tu **Wells (Penn)/Genin (WashU):** Introduction to the class
Janmey (Penn): Basic biochemistry and why it underlies mechanics
2. 8/31 Th **Carlsson (WashU):** Mechanics, force balances, and polymerization forces
3. 9/5 Tu **Dixit (WashU):** Basic plant and cell bio
4. 9/7 Th **Ostap (Penn):** The cytoskeleton
5. 9/12 Tu **Wells (Penn)/Foston (WashU):** The animal ECM and plant cell wall
6. 9/14 Th **Journal Club #1**
7. 9/19 Tu **Homework Help**

Module 2: Advanced plant and animal cell mechanics and introduction to tissue mechanics

8. 9/21 Th **Goldman (Penn):** Motor proteins; **HW #1 DUE**
9. 9/26 Tu **Braybrook (UCLA)/Janmey (Penn):** Plant and animal tissue structure and mechanics
10. 9/28 Th **Carlsson (WashU):** Perpendicular and lateral forces from cytoskeletal filaments
11. 10/3 Tu **Carlsson (WashU):** Forces from cytoskeletal arrays, protein layers and 3D condensates
12. 10/5 Th **Alisafaei (NJIT):** Mechanical properties of biological materials
13. 10/10 Tu **Journal Club #2 at Penn** (Wash U Fall Break)
14. 10/12 Th **Journal Club #2 at Wash U** (Penn fall break)

Module 3: Tissue and nuclear mechanics

15. 10/17 Tu **Anderson (Penn State):** Membrane trafficking and vesicle transport
16. 10/19 Th **Pathek (WashU):** Adhesion receptors and signal transduction; **HW #2 DUE**
17. 10/24 Tu **Discher (Penn):** Nuclear mechanics
18. 10/26 Th **Carlsson/Genin (WashU):** Statistical mechanics and diffusion; osmotic forces and force distribution within cells
19. 10/31 Tu **Lakadamyali (Penn):** Nucleus and chromatin structure

Module 4: Integrating biology and mechanics: big questions

- 20. 11/2 Th **Mauck (Penn):** Memory, the nucleus, and the ECM
- 21. 11/7 Tu **Burdick (U Colorado):** Integrating biology and mechanics through materials
- 22. 11/9 Th **Chen (BU):** Mechanics and models of regeneration /engineered microenvironments
- 23. 11/14 Tu **Journal Club #3**
- 24. 11/16 Th **Cosgrove (Penn State):** Structure and growth of plant cell walls; **HW #3 DUE**
- 25. 11/21 Tu **No Class – help as necessary on proposals** (VT on Thanksgiving break already)

(Thanksgiving break)

- 26. 11/28 Tu **Boerckel (Penn):** Developmental biology and tissue mechanics
- 27. 11/30 Th **Panel discussion** on agricultural and biomedical applications of mechanobiology
- 28. 12/5 Tu **Radhakrishnan (Penn):** Mechanical deformations of membranes
- 29. 12/7 Th **TBD**