Fundamentals of Mechanobiology

Week 1: Introduction to mechanobiology

- Biological entities as machines: Historical perspective and development
- Basic forces at play in the scale of molecules and cells
- Molecular interactions and mechanical stability

Week 2: Methods in mechanobiology

- Atomic Force Microscopy (AFM)
- Tweezers, FRET, and biosensors
- Other single-molecule techniques

Week 3: Mechanobiology during gene expression and regulation

- Transcription and replication
- DNA damage
- Protein folding

Week 4: Mechanics of intracellular transport and cell division

- Molecular components and properties of tubulin cytoskeleton
- Mechanics of vesicular transport
- Mechanics of chromosomal segregation

Week 5: Mechanobiology of membranes

- Membrane architecture and tension
- Channels and transporters
- Vesicle formation

Week 6: Actin cytoskeleton

- Maintenance of cellular morphology
- Actin dynamics during cell migration

Week 7: Cell adhesion and extracellular matrix

- Cell adhesion: Cadherin-based mechanotransduction
- ECM components
- Integrin-based mechanotransduction

Week 8: Mechanotransduction pathways within cells

- Cytoplasmic mechanotransduction
- Nuclear mechanotransduction I

Nuclear mechanotransduction II

Week 9: Mechanobiology in disease

Cancer I
Cancer II
Cardiovascular disease

Week 10: Mechanobiology in disease

Neurodegenerative and neuromuscular disorders
Regenerative applications