Questions and Purpose

• Motors proteins convert chemical energy to mechanical energy
  – How do they move and generate force?
  – What paths do they follow on filaments?
  – How much fuel do they consume and how efficient are they?

• History:
  – 1864 – Myosin/actin isolated together
  – 1940s – Myosin and actin isolated separately
  – 1963 – Dynein motor isolated
  – 1985 – Kinesin motor isolated
  – 2000s – Genome projects found many related proteins

• Purpose of book
  – Need introduction to mechanics of highly damped, diffusive motion of cells and molecules, not to billiard balls or cannonballs.
  – Neurobiologists have excellent texts available explaining voltage, resistance and capacitance for cells and membranes, no such book for mechanobiology.
  – Physical chemistry books treat electrochemistry (good for pumps and ion channels), but not “mechanochemistry”.
Muscle Contraction

(A) Schematic of muscle contraction apparatus.

(B) Graph showing muscle length change over time.

Muscle structure components:
- Z disc
- Cap Z
- tropomodulin
- titin
- M line
- myosin (thick filament)
- plus end of actin
- nebulin
- minus end
- actin (thin filament)

Sarcomere ~2.2 μm
Motility and Cytoskeletal Polymerization

Xenopus (frog) keratocyte (skin cell) migrating

Actin mesh at leading edge

Actin mesh enlarged
Models and How to Probe Them