How Living Cells Work in Health and Disease

**Mechanobiology: How do Cells Generate Force?**
- **Cell Division**
  - Research: Perform quantitative mathematical modeling in collaboration with experimental biologists.
  - Response and generation of forces in migrating cells

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**Neurotransmission**
- Quick communication between 100 billion neurons at the synapses
- Fundamental pathway of synaptic transmission: action potential gates Ca²⁺ channels
- SNARE Proteins: conserved core of cell’s fusion machinery

**Hormone Secretion**
- Regulate and maintain various physiological functions
- The release rate of hormones is highly regulated.
- Medical applications: type II diabetes is caused by impaired insulin release

**Cell Migration: Immune System, Cancer Metastasis**
- Research: Goal: understand why lateral waves are formed at the leading edge of migrating cells through mathematical modeling

**Viral Infection: Influenza, Ebola**
- Membrane enclosed viruses (e.g., Influenza, HIV, Ebola) infect cells by fusing with the host cell’s membrane
- Thousands of deaths due to viral infection annually
- Long term goal: design anti-viral drugs
- Specialized fusion proteins release genomic material near cell nucleus

**Membrane Fusion**
- Possible pathway to fusion

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