

Ion Channels

Opportunity



- Channels are **Natural Nanomachines** that Detect and Amplify tiny chemical signals
- Channels are **Devices** that convert chemical signals to electrical (but ionic) current
- Channels control a wide range of biological function

Ion Channels

Opportunity



- *Molecular Biology*

- Channels are **Proteins**
- **Genetic Engineering** allows **Atomic Control** of Channels

- *MECS MicroElectroChemical Systems*

- Channels are **Electrochemical Devices**
- **Electrostatics & Electrodifusion** govern channels

Ion Channels

Challenges



- Channels are fragile
- Channels use ions

Ion Channels

Challenge



- Using channels as **Devices** requires treatment of their **Inputs** and **Outputs**
- Theory & Simulation must contain **Inputs** and **Outputs**
- Existing Simulations do not!

Channels as Devices

Challenge



- Using Biomolecules requires understanding them
- Engineers need Design Principles & Equations
- So do Molecular Biologists

Channels as Devices

Solution



- Molecular Biologists need
Design Principles & Equations
- *Solution:*
Train Molecular BioEngineers

Ion Channels

Challenges and Solutions



- Channels are fragile
 - *Make strong channel membranes*
- Channels use ions
 - *Link ions to electrons with electrodes*

Ion Channels as *Social Devices*



- **Engineering Community**
 - must learn Protein Structure
 - must learn Tools of Molecular Genetics
- **Biological Community**
 - must learn Device Design
using Physical Laws and Mathematics

Ion Channels as *Social Devices*



- Channel Engineers will become Protein Engineers
- Protein Engineers will use Biomolecules as Medical and Technological Devices
- Protein Engineers will create Atomic Biology by adding analytical insight to trial and error methods of Molecular Biology
- **ATOMIC BIOLOGY WILL CHANGE OUR WORLD**