

# Ion Channels

Tuesday, December 9, 2014  
8:59 PM

## Quaternary Structure

	Subunits		Notes
K <sup>+</sup> Channel	4		
Hb	4	2 $\alpha$ + 2 $\beta$	- $\alpha/\beta$ = similar structure - Dimer of $\alpha\beta$ heterodimers (tetrahedral)
Nicotinic Ach Receptor	5	2 $\beta$ + $\gamma$ + $\delta$	
F1ATPase	7	3 $\alpha$ + 3 $\beta$ + 1 $\gamma$	- $\alpha/\beta$ = similar structure, diff function

Coiled Coils	- Oligomerization of 2+ amphipathic $\alpha$ -helices - stabilized by hydrophobic effect - parallel/antiparallel - homomeric/heteromeric - superhelical - important in keratin & globular proteins
Amphipathic Helix	- hydrophobic on 1 side, hydrophilic on other side - Leucine zippers

## Integral Membrane Proteins ( $\beta$ 1-Adrenergic Receptor, VDAC1, Hemolysin)

- nonpolar = tolerated
- polar & charged = not tolerated
- secondary structures to ensure H-bonds (neutralization)

## Protein Intramolecular Motions (*not rigid*)

- atomic vibrations
- coordinated movements
- triggered conformational changes

**ALLOSTERY** -  $\Delta$ structure causes  $\Delta$ function

## Protein Structure

SECONDARY - backbone of peptide chain stabilized by H-bonds between amine & carbonyl groups ( $\alpha$ -Helix/ $\beta$ -Sheet)

TERTIARY - 3D conformation with loops; inside = nonpolar / outside = polar

QUATERNARY - multi-subunit

**TRANSMEMBRANE DOMAINS** -  $\alpha$ -Helix/ $\beta$ -Sheet

## Ion Channels

ION CHANNELS - transmembrane proteins that form ion pores

- nerve conduction
- kidney filtration
- muscle contraction
- hormone secretion
- cardiac excitability
- vision, smell, taste, touch, hearing

## Ion Channel Gating

- voltage
- ligand (EC/IC)
- mechanical

## Neurotransmitter-Gated Ion Channels

**EXCITATORY** - stimulate nerves by depolarization

**INHIBITORY** - repress nerves by hyperpolarization

---

## SUMMARY

- Ion channels are integral membrane proteins that catalyze the transmembrane flux of ions down their electrochemical gradients
- Responsible for numerous physiological processes, including nerve conduction, muscle contraction and cardiac excitability.
- Three main properties of ion channels are
  - rapid ion flux
  - selective permeation
  - gating
- Rapid, selective permeation is achieved by relatively weak interactions of ions with polar groups that line the channel pore and take the place of the ion's hydration shell.
- Opening and closing of the channel pore (gating) occurs in response to environmental stimuli, including changes in transmembrane voltage and ligand binding. Ion channel pharmaceuticals can act by directly blocking the ion conduction pore or by altering the channel gating properties