Muscles – Proteins that Move : Table of Contents (4 lectures)

Muscle 1: Muscles: Overview, Contractile Proteins in Prokaryotes and Eukaryotes

(55:08 min:sec)

Muscle 2: Electrical Properties of Cells (56:47 min:sec)

0:00	Introduction
0:16	Bioelectricity: History (Gavani, Volta and Matteucci)
2:29	Ohm's Law, e=iR (volts = current x Resistance) Voltage is the force that moves current
4:05	Water flow as an analogy for electrical current
6:46	Bioelectric current – movement of charged ions
8:07	Electrical Propterties of a Cell – ion distribution, transmembrane voltage
11:50	Resting Potential – Ion Distributions – Cl^-
15:55	Resting Potential – Ion Distributions – Na^+ & K^+
17:57	Nernst Equation – force (voltage) necessary to maintain a concentration gradient of a charged substance (voltage opposes concentration)
21:17	Nernst Equation – solutions for different ions
25:50	Goldman Equation – Nernst Equation solved for multiple ions with differing permeabilities. RESTING POTENTIAL (no current <> no volts)
29:45	Action Potential – Hodgkin & Huxley and the Squid Giant Axon
33:36	Goldman Equation – Nernst Equation solved for multiple ions with differing permeabilities. ACTION POTENTIAL – voltage sensitive ion channels alter membrane permeabilites of specific ions
37:00	Voltage Sensitive Ion Channels – structure and mechanism of voltage sensitivity
42:05	Voltage Sensitive Ion Channels - Diversity
45:45	Action Potential – step by step <<>> Permeability Rules!!!
49:00	Propagation of Action Potentials – nerve cells and muscle cells
50:30	Propagation of Action Potentials – one channel triggers the next
54:30	Summary – even plants have action potentials

Muscle 3: Actin – Myosin Interactions (34:45 min:sec)

0:00	Introduction
0:13	Contractile Elements – muscles, fibers, fibrils, sarcomeres, sliding filament concept
5:48	Actin – G-actin (monomer) v. F-actin (polymer), structure and organization, helical structure (16 actin period), binding sites for actin, myosin, ATP (growth related)
10:04	Actin – Tropomyosin – Troponin: Structures, Interactions, Ca^{++} activation
14:46	Myosin – Structure, Organization, 6 dimer period, hinges, Actin and ATP binding sites (ATP hydrolysis – ATPase). Ordered arrays of Actin and Myosin.
21:40	Actin – Myosin interactions: Conformational States
26:46	Actin – Myosin interactions: ATP hydrolysis energizes myosin; multi-point binding between actin and myosin drives head rotation and release of ADP.
29:30	Actin – Myosin interactions: restatement and Ca^{++} regulation
31:55	Summary and leading question: What controls Ca^{++}? What is the basis of "Excitation / Contraction Coupling"?

Muscle 4: Control of Muscle Contraction (52:04 min:sec)

0:00	Introduction
0:32	Muscle Structure: Routes of Action Potentials: Sarcolemma >> T-Tubules >> Sarcoplasmic Reticulum (SR)
1:45	Muscle Structure: Motor Neuron >> Nerve Muscle Synapse (Neuromuscular Junction) >> Sarcolemma >> T-tubules >> SR Regulation of muscle contraction through regulation of Ca^{++}.
3:55	Steps of Muscle Contraction - Overview: AP in Motor neuron to Ca++ release and recovery (relaxation).
6:00	Synapses – general features. Presynaptic events, incl NT storage and release (voltage sensitive Ca^{++} channels). Post synaptic events incl NT receptors (NT sensitive ion channels and GPCRs) leading to generation of ionic currents. Na^{+}/K^{+} currents depolarize (stimulate) while Cl^{-} currents hyperpolarize (inhibit).
12:55	Synapses, Vertebrate Skeletal Muscle. Acetylcholine (ACh) receptors, ACh esterase
16:05	Synapses, Vertebrate Skeletal Muscle: Electron Micrograph
17:23	Synapses, Vertebrate Skeletal Muscle. ionic currents. Regions with and without voltage sensitive ion channels, without and with ACh sensitive ion channels
20:30	Sarcoplasmic Reticulum: Ca^{++} pumps and Ca^{++} channels. Ryanodine Receptors (RYR). Critical [Ca^{++}] for troponin activation.
24:38	Sarcolemma – SR coupling: DHP receptors <<>> RYR channels. Voltage sensitive "ion channel" in sarcolemma (DHPR) directly couple to RYR channels in SR membrane.
28:55	Muscle Relaxation – turning off the activation pathway, removal of Ca^{++}.
31:33	Neurotransmitter Inactivation – diffusion, transporters, enzymatic inactivation.
36:16	Graded Muscle Contractions: Vertebrate v. Insect
40:24	Muscle Energetics: Fast Twitch v. Slow Tonic muscle fibers.
43:55	Properties of Other Muscles: Cardiac and Smooth Muscle Fibers, differences from Skeletal Muscle Fibers
48:31	Summary – variations support different behaviors in diverse species.