

Neurobiology

Mostly Neurophysiology, Really

Acutally Mostly Electrophysiology

Study Material

- Textbooks..
 - Library, colleague, buy
 - neurobiology textbook pdf ...
- Online Texts
 - <http://neuroscience.uth.tmc.edu/s1/introduction.html>
- Papers.....

The screenshot shows the NCBI Bookshelf website. The browser address bar displays <http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=Books>. The page features the NCBI logo and the 'Bookshelf' title in a large red font. A navigation bar includes links for Entrez, PubMed, Nucleotide, Protein, Genome, Structure, PMC, Taxonomy, OMIM, and Books. A search bar is present with the word 'Books' entered and 'Go' and 'Clear' buttons. Below the search bar, there are links for Limits, Preview/Index, History, Clipboard, and Details. The main content area is enclosed in a red border and contains the following text:

The **Bookshelf** is a growing collection of biomedical books that can be searched directly by typing a concept into the textbox above and selecting "Go". Try one of these searches:

- ▶ [cell cycle control](#)
- ▶ [immunodeficiency](#)
- ▶ [protein evolution](#)

Books are also linked to terms in PubMed abstracts: when viewing an abstract, select the "Books" link to see [phrases](#) within the abstract hyperlinked to book sections.

▶ **New on the Bookshelf:**

- ▶ **Historical Works: Medicine in the Americas.**
[History of Medicine Division](#)
Bethesda (MD):
[National Library of Medicine](#)(US); 2004 Mar.

Overall Aims

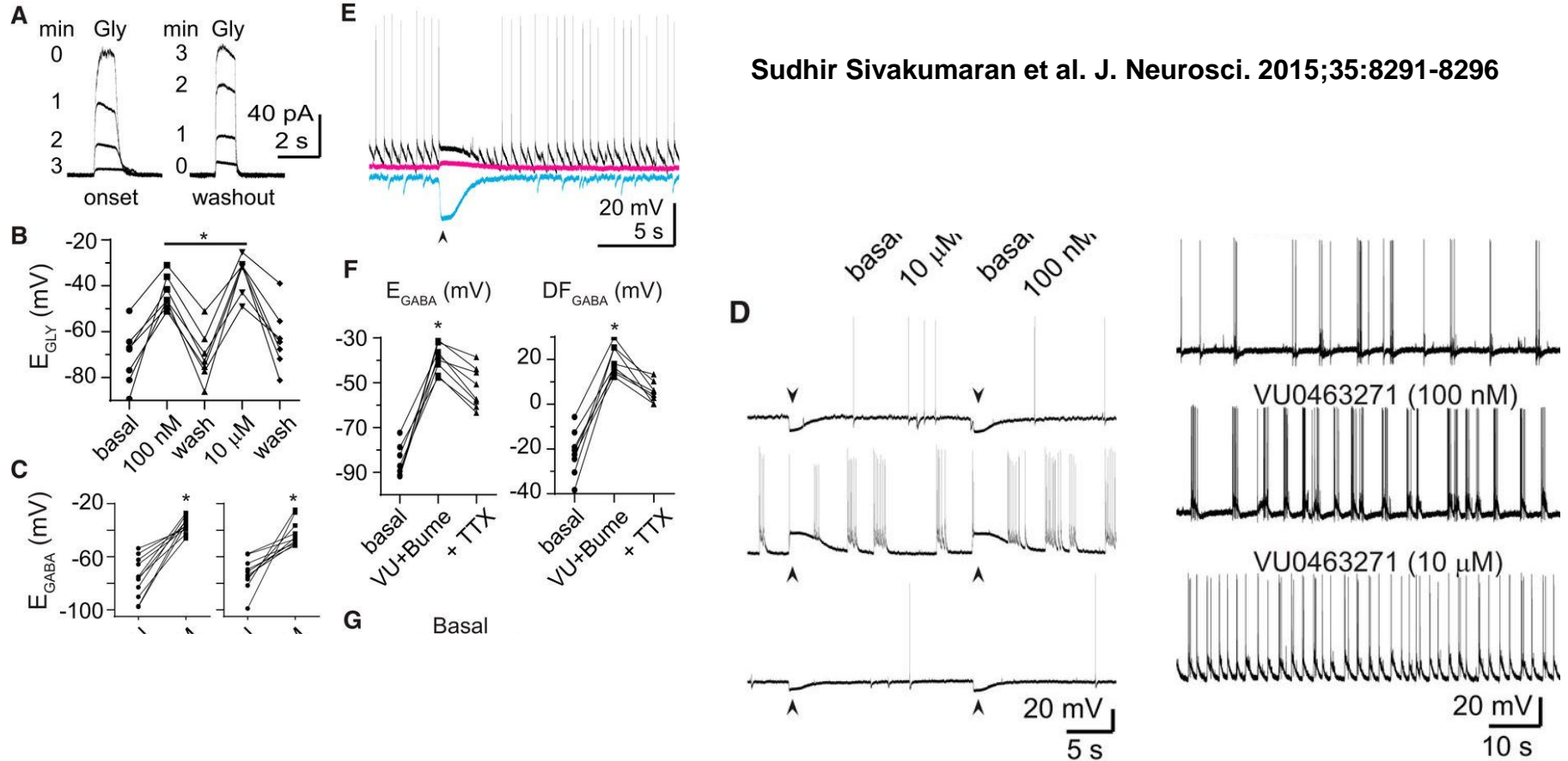
- Understand the basic concepts behind the electrical signals generated at the cell membrane.
- Know the values of the key parameters involved.
- Remember the typical techniques used to investigate these phenomena

Overall Aims

...recordings were performed at 34°C, and HEK cells were recorded at room temperature in the bath saline. For perforated patch experiments, pipettes contained saline (in mM): 140 KCl and 10 HEPES, pH 7.4 KOH. For whole-cell experiments, pipettes contained saline (in mM): 130 K-gluconate, 10 KCl, 0.1 CaCl₂, 2 Mg-ATP, 1.1 EGTA, and 10 HEPES, pH 7.4 KOH. Bath saline contained the following (in mM): 140 NaCl, 2.5 KCl, 2.5 CaCl₂, 1.2 MgCl₂, 10 HEPES, and 11 glucose, pH 7.4 NaOH. We performed an equimolar substitution of NaCl by KCl for the 10 mM [K⁺]_o experiments..... We used 20 mV voltage-ramp protocols over 1 s periods to determine the reversal potentials of the leak-subtracted muscimol-activated or glycine-activated currents. The voltages from whole-cell experiments were corrected offline using a calculated liquid junction potential value (16.3 mV) in Clampex (Molecular Devices). Transverse hippocampal slices (400 μm) were immersed in ice-cold cutting solution containing the following (in mM): 87 NaCl, 2.5 KCl, 0.5 CaCl₂, 25 NaHCO₃, 1.25 NaH₂PO₄, 7 MgCl₂, 50 sucrose, and 25 glucose (equilibrated with 95% O₂ and 5% CO₂). Slices recovered for 1 h in ACSF containing the following: (in mM) 126 NaCl, 26 NaHCO₃, 1.5 NaH₂PO₄, 2.5 KCl, 2 CaCl₂, 2 MgCl₂, and 10 glucose at 34°C. Electrodes filled with normal ACSF (1–5 MΩ resistance) and positioned in layer III of the medial entorhinal cortex were used to record epileptiform activity in normal ACSF with elevated KCl (5 mM) and lacking MgCl₂.

Overall Aims

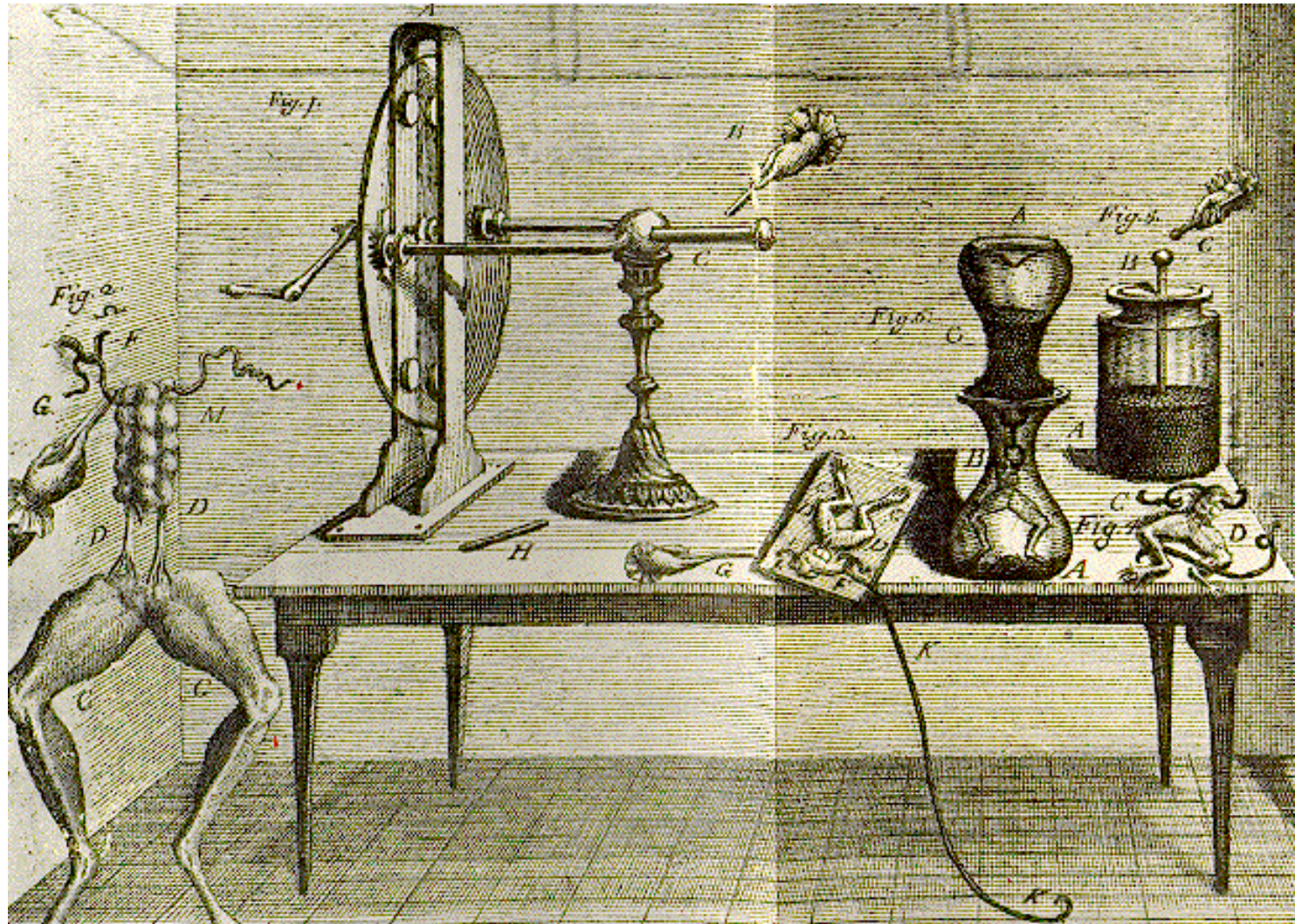
Sudhir Sivakumaran et al. *J. Neurosci.* 2015;35:8291-8296



Proposed Syllabus

Topics I	Topics II
Introduction	Synaptic Transmission
Electrochemical Gradients	Electrophysiology Techniques
Passive Membrane Properties	Basic Circuits (Spinal Cord)
Action Potential I	Sensory Systems Overview
Voltage-Gated Ion Channels	Synaptic Plasticity
Ligand-Gated Ion Channels	Recapitulation

Discovering Electricity



The Role of Electrical Signals

Ion channels and the electrical properties they confer on cells are involved in every human characteristic that distinguishes us from the stones in a field. Every perception, thought, movement, and heartbeat depends on electrical signals generated by the activity of ion channels.....

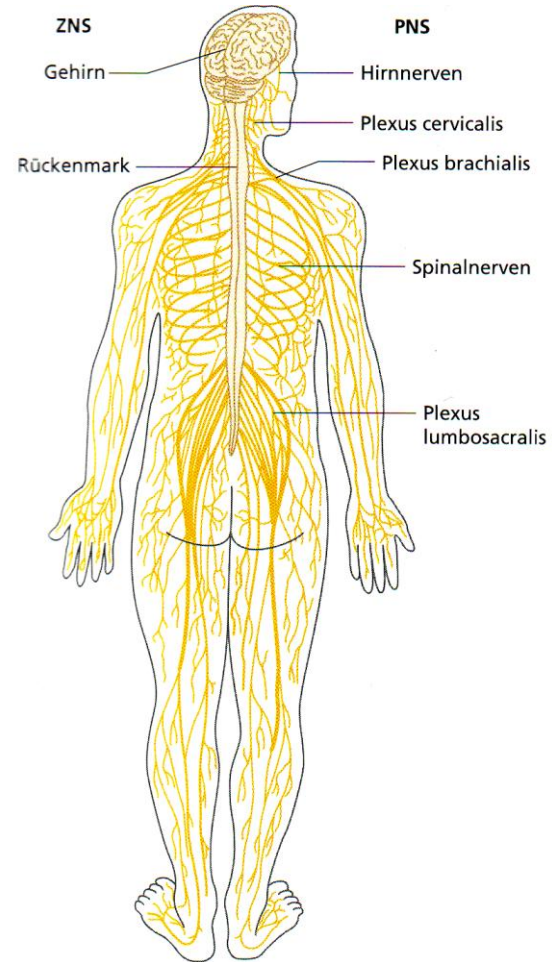
Science. STKE (Signal transduction knowledge environment)

Vol. 2003, Issue 188, pp. re10, 24 June 2003

„Voltage-Gated K Channels“

Clay M. Armstrong

Why a Nervous System?



Moving Around

Elements of Molecular Neurobiology. C. U. M. Smith
 Copyright © 2002 John Wiley & Sons, Ltd.
 ISBNs: 0-470-84353-5 (HB); 0-471-56038-3 (PB)

Figure 13.1 Rotary mechanism of a bacterial flagellum. The mechanism penetrates both the outer and inner membranes surrounding the bacterium. Energy derived from a proton gradient causes the 'M ring' (or motor) to rotate relative to the 'S ring' (or stator) at about 100 revolutions per second. The stator is embedded in the peptidoglycan layer. A rod links the M ring to a hook and then to a helical flagellar filament. A 'bearing' in the outer membrane acts as a seal. From Adler (1976), in Goldman, Pollard and Rosenbaum (eds), *Cell Motility*, Cold Spring Harbor, NY: Cold Spring Harbor Laboratory; with permission.

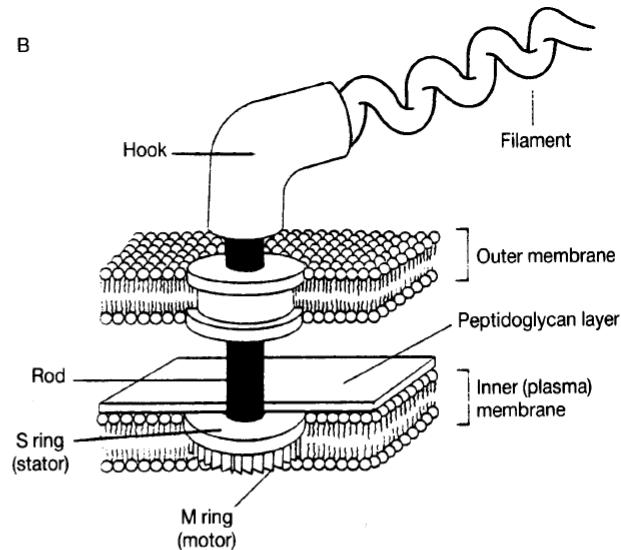
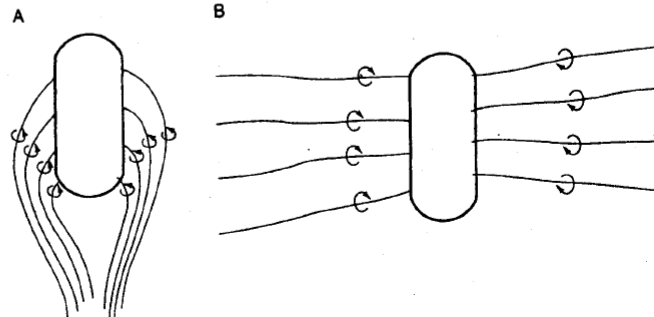
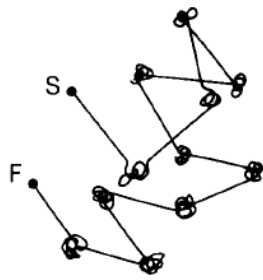


Figure 13.2 Anticlockwise and clockwise rotation of bacterial flagella. (A) Anticlockwise rotation. The flagella stream together as a single bundle which propels the bacterium forwards. (B) Clockwise rotation. The flagella each pull away from the bacterium in the direction of the straight arrows. According to the varying strength of the pull from each flagellum the bacterium veers from side to side and tumbles hither and thither.

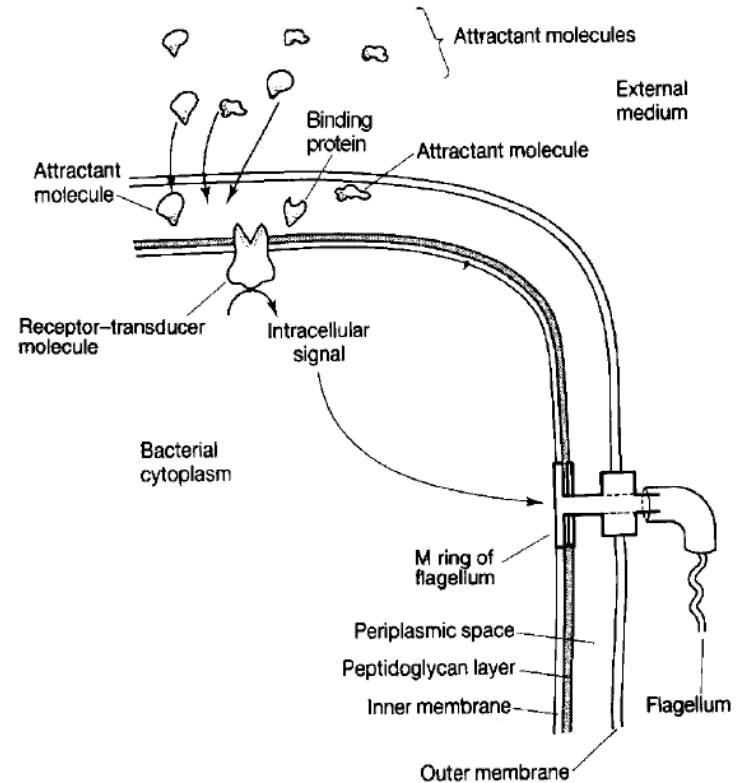
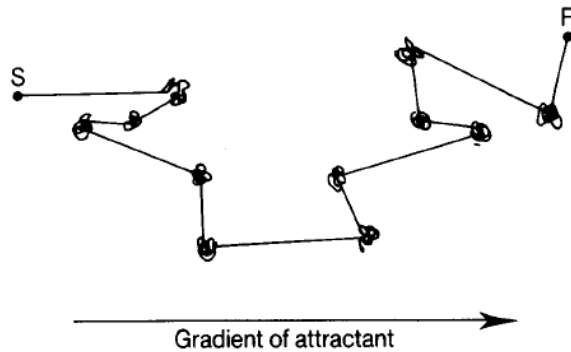


Reacting to a Gradient

A



B



Diffusion Times

Structure	Dimension	Time
Cell Membrane	1 nm	100 nano seconds
Mitochondria	1 μm	1 millisecond
Small Cell	10 μm	100 milliseconds
Large Cell	100 μm	10 seconds
Cortical Column	1 mm	16.7 minutes
Cortical Region	2 cm	4.6 days
Body	1 m	31 years

Review

- Nervous systems can quickly transmit information.
- Central nervous systems can integrate large amounts of sensory data, compute appropriate reactions and control effector organs (muscles and glands).
- This is achieved by an interplay of electrical and chemical signals.
- Within neurons the signals are generally electrical, between neurons they are mostly chemical.