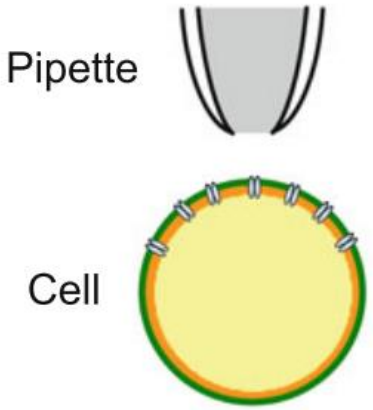
Advanced Electrophysiology

Lab 2

13, 19, 20 March 2026

Patch clamp in acute brain slices

Patch-clamp methods

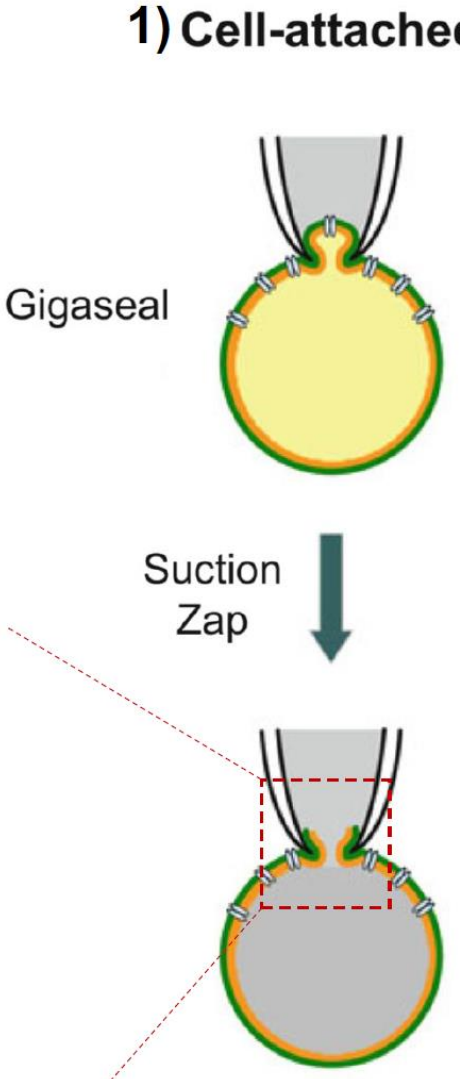


Whole-cell patch-clamp

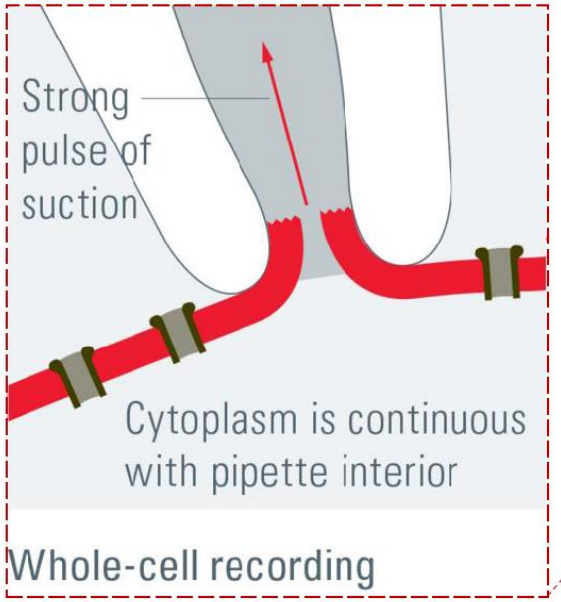
Rupture of the membrane under the pipette without rupture of the seal

to obtain **chemical and electrical access to the cell**

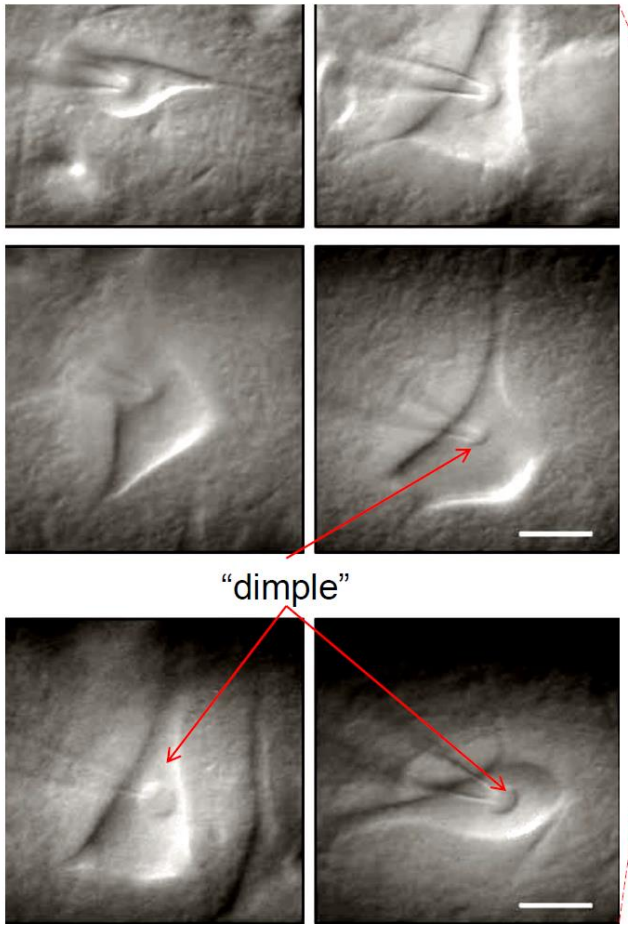
- **Pros:** control on V_m (**voltage-clamp**) or net current (**current-clamp**)
  possibility to use intracellular drugs
- **Cons:** skill-demanding (lower success rate)
  invasive (wash-out of ions and metabolites)

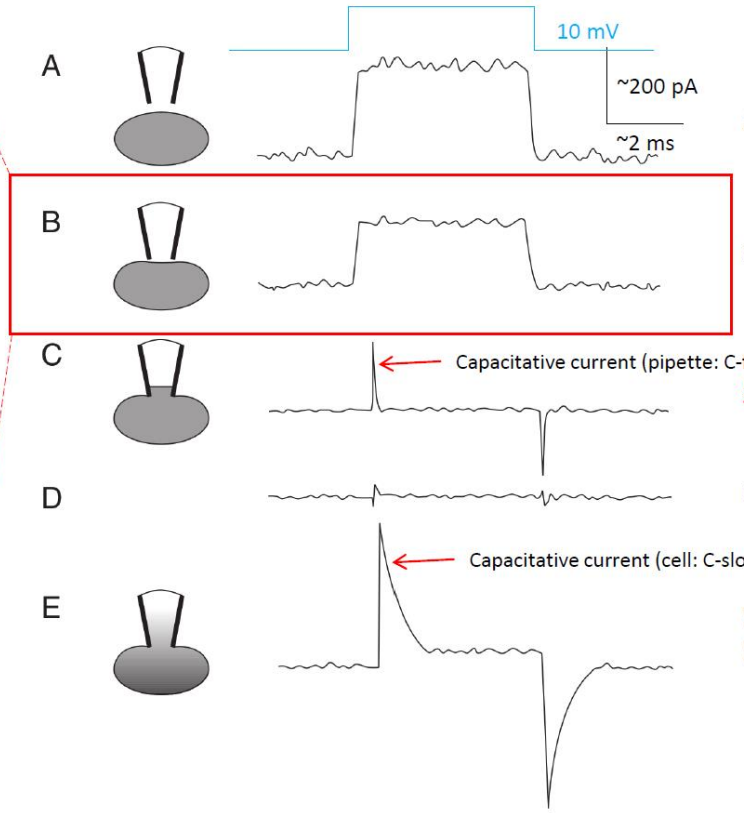


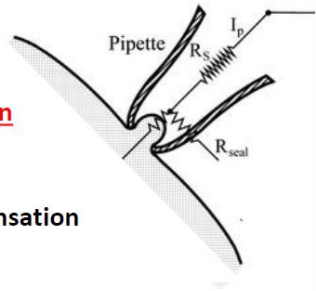
- In **current-clamp** configuration suitable for recording of APs and synaptic potentials (E/IPSPs)
- In **voltage-clamp** configuration suitable for recording **macroscopic** currents (voltage-gated or synaptic; e.g. E/IPSCs)
- But generally not suitable for single-channel recordings



The formation of a giga-seal







External solution: artificial cerebrospinal fluid (aCSF)

Salts	Cf (mM)
NaCl	124
KCl	5
NaH_2PO_4	1.25
$NaHCO_3$	26
$CaCl_2$	2
$MgSO_4$	2

Ion	Cf (mM)	
Na^+	151	← High Na^+
K^+	0	← Low / no K^+
Cl^-	133	← High Cl^-
Ca^{2+}	2	
Mg^{2+}	2	
HCO_3^-	26	(pH buffers)
SO_4^{2-}	2	
$H_2PO_4^-$	1.25	

pH = ~7.4

osmolarity = ~300 mOsm

Internal (intracellular) solution

Salts	Cf (mM)
KCl	9
KOH	10
$MgCl_2$	3.48
NaCl	4
K-gluconate	120
HEPES	10
Sucrose	17.5
Na_2ATP	4
Na_3GTP	0.4

Ion	Cf (mM)	
Na^+	13.2	← Low Na^+
K^+	139	← High K^+ (or Cs^+)
Cl^-	19.96	← Low Cl^-
Ca^{2+}	0	← Low / no Ca^{2+}
Mg^{2+}	3.48	
$Gluconate^-$	120	← Anions
HEPES	10	(pH buffers)
HCO_{3-}	0	
SO_4^{2-}	0	
$H_2PO_4^-$	0	
ATP^{2-}	4	← energy
GTP^{3-}	0.4	
Sucrose	17.5	← osmolarity

pH = 7.25-7.35

osmolarity = 295-305 mOsm
(10-20 mOsm lower than aCSF)

Learning objectives

1. Identifying neurons in acute brain slices
2. Approaching a neuron
3. Reaching a gigaseal
4. Breaking in the whole-cell configuration
5. Recording action potentials in current clamp
6. Recording currents in voltage clamp