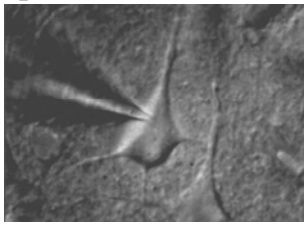
BIO 356L
Neurobiology Lab

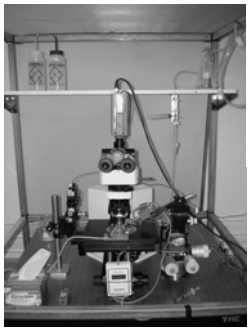
About the Course

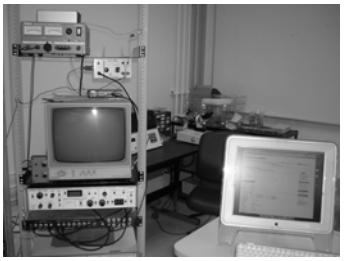
- Overview of topics and activities
- Syllabus
- Web resources: www.bio365L.net
- Lab reports
  - Using Labwrite
  - Grading

What you will do:



How you will do it:





The Big Picture:
Neurons, Neural circuits, and Behavior

- Neurons have *intrinsic properties*
  - Passive properties
  - Active properties
  - Intrinsic plasticity – changes in these properties
- Neurons are organized into functional circuits defined by their *network properties*
  - Topographical properties (the wiring)
  - Synaptic properties (the strength of the connections)
  - Synaptic plasticity – changes in these properties
- Neural networks underlie *behavior*

Theory Part I:
Passive Membrane properties

1. Basics of electricity
2. Ohms law
3. Resistors, Capacitors, and RC circuits
4. Biological membranes as RC circuits

Basics of Electricity

- Voltage: The separation of charge
- Current: The movement of charge

- Resistance: opposition to the movement of charge
- Conductance: the opposite of resistance

Ohms Law is Central

$$V = IR$$

Voltage = Current * Resistance

$R = V / I$

$I = V / R$

Electrical Components

- Resistors – oppose the flow of current
- Capacitors – store & release charge
- Resistors and capacitors together give rise to *time constants*

Quick thought experiments:

- What happens if we apply a steady current to a capacitor and measure the voltage across the capacitor?

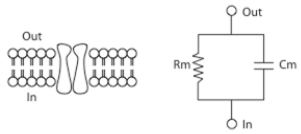
Quick thought experiments:

- What happens if we apply a steady current to a capacitor and measure the voltage across the capacitor?
- What happens if we add a resistor in parallel with the capacitor and apply a current to the RC circuit?

τ = Time Constant

- The time required for an RC circuit to reach 66% of its final voltage (or decrease to 33% of its initial voltage)
- $\tau = RC$
- $V(t) = Ve^{(-t/RC)}$

The cell membrane as an RC circuit



- The membrane exhibits resistance and capacitance
  - **The primary passive properties of the cell**
  - Resistance determined by open ion pores (channels)
  - Capacitance determined by cell size
  - Gives rise to the membrane *time constant*
- *Resistance determines the magnitude of the membrane's response to an input current*
- *Membrane time constant determines how fast the cell can respond to input.*

Practice Part I: The electrophysiology rig

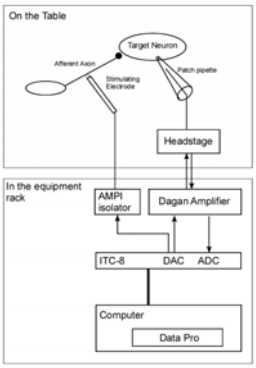
1. Physical components
2. Electrical components
3. Software

The electrophysiology rig

- Physical components
  - *Air table*
  - *Microscope*
  - *Micromanipulators*
  - *Perfusion system*
  - *Faraday cage*

The electrophysiology rig

- Electrical components
  - Computer
  - ITC digitizer
  - Dagan Amplifier
    - Current clamp
    - Voltage clamp
  - Headstage
  - AMPI stimulus isolator
- The software
  - Data Pro



Let's get to work:

Complete "Training Exercise 1: IGOR/Data pro exercises" using a model cell

What have we learned?

1. How to compute the resistance of a cell?
2. Determining the cell's time constant
3. Calculating the cell's membrane capacitance

For Next Week

1. Assigned Readings
2. Complete 1st draft of Prelab for this lab module