Introduction to Membrane Potentials

Joseph G. Griswald, Ph.D.
Dept. of Biology, The City College of New York

I. Introduction

In living things, most cell membranes have **membrane potentials**. This difference in electrical charge between the inside and outside of the membrane is the basis for many types of physiological processes, including transport of particles across the membrane and signaling among cells. It is estimated that in some cells up to 40% of energy is used to power active transport, a process that maintains or restores membrane potentials. The goal of this module is to enable you to understand the mechanisms through which potentials are developed and changed over time.

II. Student Background

To complete this module successfully, you should have or be provided with the following background:

A. Basic operating skills for computers: open programs, navigate using a mouse, type in responses, etc.

B. Definitions of chemical and electrical gradients.

C. Graphing basics: reading axes, plotting points, stating in words the trends shown by a graph.

D. Skills to read and follow simple written directions.

III. Benchmarks for the Module

Having completed this module, you will be able to:

A. To represent a cell membrane by drawing a labeled diagram.

B. To identifying the hydrophobic and hydrophilic elements, gated and passive channels, molecular pumps and the distribution of ions and molecules on the in- and outside of the membrane.

C. To determine from a diagram the net charge in and outside the cell membrane using simple counting methods, and calculate the membrane potential in a static system using algebraic methods or the free method introduced in the module.

D. To predict how ions will move through passive ion channels, given a starting ion distribution across the membrane.

E. To represent a membrane potential on a graph and plot changes in potential over time from a data set that is provided.

F. To state in words, using the terms **resting membrane potential, depolarize,** and **hyperpolarize,** the changes in membrane potential over time illustrated in a graph.

G. To predict what will happen to membrane potential with the opening & closing of gated channels.