Simple Membrane Model – Resistors in Parallel

Apparatus

low voltage power supply, ammeter, voltmeter, simple membrane circuit (5 resistors and 5 switches, shown below)

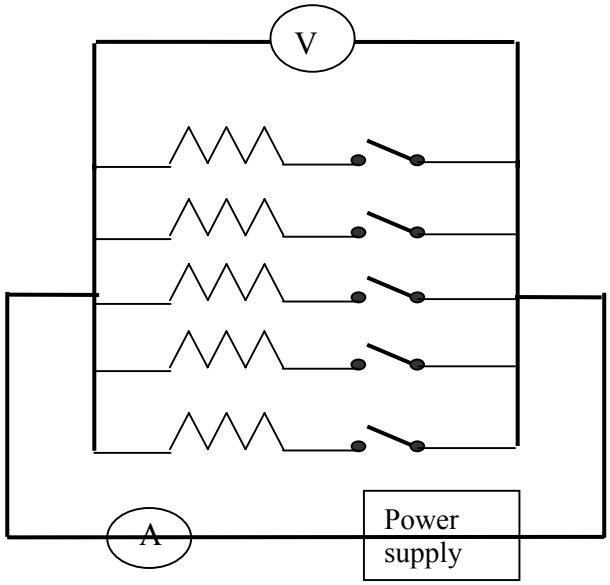
Action

The students connect the membrane circuit to the power supply and measure the voltage across the membrane and the current through the membrane with 0, 1, 2,…, 5 resistors in parallel.

The Physics

When resistors are connected in parallel the total resistance is less than any individual resistance. There are more paths for the current to flow along, and so the total current is greater. Resistance is the voltage divided by the current, $R = V/I$, so a larger current means a smaller resistance for a given voltage supply. This is a very simplified model of a cell membrane, but the basic configuration of channels which can be opened or closed in parallel across the membrane is correct.

The students should note that the voltage across the membrane does not change, but the current does. Time permitting, it is interesting to get them to plot resistance vs number of resistors connected, and note that the curve decreases with such that $R \propto 1/n$.



Accompanying sheet

Simple Membrane Model – Resistors in Parallel

Close one of the switches, leaving the rest open.
Measure the resistance of the membrane.

Close each of the switches,
and measure the resistance each time you add another resistor in parallel.

What is happening to the total resistance? Why?
What effect does this have on current flow across the membrane?