2.6.3 Electrical circuit model of the Cell Membrane.

- Model the cell membrane as a capacitor (because it separates charges)

- the Capacitance of any insulation is

$$\mathrm{Cm} = \frac{Q}{V}$$

where Q is charge across the capacitor, V is Voltage.

- two parallel conductor plates separated by an insulator of thinness of

$$Cm = \frac{k\varepsilon_0}{d}$$

k is dielectric constant

ε_0 is permittivity of flow space

- typical capacitance of cell membrane = 1.0uF/cm^2

-see Fig 2.11

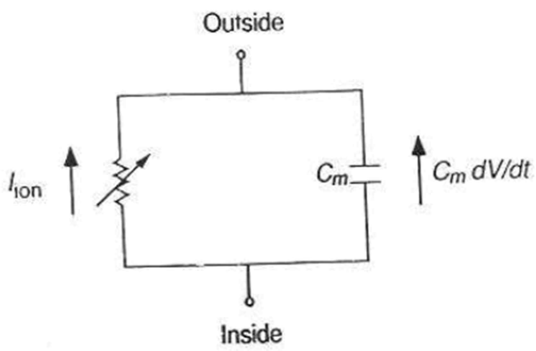

Figure 2.11 Electrical circuit model of the cell membrane.

the membrane acts like a capacitor in parallel with a resistor.

- since $I = \frac{d\theta}{dt}$

$$Cm\frac{dv}{dt} + I_{ion} = 0$$

$$V = V_i - V_0$$

- Another common Model, consider an ion and assume the potential drop has two components by the Nernst Equation.

$$V_s = \frac{RT}{ZF}\ln\left(\frac{[s]_0}{[s]_i}\right)$$

the potential drop due to the concentration differences

- Potential drop due to an electrical current = rI_s

r = channel Resistance

I_s = transmembrane current

$V = rI_s + V_s$

$I_s = g(V - V_s)$, $g = \frac{1}{r}$ = membrane conductance.

Expression of I_{ion} as a linear function of the membrane potential.