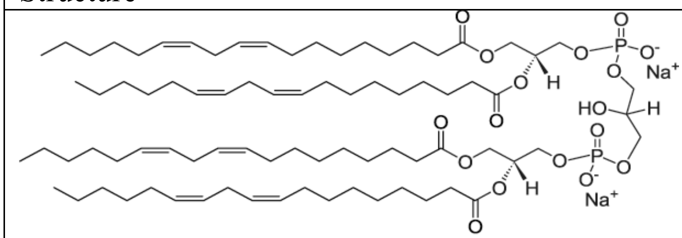
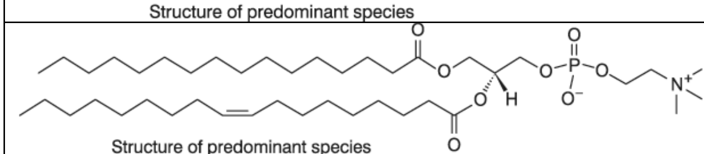
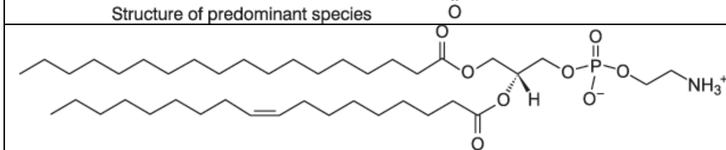
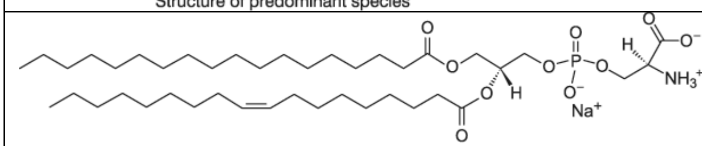
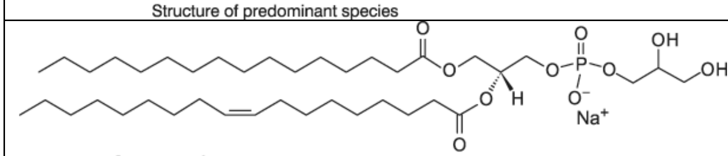
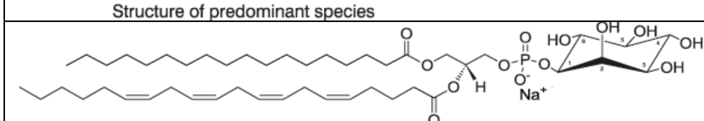
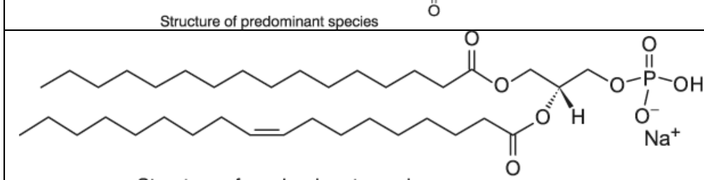
ATOMIC RADII, HYDRATION ENTHALPIES AND MOBILITIES			
Ion	Atomic Radii (Å)	Enthalpies of Hydration (kcal/mole)	Mobility (10^{-4}) (cm/sec)/(V/cm)
Tl^{+}	1.44	71	7.74
H^{+}	.	-269	36.3
NH_4^{+}	1.48	.	7.52
Cs^{+}	1.69	-72	8.01
Rb^{+}	1.48	-79.2	8.06
K^{+}	1.33	-85.8	7.62
Na^{+}	0.95	-104.6	5.19
Li^{+}	0.60	-131.2	4.01
Cl^{-}	1.81	-82	7.92
F^{-}	1.36	-114	5.74
Br^{-}	1.95	-79	8.09
I^{-}	2.16	-65	7.96
NO_3^{-}	2.90	.	7.41
Mg^{2+}	0.65	-476	2.75
Ca^{2+}	0.99	-397	3.08
Sr^{2+}	1.13	-362	3.08
Mn^{2+}	0.80	-458	.
Ba^{2+}	1.35	-328	3.30
Co^{2+}	0.74	-502	.
Ni^{2+}	0.72	-517	.
Zn^{2+}	0.74	-505	.

Source: Hille, B (1991) Ionic Channels of Excitable Membranes. Sinauer Associates. pp. 157 & 166.

Examples of Naturally Occurring Phospholipids	
Structure	Name
 Structure of predominant species	Cardiolipin
 Structure of predominant species	Phosphatidylcholine
 Structure of predominant species	Phosphatidylethanolamine
 Structure of predominant species	Phosphatidylserine
 Structure of predominant species	Phosphatidylglycerol
 Structure of predominant species	Phosphatidylinositol
 Structure of predominant species	Phosphatidic acid

Equations relevant to Membrane Transport: Geometry, Diffusion and Flux

Sphere Area: $4 \cdot \pi \cdot r^2$ Sphere Volume: $\frac{4}{3} \cdot \pi \cdot r^3$

Cylinder Area: $4 \cdot \pi \cdot r \cdot h$ Cylinder Volume: $\pi \cdot r^2 \cdot h$

Cube Area: $6 \cdot \mathrm{h}^2$ Cube Volume: h^3

Fick – 1st Diffusion Law: $J = D \cdot \frac{dc}{dx}$ Fick – 2d Diffusion Law: $\frac{dc}{dt} = D \cdot \frac{d^2c}{dx^2}$

Einstein – Random Walks: $D = \frac{1}{2} \cdot \frac{\Delta^2}{\tau}$, $\langle x^2 \rangle = 2 \cdot D \cdot t$, and $\langle r^2 \rangle = 6 \cdot D \cdot t$

Membrane Diffusion: $J = P \cdot (c_{outside} - c_{inside})$, $\mathrm{P} = \mathrm{D}\frac{\mathrm{k_p}}{\mathrm{d}}$

Membrane Diffusion: $J = -(uRT) \cdot \frac{dc}{dx} - (zFuc) \cdot \frac{d\Psi}{dx}$

Membrane Diffusion: $J = -P \cdot \left(\frac{zF\Psi}{RT}\right) \cdot \left(\frac{c_o - c_i \cdot e^{zF\Psi/RT}}{1 - e^{zF\Psi/RT}}\right)$

Nernst Equation: $\Psi = \left(\frac{RT}{zF}\right) \cdot \ln\left(\frac{c_o}{c_i}\right)$

Ohms Law: $V = I \cdot R$, $I = g \cdot V$, $R = \rho \cdot \left(l/A\right)$, and $J = I/(zF)$

Radial Diffusion: $C(r) = C_\infty \cdot \left(1 - \frac{a}{r}\right)$, and $J(r) = -D \cdot C_\infty \cdot \left(\frac{a}{r^2}\right)$

Radial Currents: $I_m = 4 \cdot \pi \cdot a^2 \cdot \beta$, and $I_d = 4 \cdot \pi \cdot a \cdot D \cdot C_\infty$

Cell Intake by Diffusion: $J = 4 \cdot \pi \cdot D \cdot C_\infty \cdot N \cdot s \cdot a/(N \cdot s + \pi \cdot a)$

Capture Probability: $P_s = a/(a + s)$

Dimensionless relations $P_e = \frac{2 \bullet a \bullet v}{D}$ and $R_e = \frac{\rho \bullet v \bullet l}{\eta}$

Goldman - Hodgkin - Katz (GHK) equation

$$\Psi = \frac{RT}{F}\ln\left(\frac{P_H c_H^o + P_{Na} c_{Na}^o + P_K c_K^o + P_{Cl} c_{Cl}^i}{P_H c_H^i + P_{Na} c_{Na}^i + P_K c_K^i + P_{Cl} c_{Cl}^o}\right)$$

Equations relevant to Bioenergetics

For the vectorial chemical reaction:

$$\text{ATP} + \text{n} \bullet \text{ion}^{\text{i}} \leftrightarrow ADP + P_i + \text{n} \bullet \text{ion}^{\text{o}}$$

(n is the stoichiometry)

$$\text{At equilibrium: } \Delta\text{G}_{\text{total}} = n \sum \Delta\mu_{ion} + \Delta G_{ATP}$$

$$\Delta G_{ATP} = \Delta G^o_{ATP} + RT \ln \frac{[ADP][P_i]}{[ATP]}$$

$$\Delta\mu_{ion} = RT \ln \frac{c^o_{ion}}{c^i_{ion}} + zF\Delta\Psi$$

Note that ΔG^o_{ATP} varies with pH and [Mg^{2+}]. For our purposes, specifying 10 kcal $mole^{-1}$ is a reasonable estimate.

Equations relevant to membrane capacitance

$$Q = C \cdot \Delta E \text{ (coulombs)} = \text{ (coulombs/volt) (volt)}$$

Charge (Q) for a spherical cell of radius r:

$$Q = \tfrac{4}{3} \cdot \pi \cdot r^3 \cdot c \cdot F$$

c is the concentration of net charge.

Capacitance of a spherical cell of radius r:

$$C = 4 \cdot \pi \cdot r^2 \cdot \text{C}' \quad C' \text{ is the capacitance per unit area}$$

(about 1 microFarad per square centimeter for cells).

Symbol	Value	Units	Comments
GAS CONSTANT			
R	8.314	J mol^{-1} K^{-1}	R is the Boltzmann constant times Avogadro's Number ($6.023 \cdot 10^{23}$)
	1.987	cal mol^{-1} K^{-1}	
	8.314	m^{-3} Pa mol^{-1} K^{-1}	
RT	$2.437 \cdot 10^{3}$	J mol^{-1}	At 20 ºC (293 ºK)
	$5.833 \cdot 10^{2}$	cal mol^{-1}	At 20 ºC (293 ºK)
	$2.437 \cdot 10^{-3}$	liter MPa mol^{-1}	At 20 ºC (293 ºK)
RT/F	25.3	mV	At 20 ºC (293 ºK)
2.303 • RT	5.612	kJ mol^{-1}	At 20 ºC (293 ºK)
	1.342	kcal mol^{-1}	At 20 ºC (293 ºK)
FARADAY CONSTANT			
F	$9.649 \cdot 10^{4}$	coulombs mol^{-1}	F is the electric charge times Avogadro's Number
	$9.649 \cdot 10^{4}$	J mol^{-1} V^{-1}	
	23.06	kcal mol^{-1} V^{-1}	
CONVERSIONS			
kcal	4.187	kJ (kiloJoules)	Joules is an energy unit (equal to 1 Newton•meter)
Watt	1	J sec^{-1}	
Volt	1	J $coulomb^{-1}$	
Amperes	1	coulomb sec^{-1}	
Pascal (Pa)	1	Newton $meter^{-2}$	Pascal is a pressure unit (equal to 10^{-5} bars)
Siemens	1	Ohm^{-1}	Siemens (S) is conductance, the inverse of resistance (Ohm)
PHYSICAL PROPERTIES			
η_w	$1.004 \cdot 10^{-3}$	Pa sec	viscosity of water at 20 ºC
ν_w	$1.004 \cdot 10^{-6}$	m^2 sec^{-1}	kinematic viscosity of water at 20 ºC (viscosity/density)

Source: Nobel, Park S (1991) Physicochemical and Environmental Physiology