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University of Utah  
Electronic Reserve Course Materials

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BE 1102

Spr 02

4/29/02

Major Concepts and Their Equations: ↓ (Reverse Order)

Bioenergetics: Metabolism —  
biochemistry, networks, ATP, NADH  
electrons, protons

Electrochemistry: batteries, fuel cells  
corrosion, Nernst equation  $E = E^{\circ} - \frac{0.06}{n} \log \frac{\text{conc 1}}{\text{conc 2}}$   
 $\sim 60 \text{ mV/decade } \Delta \text{ in conc.}$   
pH electrode

$\Delta G = -nFE$  electrical work

Reduction / oxidation potentials — half cells  
chemistry  
Biochemistry

Diffusion

Fick's Second Law — ?  
Fick's First Law

$J = -D \frac{dc}{dx}$

Einstein's approx.  $\overline{x^2} = 2D \Delta t$

Diffusion coefficient  
Drift Velocity  
chemical potential / other potentials  
Friction / Forces  
Random processes  
Maxwell-Boltzmann distribution

Enzymes

Michaelis-Menten — steady state  
K<sub>M</sub>, k<sub>cat</sub>, rate constants

Gepasi

coenzymes

Activation energy — pathways

Kinetics

Thermodynamics

## Kinetics

Activation Energy  
Maxwell-Boltzmann distribution  
Reaction rates / constants / orders  
Reversible / "irreversible"

## Thermodynamics

Chemical reactions  $\Delta G^\circ = -RT \ln K_{eq}$

Equilibrium,  $\Delta G = 0$

$\Delta G$ , free energy, the grand Yin-Yang! ←

Coupled reactions

Chemical Potential

$\Delta G = \Delta H - T\Delta S$  (first + second laws)

$\Delta S \geq q/T$  Entropy Second Law

$S = k \ln W$  randomness, states, ...

$\Delta H = q_p = (\Delta U)_p - w$  Enthalpy

calorimetry, heats of reaction

$\Delta U = q - w$  Conserv. of Energy, First Law

Systems:  $W, Q, U, m, F, P, T$

Energies: Kinetic / Potential; Works

Ideal Gases: Equations of State

## BASICS

Newton's Laws / Thermodynamics / Conservation

Buffers, pH, acids, bases, protons

Henderson-Hasselbalch Equation

$$pH = pK_a + \log [A^- / HA]$$

$K_a, pK_a; H^+, pH$

Water - polarity, bonding

Coulomb's Law

Primary / Secondary bonding

ATOMS - Ions - Molecules

Periodic Table

Creation, time, scaling

"Science" - what it is - and isn't

(Hard Rules  
Soft Rules)

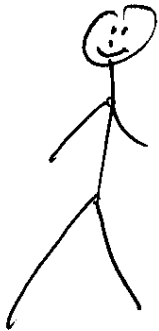
NEWS

# Bioengineering:

"Listening" :      Sensing      Signals from  
                         Measuring      system  
                         observing      Information out

"Thinking" :      Modeling  
                         Simulation  
                         Experimenting

"Talking" :      Stimulating      signals to  
                         Perturbing      system  
                              Information in



Bioengineers

