Appendix B: AP Biology Equations and Formulas

Statistical Analysis and Probability

Standard Error

$$SE_{\bar{x}} = \frac{s}{\sqrt{n}}$$

Mean

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

Standard Deviation

$$s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}}$$

Chi-Square

$$\chi^2 = \sum\frac{(o-e)^2}{e}$$

Chi-Square Table

	Degrees of Freedom							
p	1	2	3	4	5	6	7	8
0.05	3.84	5.99	7.82	9.49	11.07	12.59	14.07	15.51
0.01	6.64	9.32	11.34	13.28	15.09	16.81	18.48	20.09

s = sample standard deviation (i.e., the sample based estimate of the standard deviation of the population)

$\bar{x}$ = mean

n = size of the sample

o = observed individuals with observed genotype

e = expected individuals with observed genotype

Degrees of freedom equals the number of distinct possible outcomes minus one.

Laws of Probability

If A and B are mutually exclusive, then P (A or B) = P(A) + P(B)

If A and B are independent, then P (A and B) = P(A) x P(B)

Hardy-Weinberg Equations

$p^2 + 2pq + q^2 = 1$

$p + q = 1$

p = frequency of the dominant allele in a population

q = frequency of the recessive allele in a population

Metric Prefixes

Factor	Prefix	Symbol
10^9	giga	G
10^6	mega	M
10^3	kilo	k
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	µ
10^{-9}	nano	n
10^{-12}	pico	p

Mode = value that occurs most frequently in a data set

Median = middle value that separates the greater and lesser halves of a data set

Mean = sum of all data points divided by number of data points

Range = value obtained by subtracting the smallest observation (sample minimum) from the greatest (sample maximum)

Rate and Growth		Water Potential (Ψ)
Rate dY/dt **Population Growth** dN/dt=B-D **Exponential Growth** $\frac{dN}{dt} = r_{max}N$ **Logistic Growth** $\frac{dN}{dt} = r_{max}N\left(\frac{K-N}{K}\right)$	dY= amount of change t = time B = birth rate D = death rate N = population size K = carrying capacity r_{max} = maximum per capita growth rate of population	$\Psi = \Psi p + \Psi s$ Ψp = pressure potential Ψs = solute potential The water potential will be equal to the solute potential of a solution in an open container, since the pressure potential of the solution in an open container is zero. **The Solute Potential of the Solution** $\Psi_S = -iCRT$ i = ionization constant (For sucrose this is 1.0 because sucrose does not ionize in water) C= molar concentration R= pressure constant (R = 0.0831 liter bars/mole K) T = temperature in Kelvin (273 + °C)
Temperature Coefficient Q_{10} $Q_{10} = \left(\frac{k_2}{k_1}\right)^{\frac{10}{t_2-t_1}}$ **Primary Productivity Calculation** mg O_2/L x 0.698 = mL O_2/L mL O_2/L x 0.536 = mg carbon fixed/L	t_2 = higher temperature t_1 = lower temperature k_2 = metabolic rate at t_2 k_1 = metabolic rate at t_1 Q_{10} = the *factor* by which the reaction rate increases when the temperature is raised by ten degrees	

Surface Area and Volume		Dilution - used to create a dilute solution from a concentrated stock solution
Volume of Sphere $V = 4/3 \pi r^3$ **Volume of a cube (or square column)** V = l w h **Volume of a column** $V = \pi r^2 h$ **Surface area of a sphere** $A = 4 \pi r^2$ **Surface area of a cube** A = 6 a **Surface area of a rectangular solid** A = Σ (surface area of each side)	r = radius l = length h = height w = width A = surface area V = volume Σ=Sum of all a = surface area of one side of the cube	$C_iV_i = C_fV_f$ i=initial (starting) C = concentration of solute f=final (desired) V = volume of solution **Gibbs Free Energy** $\Delta G = \Delta H - T\Delta S$ ΔG = change in Gibbs free energy ΔS = change in entropy ΔH = change in enthalpy T = absolute temperature (in Kelvin) **pH =** $-\log [H^+]$