

ADVANCED PLACEMENT 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

Laws of Probability

If A and B are mutually exclusive, then $P(A \text{ or } B) = P(A) + P(B)$

If A and B are independent, then $P(A \text{ and } B) = P(A) \times P(B)$

Hardy Weinberg Equations

$$p^2 + 2pq + q^2 = 1 \quad p = \text{frequency of the dominant allele in a population}$$

$$p + q = 1 \quad q = \text{frequency of the recessive allele in a population}$$

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.

Metric Prefixes

<u>Factor</u>	<u>Prefix</u>	<u>Symbol</u>
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)

<p align="center">Rate and Growth</p> <p>Rate dY/dt</p> <p>Population Growth dN/dt=B-D</p> <p>Exponential Growth $\frac{dN}{dt} = r_{\max} N$</p> <p>Logistic Growth $\frac{dN}{dt} = r_{\max} N \left(\frac{K - N}{K} \right)$</p>	<p>dY= amount of change</p> <p>t = time</p> <p>B = birth rate</p> <p>D = death rate</p> <p>N = population size</p> <p>K = carrying capacity</p> <p>r_{max} = maximum per capita growth rate of population</p>	<p>Water Potential (Ψ)</p> <p>Ψ = Ψ_p + Ψ_s</p> <p>Ψ_p = pressure potential</p> <p>Ψ_s = solute potential</p> <p>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.</p>
<p>Temperature Coefficient Q₁₀</p> $Q_{10} = \left(\frac{k_2}{k_1} \right)^{\frac{10}{t_2 - t_1}}$ <p>Primary Productivity Calculation</p> <p>mg O₂/L x 0.698 = mL O₂/L</p> <p>mL O₂/L x 0.536 = mg carbon fixed/L</p>	<p>t₂ = higher temperature</p> <p>t₁ = lower temperature</p> <p>k₂ = metabolic rate at t₂</p> <p>k₁ = metabolic rate at t₁</p> <p>Q₁₀ = the <i>factor</i> by which the reaction rate increases when the temperature is raised by ten degrees</p>	<p>The Solute Potential of the Solution</p> <p>Ψ_s = -iCRT</p> <p>i = ionization constant (For sucrose this is 1.0 because sucrose does not ionize in water)</p> <p>C= molar concentration</p> <p>R= pressure constant (R = 0.0831 liter bars/mole K)</p> <p>T = temperature in Kelvin (273 + °C)</p>
<p align="center">Surface Area and Volume</p> <p>Volume of Sphere V = 4/3 π r³</p> <p>Volume of a cube (or square column) V = l w h</p> <p>Volume of a column V = π r² h</p> <p>Surface area of a sphere A = 4 π r²</p> <p>Surface area of a cube A = 6 a</p> <p>Surface area of a rectangular solid A = Σ (surface area of each side)</p>	<p>r = radius</p> <p>l = length</p> <p>h = height</p> <p>w = width</p> <p>A = surface area</p> <p>V = volume</p> <p>Σ=Sum of all</p> <p>a = surface area of one side of the cube</p>	<p>Dilution - used to create a dilute solution from a concentrated stock solution</p> <p>C_iV_i = C_fV_f</p> <p>i=initial (starting) C = concentration of solute f=final (desired) V = volume of solution</p> <p>Gibbs Free Energy</p> <p>ΔG = ΔH - TΔS</p> <p>ΔG = change in Gibbs free energy</p> <p>ΔS = change in entropy</p> <p>ΔH = change in enthalpy</p> <p>T = absolute temperature (in Kelvin)</p> <p>pH = - log [H⁺]</p>