

AP® BIOLOGY EQUATIONS AND FORMULAS

Statistical Analysis and Probability

Mean

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

Standard Deviation

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

Standard Error of the Mean

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

Chi-Square

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

Chi-Square Table

p value	Degrees of Freedom							
	1	2	3	4	5	6	7	8
0.05	3.84	5.99	7.81	9.49	11.07	12.59	14.07	15.51
0.01	6.63	9.21	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

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

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

\bar{x} = sample mean

n = sample size

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

o = observed results

e = expected results

Σ = sum of all

Degrees of freedom are equal to 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^{-1}	deci	d
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)
<p>Rate $\frac{dY}{dt}$</p> <p>Population Growth $\frac{dN}{dt} = B - D$</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>$dt =$ change in 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>$\Psi = \Psi_p + \Psi_s$</p> <p>$\Psi_p =$ pressure potential</p> <p>$\Psi_s =$ solute potential</p> <p>The water potential will be equal to the solute potential of a solution in an open container because the pressure potential of the solution in an open container is zero.</p> <p>The Solute Potential of a Solution</p> <p>$\Psi_s = -iCRT$</p> <p>$i =$ ionization constant (1.0 for sucrose 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 ($^{\circ}\text{C} + 273$)</p>
<p>Simpson's Diversity Index</p> <p>Diversity Index = $1 - \sum \left(\frac{n}{N} \right)^2$</p> <p>$n =$ total number of organisms of a particular species</p> <p>$N =$ total number of organisms of all species</p>		<p>pH = $-\log[\text{H}^+]$</p>
Surface Area and Volume		
<p>Surface Area of a Sphere $SA = 4\pi r^2$</p> <p>Surface Area of a Rectangular Solid $SA = 2lh + 2lw + 2wh$</p> <p>Surface Area of a Cylinder $SA = 2\pi rh + 2\pi r^2$</p> <p>Surface Area of a Cube $SA = 6s^2$</p>	<p>Volume of a Sphere $V = \frac{4}{3}\pi r^3$</p> <p>Volume of a Rectangular Solid $V = lwh$</p> <p>Volume of a Cylinder $V = \pi r^2 h$</p> <p>Volume of a Cube $V = s^3$</p>	<p>$r =$ radius</p> <p>$l =$ length</p> <p>$h =$ height</p> <p>$w =$ width</p> <p>$s =$ length of one side of a cube</p> <p>$SA =$ surface area</p> <p>$V =$ volume</p>