

## 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

$\Sigma$  = 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	$\mu$
$10^{-9}$	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"><b>Rate and Growth</b></p> <p><b>Rate</b>  <math>\frac{dY}{dt}</math>  <math>dY</math> = amount of change  <math>dt</math> = change in time</p> <p><b>Population Growth</b>  <math>\frac{dN}{dt} = B - D</math>  <math>B</math> = birth rate  <math>D</math> = death rate  <math>N</math> = population size</p> <p><b>Exponential Growth</b>  <math>\frac{dN}{dt} = r_{\max}N</math>  <math>K</math> = carrying capacity  <math>r_{\max}</math> = maximum per capita growth rate of population</p> <p><b>Logistic Growth</b>  <math>\frac{dN}{dt} = r_{\max}N\left(\frac{K - N}{K}\right)</math></p>		<p><b>Water Potential ( <math>\Psi</math> )</b>  <math>\Psi = \Psi_p + \Psi_s</math>  <math>\Psi_p</math> = pressure potential  <math>\Psi_s</math> = 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><b>The Solute Potential of a Solution</b>  <math>\Psi_s = -iCRT</math>  <math>i</math> = ionization constant (1.0 for sucrose because sucrose does not ionize in water)  <math>C</math> = molar concentration  <math>R</math> = pressure constant  <math>(R = 0.0831 \text{ liter bars/mole K})</math>  <math>T</math> = temperature in Kelvin (<math>^{\circ}\text{C} + 273</math>)</p>
<p><b>Simpson's Diversity Index</b>  Diversity Index = <math>1 - \sum\left(\frac{n}{N}\right)^2</math>  <math>n</math> = total number of organisms of a particular species  <math>N</math> = total number of organisms of all species</p>		<p><b>pH</b> = <math>-\log[\text{H}^+]</math></p>
<p><b>Surface Area and Volume</b></p>		
<p><b>Surface Area of a Sphere</b>  <math>SA = 4\pi r^2</math></p>	<p><b>Volume of a Sphere</b>  <math>V = \frac{4}{3}\pi r^3</math></p>	<p><math>r</math> = radius</p>
<p><b>Surface Area of a Rectangular Solid</b>  <math>SA = 2lh + 2lw + 2wh</math></p>	<p><b>Volume of a Rectangular Solid</b>  <math>V = lwh</math></p>	<p><math>l</math> = length  <math>h</math> = height  <math>w</math> = width</p>
<p><b>Surface Area of a Cylinder</b>  <math>SA = 2\pi rh + 2\pi r^2</math></p>	<p><b>Volume of a Cylinder</b>  <math>V = \pi r^2 h</math></p>	<p><math>s</math> = length of one side of a cube</p>
<p><b>Surface Area of a Cube</b>  <math>SA = 6s^2</math></p>	<p><b>Volume of a Cube</b>  <math>V = s^3</math></p>	<p><math>SA</math> = surface area  <math>V</math> = volume</p>