

AP® BIOLOGY EQUATIONS AND FORMULAS

Statistical Analysis and Probability																																											
<p>Mean</p> $\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$ <p>Standard Error of the Mean *</p> $SE_{\bar{x}} = \frac{s}{\sqrt{n}}$	<p>Standard Deviation *</p> $s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n - 1}}$ <p>Chi-Square</p> $\chi^2 = \sum \frac{(o - e)^2}{e}$																																										
Chi-Square Table																																											
<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="2" style="padding: 2px;">p value</th> <th colspan="8" style="padding: 2px;">Degrees of Freedom</th> </tr> <tr> <th style="padding: 2px;">1</th> <th style="padding: 2px;">2</th> <th style="padding: 2px;">3</th> <th style="padding: 2px;">4</th> <th style="padding: 2px;">5</th> <th style="padding: 2px;">6</th> <th style="padding: 2px;">7</th> <th style="padding: 2px;">8</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px;">0.05</td> <td style="padding: 2px;">3.84</td> <td style="padding: 2px;">5.99</td> <td style="padding: 2px;">7.81</td> <td style="padding: 2px;">9.49</td> <td style="padding: 2px;">11.07</td> <td style="padding: 2px;">12.59</td> <td style="padding: 2px;">14.07</td> <td style="padding: 2px;">15.51</td> </tr> <tr> <td style="padding: 2px;">0.01</td> <td style="padding: 2px;">6.63</td> <td style="padding: 2px;">9.21</td> <td style="padding: 2px;">11.34</td> <td style="padding: 2px;">13.28</td> <td style="padding: 2px;">15.09</td> <td style="padding: 2px;">16.81</td> <td style="padding: 2px;">18.48</td> <td style="padding: 2px;">20.09</td> </tr> </tbody> </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	<p>\bar{x} = sample mean</p> <p>n = sample size</p> <p>s = sample standard deviation (i.e., the sample-based estimate of the standard deviation of the population)</p> <p>o = observed results</p> <p>e = expected results</p> <p>Σ = sum of all</p> <p>Degrees of freedom are equal to the number of distinct possible outcomes minus one.</p>							
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<p>Laws of Probability</p> <p>If A and B are mutually exclusive, then:</p> $P(A \text{ or } B) = P(A) + P(B)$ <p>If A and B are independent, then:</p> $P(A \text{ and } B) = P(A) \times P(B)$					<p style="text-align: center;">Metric Prefixes</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; padding: 2px;">Factor</th> <th style="text-align: left; padding: 2px;">Prefix</th> <th style="text-align: left; padding: 2px;">Symbol</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px;">10^9</td> <td style="padding: 2px;">giga</td> <td style="padding: 2px;">G</td> </tr> <tr> <td style="padding: 2px;">10^6</td> <td style="padding: 2px;">mega</td> <td style="padding: 2px;">M</td> </tr> <tr> <td style="padding: 2px;">10^3</td> <td style="padding: 2px;">kilo</td> <td style="padding: 2px;">k</td> </tr> <tr> <td style="padding: 2px;">10^{-2}</td> <td style="padding: 2px;">centi</td> <td style="padding: 2px;">c</td> </tr> <tr> <td style="padding: 2px;">10^{-3}</td> <td style="padding: 2px;">milli</td> <td style="padding: 2px;">m</td> </tr> <tr> <td style="padding: 2px;">10^{-6}</td> <td style="padding: 2px;">micro</td> <td style="padding: 2px;">μ</td> </tr> <tr> <td style="padding: 2px;">10^{-9}</td> <td style="padding: 2px;">nano</td> <td style="padding: 2px;">n</td> </tr> <tr> <td style="padding: 2px;">10^{-12}</td> <td style="padding: 2px;">pico</td> <td style="padding: 2px;">p</td> </tr> </tbody> </table>				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	<p>Hardy-Weinberg Equations</p> <p>$p^2 + 2pq + q^2 = 1$ p = frequency of allele 1 in a population</p> <p>$p + q = 1$ q = frequency of allele 2 in a population</p>							
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<p>Mode = value that occurs most frequently in a data set</p> <p>Median = middle value that separates the greater and lesser halves of a data set</p> <p>Mean = sum of all data points divided by number of data points</p> <p>Range = value obtained by subtracting the smallest observation (sample minimum) from the greatest (sample maximum)</p>																																											

* For the purposes of the AP Exam, students will not be required to perform calculations using this equation; however, they must understand the underlying concepts and applications.

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

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