

FREE AP BIOLOGY FORMULA SHEET

All the Essential Formulas You Need for Test Day

Unit 1: Chemistry of Life

Water Potential

- $\Psi = \Psi_s + \Psi_p$
- Ψ = total water potential
- Ψ_s = solute potential
- Ψ_p = pressure potential

Solute Potential

- $\Psi_s = -iCRT$
- i = ionization constant (1 for sucrose, 2 for NaCl, etc.)
- C = molar concentration (M)
- R = pressure constant = 0.0831 liter·bar/mole·K
- T = temperature in Kelvin ($K = ^\circ C + 273$)

Surface Area to Volume Ratio

- SA:V = Surface Area / Volume
- Used to compare efficiency of diffusion and transport in cells

Unit 2: Cell Structure and Function

Surface Area to Volume Ratio

SA:V = Surface Area / Volume

- Cells with higher SA:V are more efficient at transport and diffusion.

Rate of Diffusion

Rate = Distance Traveled / Time

- Sometimes expressed as rate of change in concentration over time.

Unit 3: Cellular Energetics

Gibbs Free Energy

$\Delta G = \Delta H - T\Delta S$

- ΔG = change in free energy
- ΔH = change in enthalpy (total energy)
- T = temperature in Kelvin ($K = ^\circ C + 273$)
- ΔS = change in entropy

ATP Yield (simplified for AP exam)

- Aerobic cellular respiration: ~36 to 38 ATP per glucose
- Anaerobic respiration (fermentation): ~2 ATP per glucose

Photosynthetic Rate

Rate = $\Delta O_2 / \Delta t$ or Rate = $\Delta CO_2 / \Delta t$

- Measures oxygen production or carbon dioxide consumption over time

Enzyme Reaction Rate

Rate = $\Delta \text{Product} / \Delta t$ or Rate = $-\Delta \text{Reactant} / \Delta t$

- Change in concentration per unit time

***Note: Units 4 (Cell Communication & Cell Cycle) and 6 (Gene Expression & Regulation) do not introduce unique equations, so they are not included on this sheet.**

Need help mastering these formulas?

Our Ivy League AP Biology Tutors are here to help you reach your target score.

Book a free consultation on our site

Unit 5: Heredity

Probability Rules

- Multiplication Rule: $P(A \text{ and } B) = P(A) \times P(B)$
- Addition Rule: $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

Chi-Square Test

$$\chi^2 = \sum (O - E)^2 / E$$

- O = observed value; E = expected value
- Used to test if results deviate significantly from predicted ratios

Degrees of Freedom

$$df = (\text{number of categories} - 1)$$

- Used with chi-square critical values

Mendelian Ratios (expected values)

- Monohybrid cross ($Aa \times Aa$): 1:2:1 genotype, 3:1 phenotype
- Dihybrid cross ($AaBb \times AaBb$): 9:3:3:1 phenotype

Unit 7: Natural Selection

Hardy-Weinberg Equilibrium

$$p + q = 1$$

- p = frequency of dominant allele
- q = frequency of recessive allele

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

- p^2 = frequency of homozygous dominant
- $2pq$ = frequency of heterozygotes
- q^2 = frequency of homozygous recessive

Allele Frequency Change (simplified)

$$\Delta p = \text{change in allele frequency between generations}$$

- Used to track evolution in populations (qualitative, not a fixed formula)

Fitness / Relative Fitness

$$w = (\text{number of offspring genotype produces}) / (\text{number of offspring produced by most successful genotype})$$

Unit 8: Ecology

Exponential Population Growth

$$N_t = N_0 \times e^{rt}$$

- N_t = population size at time t
- N_0 = initial population size
- r = intrinsic growth rate; t = time

Logistic Growth Model

$$dN/dt = rN(1 - N/K)$$

- dN/dt = rate of population change
- r = intrinsic growth rate; N = population size
- K = carrying capacity

Mark-Recapture Method (population estimate)

$$N = (M \times C) / R$$

- M = number of individuals marked initially
- C = total number captured in second sample
- R = number of marked individuals recaptured
- N = estimated population size

Photosynthesis / Respiration Rate

$$\text{Rate} = \Delta O_2 / \Delta t \text{ or Rate} = \Delta CO_2 / \Delta t$$

- Change in oxygen production or CO₂ consumption per unit time

Net Productivity

$$NPP = GPP - R$$

- NPP = Net primary productivity
- GPP = Gross primary productivity
- R = Energy used in respiration