

AP Biology Formula and Strategy Guide

The 8 College Board units: chemistry of life, cell structure and energetics, cell communication, heredity, gene expression, natural selection, and ecology — with the reasoning AP free response rewards, not just the vocabulary.

SECTIONS	5	WORKED EXAMPLES	2	FORMAT	Print friendly
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How to use this guide

A formula you cannot place is not knowledge yet. Work the recall drill below before the questions.

- AP Biology scores claim-evidence-reasoning: state the claim, cite specific data, then explain the mechanism.
- Connect every unit back to the four Big Ideas: Evolution, Energetics, Information Storage/Transmission, Systems Interactions.
- Practice reading experimental data and graphs — AP free response leans heavily on interpretation, not recall.

1. Chemistry of life and cell structure

NAME	FORMULA	WHEN TO USE
Water's polarity	explains cohesion, adhesion, high specific heat	Explaining water's unusual properties for life.
Macromolecule monomers	amino acids (protein), nucleotides (nucleic acid), monosaccharides (carb)	Identifying a macromolecule from its building block.
Enzyme active site	specific shape binds a specific substrate	Explaining enzyme specificity and catalysis.
Membrane fluid mosaic model	phospholipid bilayer with embedded, mobile proteins	Explaining selective permeability.

2. Cellular energetics

NAME	FORMULA	WHEN TO USE
Photosynthesis: light reactions	occur in thylakoid, produce ATP/NADPH, release O ₂	Explaining where light energy is captured.
Photosynthesis: Calvin cycle	occurs in stroma, uses ATP/NADPH to build sugar	Explaining carbon fixation.
Glycolysis	glucose → pyruvate, occurs in cytoplasm, net 2 ATP	The first step of cellular respiration, anaerobic.

NAME	FORMULA	WHEN TO USE
Krebs cycle and electron transport chain	occur in mitochondria, produce most of the cell's ATP	Explaining the bulk of aerobic ATP production.

WORKED EXAMPLE

Explain why cyanide, which blocks the electron transport chain, is lethal even though glycolysis still works.

1. Glycolysis produces only 2 ATP per glucose
2. The ETC normally produces the vast majority of ATP
3. Blocking it starves the cell of the energy it needs to survive

Check: The claim (lethal), evidence (ATP yield comparison), and mechanism (ETC blockage) are all present.

3. Cell communication and the cell cycle

NAME	FORMULA	WHEN TO USE
Signal transduction	reception -> transduction -> response	Explaining how a cell responds to an external signal.
Mitosis	produces two genetically identical diploid cells	Growth and repair in body cells.
Checkpoints	G1, G2, and M checkpoints regulate cell cycle progression	Explaining how uncontrolled division (cancer) can arise.
Apoptosis	programmed cell death	Removing damaged or unneeded cells.

4. Heredity and gene expression

NAME	FORMULA	WHEN TO USE
Meiosis	produces 4 genetically varied haploid gametes	Explaining genetic variation between generations.
Independent assortment	chromosomes align randomly in meiosis I	Explaining variation from different gene combinations.
Crossing over	homologous chromosomes exchange segments in prophase I	Explaining recombination within a chromosome.
Central dogma	DNA -> RNA (transcription) -> protein (translation)	Explaining how a gene produces a trait.
Gene regulation (operons)	genes can be turned on/off in response to the environment	Explaining why not all genes are expressed at once.

WORKED EXAMPLE

Explain why siblings (except identical twins) are genetically different, even with the same two parents.

1. Independent assortment randomly combines maternal/paternal chromosomes
2. Crossing over recombines segments within chromosomes
3. Fertilization combines two already-varied gametes

Check: All three mechanisms of meiotic variation are addressed.

5. Natural selection and ecology

NAME	FORMULA	WHEN TO USE
Natural selection requirements	variation, heritability, differential survival/reproduction	Confirming a scenario describes true natural selection.
Hardy-Weinberg equilibrium	$p^2 + 2pq + q^2 = 1$, describes a NON-evolving population	A baseline to detect whether evolution is occurring.
Species interactions	competition, predation, mutualism, commensalism, parasitism	Classifying a relationship between two species.
Energy flow	only ~10% of energy transfers between trophic levels	Explaining ecosystem energy pyramids.

Notes and tutor hand-off

Bring this page to your next session so the tutor can start from what actually blocked you.

Which of the 4 Big Ideas (Evolution, Energetics, Information, Systems) needs another pass?

One claim-evidence-reasoning answer you want to practice writing out fully:

Worksheet question numbers to review with a tutor:
