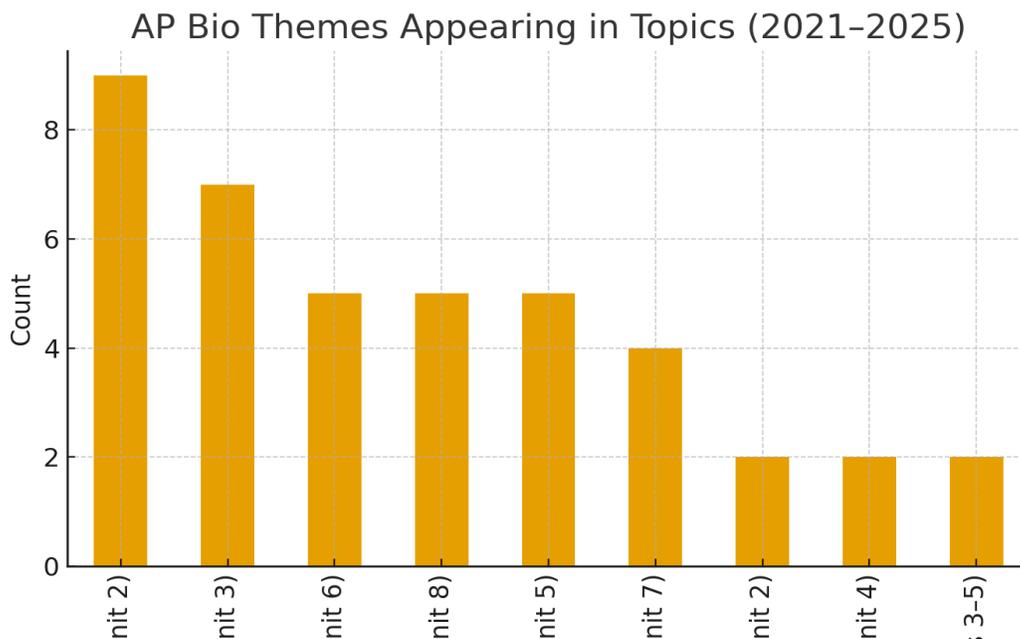


AP Biology FRQ/Topic Trends (2021–2025): Deep Analysis by Year

Based on the provided year-by-year topic list. Organized by AP Biology Units & Science Practices.

Theme Frequency Across 2021–2025



2025

Protein transport (ER & siRNA)

Likely AP Units / Themes: Cell Structure & Function (Unit 2); Gene Expression & Regulation (Unit 6)

Typical Experiment/Analysis: Knockdown/overexpression, qPCR/RT-qPCR, reporter (luciferase) assays; normalization and fold change. • Membrane transport assays (facilitated diffusion/active transport); inhibitor/temperature effects.

- Explain effects on translation/stability | Analyze reporter/qPCR fold change | Relate structure to transport mechanism | Use inhibitor/temperature evidence

GPCR signaling in moths

Likely AP Units / Themes: Cell Communication (Unit 4)

Typical Experiment/Analysis: Ligand-binding and second-messenger assays; treatments vs. controls; time-course graphs.

- Trace signaling cascade | Predict effects of agonists/antagonists or mutations

Invasive grass ecology

Likely AP Units / Themes: Ecology (Unit 8)

Typical Experiment/Analysis: Population growth/interaction graphs; community manipulations; stability/resilience metrics.

- Model community effects | Argue stability/resilience outcomes

Allopatric speciation

Likely AP Units / Themes: Natural Selection (Unit 7)

Typical Experiment/Analysis: Phylogenetic trees; trait matrices; allopatric vs. sympatric scenarios; Hardy–Weinberg checks.

- Interpret trees & common ancestry | Predict isolation mechanisms; Hardy–Weinberg checks

Enzyme regulation

Likely AP Units / Themes: Cellular Energetics (Unit 3)

Typical Experiment/Analysis: Rate measurements vs. substrate/temp/pH; Lineweaver–Burk or Michaelis–Menten style data.

- Calculate rates; evaluate effects of temp/pH/substrate | Propose controls & follow-ups

Meiosis protein function

Likely AP Units / Themes: Heredity (Unit 5)

Typical Experiment/Analysis: Pedigree or cross outcomes; genotype frequencies; chi-square or probability expectations.

- Predict ratios; run chi-square | Explain non-Mendelian patterns

2024

Crossing-over suppression in yeast

Likely AP Units / Themes: Cell Structure & Function (Unit 2); Heredity (Unit 5)

Typical Experiment/Analysis: Pedigree or cross outcomes; genotype frequencies; chi-square or probability expectations.

- Predict ratios; run chi-square | Explain non-Mendelian patterns

Temperature & metabolism in toads

Likely AP Units / Themes: Cell Structure & Function (Unit 2); Cellular Energetics (Unit 3)

Typical Experiment/Analysis: Rate measurements vs. substrate/temp/pH; Lineweaver–Burk or Michaelis–Menten style data.

- Calculate rates; evaluate effects of temp/pH/substrate | Propose controls & follow-ups

Glucose uptake in RBCs

Likely AP Units / Themes: Cell Membrane Transport (Unit 2)

Typical Experiment/Analysis: Membrane transport assays (facilitated diffusion/active transport); inhibitor/temperature effects.

- Relate structure to transport mechanism | Use inhibitor/temperature evidence

Invasive oats & biocontrol

Likely AP Units / Themes: Ecology (Unit 8)

Typical Experiment/Analysis: Population growth/interaction graphs; community manipulations; stability/resilience metrics.

- Model community effects | Argue stability/resilience outcomes

Antifreeze-gene evolution in cods

Likely AP Units / Themes: Natural Selection (Unit 7)

Typical Experiment/Analysis: Phylogenetic trees; trait matrices; allopatric vs. sympatric scenarios; Hardy–Weinberg checks.

- Interpret trees & common ancestry | Predict isolation mechanisms; Hardy–Weinberg checks

Translation efficiency

Likely AP Units / Themes: Gene Expression & Regulation (Unit 6)

Typical Experiment/Analysis: Knockdown/overexpression, qPCR/RT-qPCR, reporter (luciferase) assays; normalization and fold change.

- Explain effects on translation/stability | Analyze reporter/qPCR fold change

2023

Yeast phosphate regulation

Likely AP Units / Themes: Cellular Energetics (Unit 3)

Typical Experiment/Analysis: Design an experiment: identify IV/DV, constants, control group; choose an appropriate statistical test.

- Design a controlled experiment; match the correct statistical test

Mitochondrial inheritance under CO₂ rise

Likely AP Units / Themes: Cell Structure & Function (Unit 2); Heredity (Unit 5)

Typical Experiment/Analysis: Pedigree or cross outcomes; genotype frequencies; chi-square or probability expectations.

- Predict ratios; run chi-square | Explain non-Mendelian patterns

Climate change effects on keystone species

Likely AP Units / Themes: Ecology (Unit 8)

Typical Experiment/Analysis: Population growth/interaction graphs; community manipulations; stability/resilience metrics.

- Model community effects | Argue stability/resilience outcomes

Photosynthesis pathways

Likely AP Units / Themes: Cellular Energetics (Unit 3)

Typical Experiment/Analysis: Rate measurements vs. substrate/temp/pH; Lineweaver–Burk or Michaelis–Menten style data.

- Calculate rates; evaluate effects of temp/pH/substrate | Propose controls & follow-ups

Phylogeny & convergent evolution

Likely AP Units / Themes: Cell Structure & Function (Unit 2); Natural Selection (Unit 7)

Typical Experiment/Analysis: Phylogenetic trees; trait matrices; allopatric vs. sympatric scenarios; Hardy–Weinberg checks.

- Interpret trees & common ancestry | Predict isolation mechanisms; Hardy–Weinberg checks

Gene expression stability

Likely AP Units / Themes: Experimental Design & Data Analysis (Science Practices 3–5)

Typical Experiment/Analysis: Knockdown/overexpression, qPCR/RT-qPCR, reporter (luciferase) assays; normalization and fold change.

- Explain effects on translation/stability | Analyze reporter/qPCR fold change

2022

Cholera toxin & GPCR signaling

Likely AP Units / Themes: Cell Communication (Unit 4); Cell Structure & Function (Unit 2)

Typical Experiment/Analysis: Ligand-binding and second-messenger assays; treatments vs. controls; time-course graphs.

- Trace signaling cascade | Predict effects of agonists/antagonists or mutations

Chromatid breaks in corn

Likely AP Units / Themes: Heredity (Unit 5)

Typical Experiment/Analysis: Pedigree or cross outcomes; genotype frequencies; chi-square or probability expectations.

- Predict ratios; run chi-square | Explain non-Mendelian patterns

Enzyme luciferase kinetics

Likely AP Units / Themes: Cell Structure & Function (Unit 2); Cellular Energetics (Unit 3); Gene Expression & Regulation (Unit 6)

Typical Experiment/Analysis: Knockdown/overexpression, qPCR/RT-qPCR, reporter (luciferase) assays; normalization and fold change. • Rate measurements vs. substrate/temp/pH; Lineweaver–Burk or Michaelis–Menten style data.

- Calculate rates; evaluate effects of temp/pH/substrate | Propose controls & follow-ups | Explain effects on translation/stability | Analyze reporter/qPCR fold change

Trout isolation & drift

Likely AP Units / Themes: Experimental Design & Data Analysis (Science Practices 3–5)

Typical Experiment/Analysis: Design an experiment: identify IV/DV, constants, control group; choose an appropriate statistical test.

- Design a controlled experiment; match the correct statistical test

Food-web resilience

Likely AP Units / Themes: Ecology (Unit 8)

Typical Experiment/Analysis: Population growth/interaction graphs; community manipulations; stability/resilience metrics.

- Model community effects | Argue stability/resilience outcomes

mRNA cap modifications & vaccines

Likely AP Units / Themes: Gene Expression & Regulation (Unit 6)

Typical Experiment/Analysis: Knockdown/overexpression, qPCR/RT-qPCR, reporter (luciferase) assays; normalization and fold change.

- Explain effects on translation/stability | Analyze reporter/qPCR fold change

2021

Kidney disease & Na⁺/K⁺-ATPase

Likely AP Units / Themes: Cell Membrane Transport (Unit 2); Cellular Energetics (Unit 3)

Typical Experiment/Analysis: Rate measurements vs. substrate/temp/pH; Lineweaver–Burk or Michaelis–Menten style data. • Membrane transport assays (facilitated diffusion/active transport); inhibitor/temperature effects.

- Calculate rates; evaluate effects of temp/pH/substrate | Propose controls & follow-ups | Relate structure to transport mechanism | Use inhibitor/temperature evidence

Mitochondrial inheritance of disorder

Likely AP Units / Themes: Cell Structure & Function (Unit 2); Heredity (Unit 5)

Typical Experiment/Analysis: Pedigree or cross outcomes; genotype frequencies; chi-square or probability expectations.

- Predict ratios; run chi-square | Explain non-Mendelian patterns

Resveratrol & ATP production

Likely AP Units / Themes: Cell Structure & Function (Unit 2); Cellular Energetics (Unit 3)

Typical Experiment/Analysis: Rate measurements vs. substrate/temp/pH; Lineweaver–Burk or Michaelis–Menten style data.

- Calculate rates; evaluate effects of temp/pH/substrate | Propose controls & follow-ups

Galápagos finches speciation

Likely AP Units / Themes: Natural Selection (Unit 7)

Typical Experiment/Analysis: Phylogenetic trees; trait matrices; allopatric vs. sympatric scenarios; Hardy–Weinberg checks.

- Interpret trees & common ancestry | Predict isolation mechanisms; Hardy–Weinberg checks

Invasive ragweed impacts

Likely AP Units / Themes: Ecology (Unit 8)

Typical Experiment/Analysis: Population growth/interaction graphs; community manipulations; stability/resilience metrics.

- Model community effects | Argue stability/resilience outcomes

Heat-shock proteins in krill

Likely AP Units / Themes: Gene Expression & Regulation (Unit 6)

Typical Experiment/Analysis: Design an experiment: identify IV/DV, constants, control group; choose an appropriate statistical test.

- Design a controlled experiment; match the correct statistical test

Cross-Year Mapping to AP Biology Units

Year	Topic	Mapped Units/Themes
2021	Galápagos finches speciation	Natural Selection (Unit 7)
2021	Heat-shock proteins in krill	Gene Expression & Regulation (Unit 6)
2021	Invasive ragweed impacts	Ecology (Unit 8)
2021	Kidney disease & Na ⁺ /K ⁺ -ATPase	Cell Membrane Transport (Unit 2); Cellular Energetics (Unit 3)
2021	Mitochondrial inheritance of disorder	Cell Structure & Function (Unit 2); Heredity (Unit 5)
2021	Resveratrol & ATP production	Cell Structure & Function (Unit 2); Cellular Energetics (Unit 3)
2022	Cholera toxin & GPCR signaling	Cell Communication (Unit 4); Cell Structure & Function (Unit 2)
2022	Chromatid breaks in corn	Heredity (Unit 5)
2022	Enzyme luciferase kinetics	Cell Structure & Function (Unit 2); Cellular Energetics (Unit 3)
2022	Food-web resilience	Ecology (Unit 8)
2022	Trout isolation & drift	Experimental Design & Data Analysis (Science Practices 1-9)
2022	mRNA cap modifications & vaccines	Gene Expression & Regulation (Unit 6)
2023	Climate change effects on keystone species	Ecology (Unit 8)
2023	Gene expression stability	Experimental Design & Data Analysis (Science Practices 1-9)
2023	Mitochondrial inheritance under CO ₂ rise	Cell Structure & Function (Unit 2); Heredity (Unit 5)
2023	Photosynthesis pathways	Cellular Energetics (Unit 3)
2023	Phylogeny & convergent evolution	Cell Structure & Function (Unit 2); Natural Selection (Unit 7)
2023	Yeast phosphate regulation	Cellular Energetics (Unit 3)
2024	Antifreeze-gene evolution in cods	Natural Selection (Unit 7)
2024	Crossing-over suppression in yeast	Cell Structure & Function (Unit 2); Heredity (Unit 5)
2024	Glucose uptake in RBCs	Cell Membrane Transport (Unit 2)
2024	Invasive oats & biocontrol	Ecology (Unit 8)
2024	Temperature & metabolism in toads	Cell Structure & Function (Unit 2); Cellular Energetics (Unit 3)
2024	Translation efficiency	Gene Expression & Regulation (Unit 6)
2025	Allopatric speciation	Natural Selection (Unit 7)
2025	Enzyme regulation	Cellular Energetics (Unit 3)
2025	GPCR signaling in moths	Cell Communication (Unit 4)
2025	Invasive grass ecology	Ecology (Unit 8)
2025	Meiosis protein function	Heredity (Unit 5)
2025	Protein transport (ER & siRNA)	Cell Structure & Function (Unit 2); Gene Expression & Regulation (Unit 6)

Science Practices Emphasis (What the Topics Tend to Test)

Practice	What You'll Do on FRQs
SP1 Concept Explanation	Mechanisms (GPCR cascade; enzyme regulation; inheritance patterns).
SP2 Visual Representations	Interpret graphs/diagrams: signaling pathways, phylogenies, energy diagrams, transport curves.

Practice	What You'll Do on FRQs
SP3 Questions & Methods	Design controlled experiments; pick controls; sampling strategies.
SP4 Representing Data	Axes, units, error bars; calculate rates; transform data when needed.
SP5 Statistical Tests	Chi-square for genetics; compare means (t-test/ANOVA); interpret CI.
SP6 Argumentation	Make claims with evidence & reasoning; evaluate alt. explanations & limits.