The Simple AP® Biology Unit 8 Cheat Sheet

8.1 Responses to the Environment

Behavior Basics

Behavior: a response to a stimulus, shaped by natural selection to help survival.
Innate = born with it. **Learned** = from experience.

Behavior	Example
Taxis	Moth flies to light
Kinesis	Pill bugs move faster in dry
Imprinting	Goslings follow mom
Conditioning	Pavlov's dog
Habituation	Ignore harmless things

Taxis has a direction; **kinesis** is random.

Communication

Signals: sight, sound, smell (**pheromones**), touch.
Bee waggle dance shows other bees the direction and distance to a good food source.
Group living: herds and packs → safer from predators and better at finding food together.
Altruism: helping relatives at a cost to yourself still helps your shared genes survive.

Other Responses

Plants: bend toward light; flower by day length.
Animals: hibernate, migrate, follow daily rhythms.
Pill bug lab: choice chambers test which conditions (wet or dry) animals prefer.

⚠ Taxis = directed movement. Kinesis = random change in speed or turning only.

✓ Link each behavior to survival or reproduction.

8.2 Energy Flow Through Ecosystems

Trophic Levels

Producers → **herbivores** → **carnivores**.
Decomposers break down the dead.
Energy flows one way; **matter cycles**.
10% rule: only ~10% of energy passes up each level. The rest is lost, mostly as heat.
Example: 10,000 → 1,000 → 100 → 10 kcal.
Few top predators: little energy reaches the top.
Food chains rarely go past 4–5 levels.
Food web arrows point from food to eater.

Productivity

GPP: all energy captured by plants. **NPP** = GPP − plant respiration (what's left for consumers).
Most productive: tropical rainforests, estuaries and coral reefs (lots of light and water).
Open ocean: low per area, but huge in total.

Body Heat

	Endotherm	Ectotherm
Heat from	Own body	Surroundings
Food needed	More	Less

Small endotherms lose body heat fast → they need more food per gram of body weight.
Deep-sea vents: bacteria use chemicals, not light, to make food (called chemosynthesis).
Decomposers recycle nutrients, not energy.
Energy left over after daily needs → used for growth, storage and reproduction.

⚠ Energy is lost as heat, not recycled.

✓ Multiply by 0.1 for each level up.

8.2 Biogeochemical Cycles

Carbon Cycle

In: photosynthesis pulls CO_2 from the air.
Out: respiration, decomposition and burning fuels all release CO_2 back into the air.
Humans: burning fossil fuels and cutting forests → more CO_2 → warming, more acidic oceans.
Oceans absorb CO_2 → seawater becomes more acidic → shells and coral skeletons dissolve.

Nitrogen Cycle

Step	What happens
Fixation	N_2 gas → ammonia
Nitrification	Ammonia → nitrate
Assimilation	Plants absorb it
Denitrification	Nitrate → N_2 gas

Bacteria do most steps (some live in nodules on legume roots, like peas and beans).
Needed for proteins and DNA in every cell.
Most living things can't use N_2 gas directly from the air; bacteria must fix it into ammonia first.

Phosphorus & Water

Phosphorus: comes from weathered rocks; it has no gas form. Needed for DNA and ATP.
Water: evaporation, transpiration, rain, runoff.
Fertilizer runoff → algae bloom → algae die → decomposers use up oxygen (dead zone).

⚠ Phosphorus has no air step. Nitrogen does.

✓ Cycle Q: name the molecule, the process, and which organism (or human activity) does it.

8.3 Population Ecology

Population Basics

Population: one species in one area.
Spacing: clumped (most common), even (territorial animals), or random (rare).
Density = number of individuals per area.

Growth (Formula Sheet)

Change: dN/dt = births − deaths.
Exponential: dN/dt = $r_{max}N$ → a **J-curve** (only happens when resources are unlimited).
Example: 500 individuals, 60 births, 10 deaths per year → grows by 50 individuals per year.
r = growth per individual = 50 ÷ 500 = 0.1.
Seen in: new habitats, invasive species, bacteria.

Survivorship

Curve	Pattern
Type I	Most die old (humans)
Type II	Steady deaths (birds)
Type III	Most die young (fish)

r-selected: many babies, little care. **K-selected**: few babies, lots of parental care each.
Age pyramid: wide base → growing fast.
Humans: grew fast after farming and modern medicine raised the carrying capacity.
Bacteria in fresh food: 1 → 2 → 4 → 8 → 16, doubling every generation (exponential).

⚠ Exponential growth never lasts forever.

✓ Show the formula, plug in, include units.

8.4 Effect of Density on Populations

Logistic Growth

Logistic: dN/dt = $r_{max}N((K - N)/K)$ → **S-curve**.
Carrying capacity (K): the most individuals a habitat can support over the long term.
Fastest growth at half of K; stops at K.
Example: r = 0.2, N = 400, K = 1,000 → 48/yr.
Overshoot: population goes above K → deaths rise → numbers fall back below K again.

Limiting Factors

Density-dependent	Density-independent
Competition	Fire
Disease	Flood
Predators	Extreme weather

Density-dependent: stronger in crowded populations (e.g., disease, competition).
Density-independent: affects populations of any size the same way (e.g., a flood).
Density-dependent factors act like negative feedback → they hold a population near K.

Predator & Prey

Cycles: more prey → more predators → fewer prey → fewer predators → the cycle repeats.
K can change with more food or space.
Example: lynx and snowshoe hare population cycles in Canada, ~10 years long.
Small populations can crash if mates become too hard to find (called the Allee effect).

⚠ Growth is fastest at half of K, not at K.

✓ J-curve = exponential. S-curve = logistic.

8.5 Community Ecology

Species Interactions

Interaction	Effect	Example
Competition	− / −	Lions, hyenas
Predation	+ / −	Wolf, deer
Parasitism	+ / −	Tick, dog
Mutualism	+ / +	Bee, flower
Commensalism	+ / 0	Barnacle, whale

Niches

Niche: a species' role and resources.
Competitive exclusion: two species can't share the exact same niche for long; one wins out.
Resource partitioning: species split up the resources so they can live in the same place.
Example: warblers feed at different tree heights.
Diversity = number of species (richness) + how even their population sizes are (evenness).

Diversity

Simpson's index: $D = 1 - \Sigma(n/N)^2$. The closer D is to 1, the more diverse the community.
Example: 50, 30, 20 of 100 → D = 0.62.
Succession: communities rebuild after disturbance (lichens → forest).
Defenses: camouflage, warning colors, mimicry.
Primary succession starts on bare rock; **secondary** starts on soil after a fire.

⚠ Parasites usually don't kill the host quickly.

✓ Write +, − or 0 for each species, then name it.

8.6 Biodiversity

Why Diversity Matters

More diversity → an ecosystem recovers better from a disturbance like a fire or drought.
Backup species: if one species is lost, others that do the same job can step in and fill its role.
Genetic diversity helps a species survive new diseases and sudden environmental changes.

Key Species

Type	Example
Keystone	Sea otter, starfish
Foundation	Coral, kelp
Ecosystem engineer	Beaver

Keystone species: big impact for their numbers.
Example: sea otters gone → sea urchins boom → urchins eat the kelp → kelp forests vanish.
Starfish removed from tide pools → mussels take over the rocks → far fewer species.

Trophic Cascades

Top-down: predators control the levels below them (e.g., gray wolves in Yellowstone).
Bottom-up: nutrients control higher levels.
Yellowstone: wolves → fewer elk → more willows along streams → more beaver dams.
Ecosystem services: free benefits from nature like pollination, clean water, soil, medicine and food.

⚠ Keystone species are often not the most common species. Impact ≫ numbers.

✓ Remove a species → trace the effects up and down the food web, step by step.

8.7 Disruptions & Exam Strategy

Disruptions

Invasive species: no natural predators → push out native species (kudzu, cane toads).
Habitat loss: top cause of extinction today.
Climate change: warming, coral bleaching, species ranges shifting toward the poles.
Biomagnification: toxins like DDT and mercury build up at the top of food chains.
Natural events: fires, floods, El Niño.
Overfishing and poaching crash populations.
Fast change outpaces evolution; species with short generations adapt the best.
Conservation: protected areas, wildlife corridors, and removing harmful invasive species.

Exam Moves

Calculation	Use
$r_{max}N$	Exponential
$\times (K - N)/K$	Logistic
$1 - \Sigma(n/N)^2$	Simpson's D

Data questions: name the IV and DV, describe the trend, then predict what happens next.
10% rule: multiply by 0.1 per level up.
Links: Unit 3 energy, Unit 7 natural selection.
Show work: formula, numbers, units, answer.
Claim, evidence, reasoning: state the effect, cite the data, explain why it happens.

⚠ Top predators get the highest toxin levels.

✓ Name the interaction, the change, and why.