The Simple AP® Environmental Science Unit 1 Cheat Sheet

1.1 Introduction to Ecosystems

Levels of Organization

Population (1 species) → **community** (all species) → **ecosystem** (community + nonliving parts).

Biotic = living (plants, animals, microbes). **Abiotic** = nonliving (sunlight, water, temp, soil, pH).

Species Interactions

Type	Effect
Predation	+ / − (lynx eats hare)
Parasitism	+ / − (tick on deer)
Mutualism	+ / + (bees, flowers)
Commensalism	+ / 0 (barnacle)
Competition	− / −

Symbiosis = close, long-term bond between 2 species: mutualism, commensalism or parasitism.

Predator–prey cycle: prey ↑ → predators ↑ (w/ a lag) → prey ↓ → predators ↓ → repeat.

Competition & Niches

Niche = a species' role (food, habitat, timing).

Competitive exclusion: 2 species can't share the exact same niche for long; one loses or shifts.

Resource partitioning (splitting resources) ↓ competition: by **time** (hawk day, owl night) or **space** (birds feed at different tree heights).

⚠ Parasites usually harm but DON'T kill the host (dead host = no food). Predators kill prey.

✓ FRQ: name the interaction AND each species' effect (+, −, 0) to earn the point.

1.2 Terrestrial Biomes

What Sets a Biome

Biome = region w/ similar climate & plants. Set by avg **temperature** & **precipitation** (climatograph).

Latitude & elevation: climbing a mountain ≈ moving toward the poles (colder, drier).

Biome	Key Trait
Trop. rainforest	Hot, wet, most species
Temp. deciduous	4 seasons
Grassland	Deep, fertile soil
Desert	<25 cm rain/yr
Taiga	Cold, conifers
Tundra	Permafrost

Soil & Adaptations

Rainforest soil = thin & poor: rain **leaches** (washes out) nutrients; most nutrients are in plants.

Grassland soil = deep & fertile → best farmland.

Taiga soil = acidic & nutrient-poor (from pine needles + very slow decay in the cold).

Adaptations fit climate: deep roots (desert), needles shed snow (taiga), fire-resistant seeds.

Climate change pushes biomes toward the poles & uphill; species that can't move decline.

Chaparral: hot, dry summers & mild, wet winters; shrubs adapted to frequent wildfires.

⚠ Biomes are set by climate, not continent.

✓ Climatograph MCQ: read BOTH the temp line and the rain bars, then match the biome.

1.3 Aquatic Biomes

What Sets an Aquatic Biome

Key factors: salinity (salt), depth, flow, temp, dissolved O_2 (DO), nutrients, light.

Biome	Key Fact
River/stream	Fast flow, high DO
Lake/pond	Light zones
Wetland	Filters, flood control
Estuary	Fresh + salt mix
Coral reef	Warm, clear, shallow
Open ocean	Low nutrients

Freshwater

Wetlands: waterlogged soil; filter pollution, soak up floods, recharge groundwater, store carbon.

Cold, moving water holds more dissolved O_2 than warm, still water, so it supports more fish.

Lake zones: **littoral** (shallow edge), **limnetic** (open, sunlit), **benthic** (bottom).

Marine

Estuary = river meets ocean (brackish); nutrient-rich → very productive; nursery for young fish.

Coral reefs: coral + algae = mutualism. Too-warm water → algae leave → **bleaching**.

Open ocean: **photic zone** (sunlit) vs. **aphotic** (dark). Phytoplankton make ~half of Earth's O_2.

Intertidal zone: between high & low tide; life must handle waves, drying out & salt changes.

⚠ Most productive: estuaries, wetlands & reefs. NOT the open ocean (too few nutrients).

1.4 Carbon Cycle & 1.7 Water Cycle

Carbon Cycle

Process	Moves Carbon
Photosynthesis	Air → plants
Respiration	Organisms → air
Combustion	Fuels → air
Ocean uptake	Air → ocean
Sedimentation	Shells → rock

Reservoirs: rock & fossil fuels (largest, slow), ocean (largest active), soil, plants, air.

Sink = stores more C than it releases (forests, ocean). **Source** = releases more (burning fuel).

Human impact: burning fossil fuels → CO_2 ↑ in air → warming & **ocean acidification**.

Photosynthesis: $CO_2 + H_2O$ + sunlight → sugar + O_2. **Respiration** is the reverse, releasing CO_2.

Water Cycle

Ocean holds ~97% of water. Most freshwater is in ice; **groundwater** is the largest liquid store.

Steps: evaporation, **transpiration** (water from plants), condensation, precipitation, runoff, **infiltration** (soaks into ground).

Pavement ↑ runoff & ↓ infiltration.

Aquifer = underground layer of porous rock that holds groundwater; refills slowly.

⚠ Burning fossil fuels moves C from slow storage to the air FAST, faster than sinks absorb.

✓ The sun drives evaporation; gravity drives rain, runoff & infiltration into the ground.

1.5 Nitrogen & 1.6 Phosphorus Cycles

Nitrogen Cycle

Reservoir: air (N_2 ~78%), but most living things can't use N_2 directly; it must be fixed.

Step	What Happens
Fixation	$N_2 \rightarrow NH_3$ (bacteria)
Nitrification	$NH_4^+ \rightarrow NO_3^-$
Assimilation	Plants take up N
Ammonification	Decay → NH_3
Denitrification	$NO_3^- \rightarrow N_2$ gas

Rhizobium bacteria fix N in legume root nodules (mutualism); so does lightning.

Human impact: fertilizer & burning fuel add extra N → runoff → algal blooms (eutrophication).

Denitrifying bacteria live in low-O_2 (anaerobic) soil & water, returning N_2 to the air.

Phosphorus Cycle

No gas phase → slowest cycle. Stored in rocks & ocean sediment; moves mostly in water.

Weathering (rock breaking down) releases phosphate → plants → animals → sediment.

Limiting nutrient: P is often scarce, esp. in water, so adding P boosts algae growth.

Human P sources: fertilizer, detergents, sewage.

Eutrophication

Extra N/P → **algal bloom** → algae die → decomposers use up O_2 → fish die (**dead zone**).

⚠ Nitrification makes nitrate (NO_3^-); denitrification returns N_2 gas to the air.

✓ Only nitrogen has a gas reservoir in the air.

1.8 Primary Productivity

GPP vs. NPP

GPP (gross primary productivity) = total rate of photosynthesis by all producers in an area.

NPP (net) = **GPP − R**, where R = energy plants use for their own cellular respiration.

NPP = energy left over for plant growth & available to consumers that eat the plants.

Biomass = mass of living matter; NPP adds new biomass every year (g/m²/yr or kcal/m²/yr).

Units: kcal/m²/yr. **Example**: GPP 20,000 − R 12,000 = NPP 8,000 kcal/m²/yr.

High vs. Low NPP

High NPP	Low NPP
Tropical rainforest	Desert
Estuaries, wetlands	Tundra
Coral reefs	Open ocean (per m²)

Limits: light, water, temp & nutrients. Warm + wet + nutrient-rich = high NPP; cold or dry = low.

Open ocean: low NPP per m², but it covers so much area that its total NPP is very large.

Measuring & Light

Light/dark bottle: change in O_2 shows NPP (light) & respiration (dark); **GPP = NPP + R**.

In water: blue light reaches deepest; red light is absorbed near the surface first.

Efficiency: plants capture only ~1% of sunlight.

⚠ NPP is always less than GPP. Given NPP & R? ADD them to get GPP; don't subtract.

⚠ Always write units (kcal/m²/yr) on every step of a calculation, including the answer.

1.9 Trophic Levels & 1.10 10% Rule

Trophic Levels

Producers (plants, algae) → **primary consumers** (herbivores) → **secondary** → **tertiary** consumers.

Decomposers (bacteria, fungi) break down dead matter & return nutrients to the soil.

Detritivores (worms, millipedes, crabs) eat dead plant & animal matter (detritus).

Matter cycles; **energy flows** one way and finally leaves the ecosystem as waste heat.

Laws of Thermodynamics

1st law: energy is converted from one form to another, never created or destroyed.

2nd law: each energy conversion loses some energy as **heat**, so less moves up each level.

10% Rule

Level	Energy (kcal)
Producers	10,000
Primary	1,000
Secondary	100
Tertiary	10

~10% passes up each level; ~90% is lost (mostly as heat from respiration, plus waste).

Result: few top predators; eating lower on the food chain feeds more people per acre.

Example: 1,000,000 kcal in grass → a tertiary consumer gets only ~1,000 kcal (× 0.1^3).

⚠ Pyramids of numbers can be upside down (1 tree, many insects). Energy pyramids never are.

✓ Multiply by 0.1 for each level up. Show each step + the units in your written work.

1.11 Food Webs & FRQ Moves

Food Chains & Webs

Food chain = 1 feeding path. **Food web** = many linked chains → more realistic & stable.

Arrows point from the eaten → the eater, showing the direction energy flows through the web.

Omnivores eat at more than 1 trophic level (bear eats berries & fish; humans eat both).

Predicting Changes

Remove a species: its prey ↑, its predators ↓. Ripple effects = **trophic cascade**.

Example: wolves return to Yellowstone → elk ↓ → willows recover → beavers ↑ → more wetlands.

Keystone species: big effect on its community (sea otters eat urchins → kelp forests survive).

FRQ Verb	Do This
Identify	Name it
Describe	Give key traits
Explain	Say how/why
Calculate	Setup, units, answer

Design an Investigation

Independent variable = what you change.

Dependent variable = what you measure. Add a **control group** & keep other factors constant.

Data FRQ: describe the trend w/ numbers + units, then explain why it happens (the cause).

⚠ "grass → rabbit" means energy moves INTO the rabbit from the grass, not the reverse.

✓ Use specific species & numbers from the prompt; vague answers earn 0.