

Updated Physiological Ecology Chapter

Physiological Ecology has been revised for 2023 to produce a chapter that is more accessible, focused, and engaging.

KEY CHANGES INCLUDE:

- We updated the simulation that explores the relationship between temperature, evapotranspiration, and precipitation to clarify these relationships and help students understand the distinction between potential and actual evapotranspiration.
- We added a new video explaining how to read and interpret climate diagrams.
- We revised the PET/AET sequence to address student-reported confusions. We improved scaffolding and added feedback questions to aid self-assessment.
- We updated graphics in the section on acclimation and adaptation, added feedback questions to help students distinguish between the two processes, and lightly edited the text for clarity.
- We added a quantitative water budget for kangaroo rats.
- We reworked the interactive sequence introducing the heat budget for the kangaroo rat. Students now spend more time exploring the factors affecting the terms in the budget and less time plugging-and-chugging through calculations.
- We added examples to both the water and heat budgets that highlight how different species modify the various terms in the budgets.
- We reworked the sequence exploring factors limiting transpiration, and we condensed and moved the discussion of water potentials to an extension (sidebar). These changes focus student effort on the high-level factors that determine transpiration rates and cavitation risk.
- We restructured the discussion of C₃, C₄, and CAM photosynthesis around the question: What are the conditions that favor each photosystem? Students now discover that C₃ is favored when water is plentiful, but that systems with mechanisms for concentrating CO₂ are favored when it is hot, and CAM is especially favored when it is dry.
- Details of the light-dependent and dark reactions of the 3 photosynthetic systems have been de-emphasized. Instead, students are encouraged to think about the similarities and differences of these systems and the importance of rubisco to all of them.

**SECTION 1: CLIMATE, BIOMES, AND SPECIES DISTRIBUTIONS
(FORMERLY: TRADE-OFFS AND SPECIES DISTRIBUTIONS)**

- The Fundamental Tasks of Living
- Do Species Distributions Form Patterns?
- Whittaker's Diagram: Biomes
- Temperature Drives Evaporation (*new*)
- Temperature vs. Water
- Potential and Actual Evapotranspiration
- Climate Diagrams (includes narrated animation)
- Tolerances Define Species Ranges
- Law of the Minimum

- The Fundamental Tasks of Living
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- Temperature vs. Water
- Potential and Actual Evapotranspiration
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**SECTION 2: ACCLIMATION AND ADAPTATION
(FORMERLY: ADAPTATION AND ACCLIMATION)**

- Trout Respond to Temperature Change
- Acclimation vs. Adaptation (*new*)
- Activity Curves
- Acclimation
- Adaptation through Evolution
- Managing Large Dams for Conservation
- Adaptation and Acclimation Influence Species' Ranges (*new*)
- Irreversible Acclimation
- Distinguishing Between Acclimation and Adaptation

- Trout Respond to Temperature Change
- Activity Curves
- Acclimation
- Adaptation through Evolution
- Managing Dams
- Irreversible Acclimation
- Acclimation vs Adaptation

SECTION 3: HOMEOSTASIS

- Facing a Basic Challenge
- Water Balance
- Budgets Highlight How Homeostasis is Maintained (*new*)
- Temperature Regulation
- Heat Budget for a Homeothermic K-rat
- Full Heat Budget

- Facing a Basic Challenge
- Water Balance/Adaptations for Water conservation
- Temperature Regulation
- Exercise: Homeostatic Kangaroo Rat / Adaptations for Controlling Internal Temp.
- Heat Balance Equation

SECTION 4: PLANT METABOLISM
(FORMERLY: METABOLISM)

- The Shortcomings of Tall Trees
 - The Currency of Photosynthesis (*new*)
 - Transpiration Drives Water Movement (*new*)
 - Explore Transpiration
 - Cavitation
 - C₃ Photosynthesis and Photorespiration
 - C₄ Photosynthesis
 - CAM Photosynthesis
 - Photosynthetic Pathways Explain Plant Distributions (*new*)
- Physiology Requires Energy
 - Water Potential
 - Water Potential
 - Water Potential
 - Photosynthesis / Photorespiration
 - C₄ Photosynthesis
 - CAM and Water Conservation