Animal Diversity, 8th edition
Hickman, Roberts, Keen, Larson, and Eisenhour

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Chapter-by-Chapter Changes:

A major new feature of edition 8 is a list of learning objectives at the start of each chapter. These objectives help students to place a chapter's detailed information into the context of its major organizing principles.

Many revisions to the eighth edition are primarily to improve pedagogy. The content of *Animal Diversity* is condensed from the more comprehensive textbook, *Integrated Principles of Zoology*. The recently completed seventeenth edition of *Integrated Principles of Zoology* was guided by an electronic tabulation of students' responses to questions linked to the book. Authors received a heat map showing for each paragraph the percentage of correct student responses for the material covered. We focused our revisions on improving explanations wherever the heat map showed that correct responses were below 50%. With this detailed and insightful guidance, we made our text more accessible and memorable to its readers. We import these pedagogical improvements from the seventeenth edition of *Integrated Principles of Zoology* to the corresponding sections of the eighth edition of *Animal Diversity*.

Most of these revisions comprise more detailed explanations, including new illustrative examples. For example, to reinforce the statement in Chapter 1 that Charles Lyell's geological studies convinced him that earth's age must be measured in hundreds of millions of years, we add the supporting information "For example, as skeletal remains of corals, foraminiferans, and mollusks accumulate on the sea floor, they form sediments of calcium carbonate that eventually become compressed into limestone. Measured rates of sedimentation are much too slow to have produced earth's sedimentary rock formations in a shorter period of time." Potassium-argon dating of rock strata was another point that required some further explanation to be fully accessible, so we added to our explanation in Chapter 1 "Argon is a noble gas that evaporates from liquid media. It accumulates in the crystal structure of rock only after the rock has solidified and the nuclear decay of potassium-40 produces a trapped atom of argon."

Comparable changes occur throughout our eighth edition.

Additional changes to Chapter 1 include greater explanation of adaptive radiation in oceanic islands and in lakes. The classic example of adaptive radiation of Galápagos finches is updated to include new information that questions whether the ecologically discrete forms are in fact discrete species, as traditionally interpreted, or whether they are alternative developmental modes that constitute polymorphisms within a set of genetically connected, geographic populations. To illustrate punctuated equilibrium, we replace an earlier example that was not well understood by students with the best-documented case, evolutionary history of the ectoproct genera Metrarhabdotos and Stylopoma in the Caribbean Sea. We reorder and expand our coverage of microevolutionary processes under a new heading "Forces of Evolutionary Change" near the end of Chapter 1.

Revisions to Chapter 2 include a greater emphasis on process of inquiry, explaining that “population” and “metapopulation” constitute conceptual models that investigators use to measure distributions and abundances of diverse organisms. We increase consistency in terminology; for example, we use “sigmoid” rather than a mix of “sigmoid” and “logistic” in text discussions of population growth, while explaining the relationship between these concepts in a boxed essay. Likewise, use of “abundance” rather than “fitness” in some places avoids confounding the ecological concept with population-genetic “fitness” as discussed in chapter 1. We expand the explanation of how primary producers fix carbon and nitrogen from atmospheric gases, following evidence from our heat map that this concept often is not an intuitive one.

In Chapters 3 and 4, many revisions increase precision and consistency in key concepts. For example, “cytoplasmic” replaces the more nebulous term “protoplasmic” in Chapter 3, and references to current taxonomic groups replace the now archaic terms “protozoan” and “metazoan.” Chapter 4 makes a stronger distinction between “classification” and “taxonomy” as central concepts. Chapter 4 also expands examples drawn from human evolution and the salamander genus Ensatina to illustrate the main issues that separate contrasting concepts of the species category. In asking how contrasting concepts of species would yield different species-level taxonomies of Ensatina populations, we lead students through the actual debates from relevant literature. Revisions clarify the relationship between the key phylogenetic concepts of clade and synapomorphy; definition of a clade makes no reference to synapomorphy, but synapomorphy is critical for testing the hypothesis that a particular grouping of species constitutes a clade. The explanation of evolutionary taxonomy is revised to emphasize that it retains pre-evolutionary Linnaean taxonomic principles that cladistic taxonomy rejects.

Subsections “Major Divisions of Life” and “Major Subdivisions of the Animal Kingdom” are greatly rewritten, replacing archaic schemes (such as Whittaker’s five kingdoms) with newer rank-free taxonomies that follow cladistic principles and current molecular phylogenetic results.

The remaining chapters cover the details of animal evolutionary origins and diversification using the theoretical framework presented in Chapters 1-4. In each case, updates to species diversity and taxonomic relationships replace earlier hypotheses that new data have rejected. New opening essays for Chapters 5 and 6 reflect new ideas on the origin of the eukaryotic cell and the advent of multicellularity, respectively. Chapter 7 presents a new phylogenetic hypothesis for parasitic cnidarians of the clade Myxozoa. Chapter 8 now includes coverage and illustrations of the new taxon Xenacoelomorpha, consolidating some material on the former Xenoturbellida from Chapter 14. A new cladogram in Chapter 11 illustrates new phylogenetic reaults that place Sipuncula within Annelida.

Updates to Chapter 14 include new hypotheses on early evolution of deuterostomes and of echinoderms, with correspondingly revised cladograms. Revisions to Chapter 15 update phylogenies for the early chordates and fishes using new paleontological results. Coverage of the role of Hox genes is reduced following rejection of some earlier hypotheses that overestimated their roles in chordate evolutionary diversification, and coverage of paraphyly of the traditional Class Reptilia is consolidated with related material in Chapter 18. Changes to Chapter 16 include extensive replacement of photographs with improved ones, plus a new figure describing aestivation in lungfishes.

Changes to the narrative on the origin of terrestrial vertebrates in Chapter 17 emphasize that this was a fortuitous rather than a directed, progressive process. Chapter 18 incorporates new information on early events in turtle evolution, and Chapter 19 updates the species inventory and taxonomy of birds. In Chapter 20, early diversification of mammals is revised in light of data rejecting the hypothesis that most mammal groups arose

after the end-Cretaceous mass extinction. Chapter 20 also includes an expanded and clarified discussion of mammalian feeding specializations, and incorporation of new fossil finds in understanding human evolution. Some material formerly included on density-dependent versus density- independent control of mammal populations is now consolidated with coverage of that topic in chapter 2.