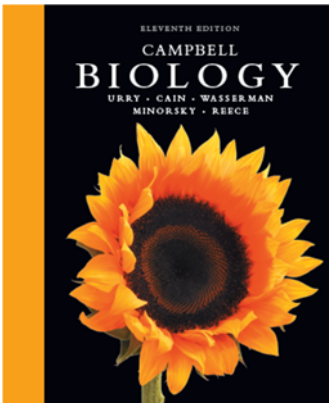
Pearson



Campbell BIOLOGY Eleventh Edition
Highlights of New Content

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This document highlights selected new content and pedagogical changes in *CAMPBELL BIOLOGY*, Eleventh Edition.

Chapter 1 Evolution, the Themes of Biology, and Scientific Inquiry

Chapter 1 opens with a new introduction to a case study on the evolution of coloration in mice. New text and a new photo (Figure 1.12) inform students about the effects of climate change on species survival and diversity.

UNIT 1 The Chemistry of Life

In Unit 1, new content engages students in learning this foundational material. The opening of Chapter 3 and new Figure 3.7 show organisms affected by loss of Arctic sea ice. Chapter 5 has updates on lactose intolerance, *trans* fats, the effects of diet on blood cholesterol, protein sequences and structures, and intrinsically disordered proteins. New Visualizing Figure 5.16 helps students understand various ways proteins are depicted. A new Problem-Solving Exercise engages students by having them compare DNA sequences in a case of possible fish fraud.

UNIT 2 The Cell

Our main goal for this unit was to make the material more accessible and inviting to students. New Visualizing Figure 6.32 shows the profusion of molecules and structures in a cell, all drawn to scale. In Chapter 7, a new figure illustrates levels of LDL receptors in people with and without familial hypercholesterolemia. Chapter 8 includes a beautiful new photo of a geyser with thermophilic bacteria in Figure 8.17, bringing to life the graphs of optimal temperatures for enzyme function. Chapter 10 discusses current research trying to genetically modify rice (a C_3 crop) so that it is capable of carrying out C_4 photosynthesis to increase yields. Chapter 11 includes a new Problem-Solving Exercise that guides students through assessing possible new treatments for bacterial infections by blocking quorum sensing. In Chapter 12, the mechanism of chromosome movement in bacteria has been updated and more cell cycle control checkpoints have been added, including one proposed by researchers in 2014.

UNIT 3 Genetics

In Chapters 13–17, we have incorporated changes that help students grasp the more abstract concepts of genetics and their chromosomal and molecular underpinnings. For example, a new Visual Skills Question with Figure 13.6 asks students to identify where in the three life cycles haploid cells undergo mitosis, and what type of cells are formed. Chapter 14 includes new information from a 2014 genomic study on the number of genes and genetic variants contributing to height. Figure 14.15b now uses "inability to taste PTC" rather than "attached earlobe." Chapters 14 and 15 are more inclusive, clarifying the meaning of the term "normal" in genetics and explaining that sex is no longer thought to be simply binary. Other updates in Chapter 15 include new research in sex determination and a technique being developed to avoid passing on mitochondrial diseases. New Visualizing Figure 16.7 shows students various ways that DNA is illustrated. Chapter 17 has a new opening photo and story about albino donkeys to pique student interest in gene expression. To help students understand the Beadle and Tatum experiment, new Figure 17.2 explains how they obtained nutritional mutants. A new Problem-Solving Exercise asks students to identify mutations in the insulin gene and predict their effect on the protein.

Chapters 18–21 are extensively updated, driven by exciting new discoveries based on DNA sequencing and gene-editing technology. Chapter 18 has updates on histone modifications, nuclear location and the persistence of transcription factories, chromatin remodeling by ncRNAs, long noncoding RNAs (lncRNAs), the role of master regulatory genes in modifying chromatin structure, and the possible role of *p53* in the low incidence of cancer in elephants. Make Connections Figure 18.27, "Genomics, Cell Signaling, and Cancer," has been expanded to include more information on cell signaling. Chapter 19 features a new section that covers bacterial defenses against bacteriophages and describes the CRISPR-Cas9 system (Figure 19.7); updates include the Ebola, Chikungunya, and Zika viruses (Figure 19.10) and discovery of the largest virus known to date. A discussion has been added of mosquito transmission of diseases and concerns about the effects of global climate change on disease transmission. Chapter 20 has a new photo of next-generation DNA sequencing machines (Figure 20.2) and a new illustration of the widely used technique of RNA sequencing (Figure 20.13). A new section titled Editing Genes and Genomes has been added describing the CRISPR-Cas9 system (Figure 20.14) that has been developed to edit genes in living cells. Information has also been added later in the chapter on use of the CRISPR-Cas9 system, including a study in which a genetic mutation for the disease tyrosinemia was corrected in mice. Finally, the discussion of ethical considerations has been updated to include a recent report of scientists using the CRISPR-Cas9 system to edit a gene in human embryos, along with a discussion of the ethical questions raised by such experiments, such as its usage along with the gene drive approach to combat carrying of diseases by mosquitoes. In Chapter 21, in addition to the usual updates of sequence-related data (speed of sequencing, number of species' genomes sequenced, etc.), there are several research updates, including some early results from the new Roadmap Epigenomics Project and results from a 2015 study focusing on 414 important yeast genes.

UNIT 4 Mechanisms of Evolution

A major goal for this revision was to strengthen how we help students understand and interpret visual representations of evolutionary data and concepts. Toward this end, we have added a new figure (Figure 25.8), “Visualizing the Scale of Geologic Time,” and a new figure (Figure 23.12) on gene flow. Several figures have been revised to improve the presentation of data, including Figure 24.6 (on reproductive isolation in mosquitofish), Figure 24.10 (on allopolyploid speciation), and Figure 25.25 (on the origin of the insect body plan). The unit also features new material that connects evolutionary concepts and societal problems. Examples include text in Chapter 22 on the 2015 discovery of teixobactin, an antibiotic that is effective against hard-to-treat pathogens, a new discussion in Chapter 24 on the impact of climate change on hybrid zones, and a new Problem-Solving Exercise in Chapter 24 on how hybridization has led to the spread of insecticide resistance genes in mosquitoes that transmit malaria. The unit also includes new chapter-opening stories in Chapter 22 (on a moth whose features illustrate the concepts of unity, diversity, and adaptation) and Chapter 25 (on the discovery of whale bones in the Sahara Desert). Additional changes include new text in Concept 22.3 emphasizing how populations can evolve over short periods of time, a new table (Table 23.1) highlighting the five conditions required for a population to be in Hardy-Weinberg equilibrium, and new material in Concept 25.1 describing how researchers recently succeeded for the first time in constructing a “protocell” in which replication of a template strand of RNA could occur.

UNIT 5 The Evolutionary History of Biological Diversity

In keeping with our goal of improving how students interpret and create visual representations in biology, we have added a new figure (Figure 26.5, “Visualizing Phylogenetic Relationships”) that introduces the visual conventions used in phylogenetic trees and helps students understand what such trees do and don’t convey. Students are also provided many opportunities to practice their visual skills, with more than ten new Visual Skills Questions on topics ranging from interpreting phylogenetic trees to predicting which regions of a bacterial flagellum are hydrophobic. The unit also contains new content on tree thinking, emphasizing such key points as how sister groups provide a clear way to describe evolutionary relationships and how trees do not show a “direction” in evolution. Other major content changes include new text in Concepts 26.6, 27.4, and 28.1 on the 2015 discovery of the Lokiarchaeota, a group of archaea that may represent the sister group of the eukaryotes, new text and a new figure (Figure 26.22) on horizontal gene transfer from prokaryotes to eukaryotes, new text in Concept 27.6 describing the CRISPR-Cas system and a new figure (Figure 27.21) that illustrates one example of how CRISPR-Cas 9 technology has opened new avenues of research on HIV, and new material in Concept 29.3 describing how early forests contributed to global climate change (in this case, global cooling). A new Problem-Solving Exercise in Chapter 34 engages students in interpreting data from a study investigating whether frogs can acquire resistance to a fungal pathogen through controlled exposure to it. Other updates include the revision of many phylogenies to reflect recent phylogenomic data, new chapter-opening stories in Chapter 31 (on how mycorrhizae link trees of different species) and Chapter 33 (on the “blue dragon,” a

mollusc that preys on the highly toxic Portuguese man-of-war), new text and a new figure (Figure 34.37) on the adaptations of the kangaroo rat to its arid environment, and new material in Concept 34.7, including a new figure (Figure 34.52) describing fossil and DNA evidence indicating that humans and Neanderthals interbred, producing viable offspring. The discussion of human evolution also includes new text and a new figure (Figure 34.53) on *Homo naledi*, the most recently discovered member of the human evolutionary lineage.

UNIT 6 Plant Form and Function

A major aim in revising Chapter 35 was to help students better understand how primary and secondary growth are related. New Visualizing Figure 35.11 enables students to picture growth at the cellular level. Also, the terms *protoderm*, *procambium*, and *ground meristem* have been introduced to underscore the transition of meristematic to mature tissues. A new flowchart (Figure 35.24) summarizes growth in a woody shoot. New text and a figure (Figure 35.26) focus on genome analysis of *Arabidopsis* ecotypes, relating plant morphology to ecology and evolution. In Chapter 36, new Figure 36.8 illustrates the fine branching of leaf veins, and information on phloem-xylem water transfer has been updated. New Make Connections Figure 37.10 highlights mutualism across kingdoms and domains. Figure 37.13 and the related text include new findings on how some soil nitrogen derives from weathering of rocks. New Figure 38.3 clarifies how the terms *carpel* and *pistil* are related. The text on flower structure and the angiosperm life cycle figure identify carpels as megasporophylls and stamens as microsporophylls, correlating with the plant evolution discussion in Unit 5. In Concept 38.3, the current problem of glyphosate-resistant crops is discussed in detail. A revised Figure 39.7 helps students visualize how cells elongate. Figure 39.8 now addresses apical dominance in a Guided Tour format. Information about the role of sugars in controlling apical dominance has been added. In Concept 39.4, a new Problem-Solving Exercise highlights how global climate change affects crop productivity. Figure 39.26 on defense responses against pathogens has been simplified and improved.

UNIT 7 Animal Form and Function

A major goal of the Unit 7 revision was to transform how students interact with and learn from representations of anatomy and physiology. For example, gastrulation is now introduced with a Visualizing Figure (Figure 47.8) that provides a clear and carefully paced introduction to three-dimensional processes that may be difficult for students to grasp. In addition, a number of the new and revised figures help students explore spatial relationships in anatomical contexts, such as the interplay of lymphatic and cardiovascular circulation (Figure 42.15) and the relationship of the limbic system to overall brain structure (Figure 49.14). A new Problem-Solving Exercise in Chapter 45 taps into student interest in medical mysteries through a case study that explores the science behind laboratory testing and diagnosis. Content updates help students appreciate the continued evolution of our understanding of even familiar phenomena, such as the sensation of thirst (Concept 44.4) and the locomotion of kangaroos and jellies (Concept 50.6). Furthermore, new text and figures introduce students to cutting-

edge technology relating to such topics as RNA-based antiviral defense in invertebrates (Figure 43.4) and rapid, comprehensive characterization of viral exposure (Figure 43.24), as well as recent discoveries regarding brown fat in adult humans (Figure 40.16), the microbiome (Figure 41.17), parthenogenesis (Concept 46.1), and magnetoreception (Concept 50.1). As always, there is fine-tuning of pedagogy, as in discussions of the complementary roles of inactivation and voltage gating of ion channels during action potential formation (Concept 48.3) and of the experimental characterization of genetic determinants in bird migration (Figure 51.24).

UNIT 8 Ecology

The Ecology Unit has been extensively revised for the Eleventh Edition. We have reorganized and improved the conceptual framework with which students are introduced to the following core ecological topics: life tables, per capita population growth, intrinsic rate of increase ("*r*"), exponential population growth, logistic population growth, density dependence, species interactions (in particular, parasitism, commensalism, and mutualism), and MacArthur and Wilson's island biogeography model. The revision also includes a deeper integration of evolutionary principles, including a new Key Concept (52.5) and two new figures (Figures 52.22 and 52.23) on the reciprocal effects of ecology and evolution, new material in Concept 52.4 on how the geographic distributions of species are shaped by a combination of evolutionary history and ecological factors, and five new Make Connections Questions that ask students to examine how ecological and evolutionary mechanisms interact. In keeping with our goal of expanding and strengthening our coverage of climate change, we have added a new discussion and a new figure (Figure 52.20) on how climate change has affected the distribution of a keystone species, a new section of text in Concept 55.2 on how climate change affects NPP, a new figure (Figure 55.8) on how climate change has caused an increase in wildfires and insect outbreaks, a new Problem-Solving Exercise in Chapter 55 that explores how insect outbreaks induced by climate change can cause an ecosystem to switch from a carbon sink to a carbon source, a new figure (Figure 56.29) on the greenhouse effect, new text in Concept 56.4 on biological effects of climate change, and a new Make Connections Figure (Figure 56.30) on how climate change affects all levels of biological organization. Additional updates include a new figure (Figure 53.25) on per capita ecological footprints, a new chapter-opening story in Chapter 54 on a seemingly unlikely mutualism between a shrimp and a much larger predatory fish, new text in Concept 54.1 emphasizing that each partner in a mutualism experiences both benefits and costs, new text in Concept 54.1 describing how the outcome of an ecological interaction can change over time, two new figures (Figures 54.29 and 54.30) on the island equilibrium model, a new figure (Figure 54.31) documenting two shrew species as unexpected hosts of the Lyme disease, and new text in Concept 56.1 that describes how extinction rates seen today are much higher than those typically seen in the fossil record.