Organization and New Content

Organization

Campbell Biology in Focus, Third Edition, is organized into an introductory chapter and seven units that cover core concepts of biology at a thoughtful pace. When we adapted *Campbell Biology* to write the first edition of this text, we made informed choices about how to design each chapter of *Campbell Biology in Focus* to meet the needs of instructors and students. We analyzed over 1,000 syllabi, read hundreds of reviews, and talked to biology instructors across the country. In some chapters, we retained most of the content; in other chapters, we pruned some material; and in still others, we completely reconfigured the coverage. In creating the Third Edition, we solicited feedback from reviewers and used their thoughtful critiques to further fine-tune the content and pedagogy.

CHAPTER 1 Introduction: Evolution and the Foundations of Biology

Chapter 1 introduces the **five biological themes** woven throughout the text: the core theme of **Evolution**, together with **Organization, Information, Energy and Matter**, and **Interactions**. Chapter 1 also explores the process of scientific inquiry through a case study describing experiments on the evolution of coat color in the beach mouse. The chapter concludes with a discussion of the importance of diversity within the scientific community.

UNIT 1 Chemistry and Cells

A succinct, two-chapter treatment of basic chemistry (Chapters 2 and 3) provides the foundation for this unit focused on cell structure and function. The related topics of cell membranes and cell signaling are consolidated into one chapter (Chapter 5). Due to the importance of the fundamental concepts in Units 1 and 2, much of the material in the rest of these two units has been retained from *Campbell Biology*.

UNIT 2 Genetics

Topics in this unit include meiosis, classical genetics, the chromosomal and molecular basis for genetics and gene expression (Chapters 10–14), regulation of gene expression (Chapter 15), and the role of gene regulation in development, stem cells, and cancer (Chapter 16). Methods in biotechnology are integrated into appropriate chapters. The stand-alone chapter on viruses (Chapter 17) can be taught at any point in the course. The final chapter in the unit, on genome evolution (Chapter 18), provides both a capstone for the study of genetics and a bridge to the evolution unit.

UNIT 3 Evolution

This unit provides in-depth coverage of essential evolutionary topics, such as mechanisms of natural selection, population genetics, speciation, and long-term patterns of evolutionary change. Early in the unit, Chapter 20 introduces "tree thinking" to support students in interpreting phylogenetic trees and thinking about the big picture of evolution.

UNIT 4 The Evolutionary History of Life

This unit employs a novel approach to studying the evolutionary history of biodiversity. Each chapter focuses on one or more major steps in the history of life, such as the origin of cells or the colonization of land. The coverage of natural history and biological diversity also emphasizes the evolutionary process—how factors such as the origin of key adaptations have influenced the rise and fall of different groups of organisms over time.

UNIT 5 Plant Form and Function

The form and function of vascular plants are often treated as separate topics, making it difficult for students to make connections between the two. In Unit 5, plant anatomy (Chapter 28) and the acquisition and transport of resources (Chapter 29) are bridged by a discussion of how plant architecture influences resource acquisition. Chapter 30 provides an introduction to plant reproduction and examines controversies surrounding the genetic engineering of crop plants. The final chapter (Chapter 31) explores how plants sense and respond to environmental challenges and opportunities by effecting changes in their growth and reproduction.

UNIT 6 Animal Form and Function

This unit's focused exploration of animal physiology and anatomy uses a comparative approach to bring out fundamental principles and conserved mechanisms. An integrative introductory chapter (Chapter 32) introduces students to the closely related topics of endocrine signaling and homeostasis. Other interconnections are explored in chapters that meld presentations of circulation and gas exchange, reproduction and development, neurons and nervous systems, and motor mechanisms and behavior.

UNIT 7 Ecology

This unit applies the key themes of the text, including evolution, interactions, and energy and matter, to help students learn ecological principles. Chapter 40 integrates material on population growth and Earth's environment, highlighting the importance of both biological and physical processes in determining where species are found. Chapter 43 ends the book with a focus on conservation biology and global change.

Highlights of New Content

Here, we highlight the major content updates and revisions made to the Third Edition of *Campbell Biology in Focus*.

CHAPTER 1 Introduction: Evolution and the Foundations of Biology

Chapter 1 includes several new and significantly revised figures: Figure 1.13, depicting researchers studying hominin fossils in South Africa, providing a new example of how life on Earth has changed over time; Figure 1.15, providing a new example of unity and diversity in birds; and Figure 1.18, a new image depicting Jane Goodall observing a chimpanzee mother and baby in the field.

UNIT 1 Chemistry and Cells

In Unit 1, new content engages students in learning foundational chemistry and making the cell-related material more accessible and inviting. The opening of Chapter 2 and a new figure show organisms affected by **loss of Arctic sea ice (Figure 2.21)**. Chapter 3 has a new chapter opener featuring Qinling golden snub-nosed monkeys, as well as updates on lactose intolerance, *trans* fats, dietary fiber (with a nutritional label), protein sequences and structures, and intrinsically disordered proteins. New Visualizing Figure 3.20 helps students understand various ways proteins are depicted. A new Problem-Solving Exercise in Concept 3.7 engages students by having them compare DNA sequences in a case of possible fish fraud.

▼ Figure 2.21 Effects of climate change on the Arctic.

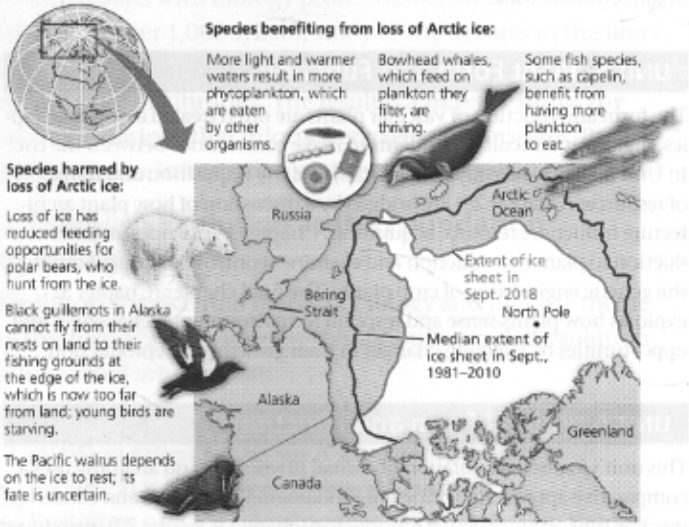


Figure 4.1 is a new chapter-opening photo—a striking colorized micrograph of the rods and cones in the eye. New Visualizing Figure 4.30 shows the profusion of molecules and structures in a cell, all drawn to scale. Chapter 5 begins with a new chapter opener, a computer-based, artistic image depicting a cross section through two brain cells, showing neurotransmitter release during exocytosis. Chapter 6 includes a new photo of a firefly to show terrestrial bioluminescence. To illustrate order as a characteristic of life, Figure 6.4 includes photos of a Venus flower basket glass sponge and La Sagrada Família church in Barcelona, Spain. The structure of the glass sponge inspired the architect Antoni Gaudí in his design of the church's towers. Chapter 7 begins with striking photos of puffins, both capturing food and in flight, and includes an addition on the role of fermentation and anaerobic respiration in the production of chocolate from cacao beans. Chapter 8 includes a new concept head (Concept 8.4, Life depends on photosynthesis) to facilitate instructor use of this final summary and the two important review figures at the end of the chapter. In Chapter 9, more cell cycle control checkpoints have been added.

UNIT 2 Genetics

Chapters 10–14 incorporate 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 10.6 asks students to identify where haploid cells undergo mitosis in the three life cycles shown in the figure and what type of cells are formed. Chapter 11 includes information on a 2014 genomic study on the number of genes and genetic variants contributing to height. In Chapter 12, the section on sex determination is more inclusive, explaining that sex is no longer thought to be simply binary and clarifying the emerging distinction between the terms *sex* and *gender*. Also, new research on sex determination has been added. New Visualizing Figure 13.8 shows various ways that DNA is illustrated. In Concept 13.4, updates to the CRISPR-Cas9 coverage include progress on attempting to cure sickle-cell disease, use of gene drives to address insect-borne diseases, a photo of **Jennifer Doudna with a CRISPR-Cas9 model (Figure 13.33)**, text about her role in discovering CRISPR technology, and text about ethical considerations. Chapter 14 has a new opening photo and story about albino donkeys to pique student interest in gene expression, and the one-letter codes for amino acids have been added to increase student familiarity with these widely used symbols. A new Problem-Solving Exercise asks students to identify mutations in the insulin gene and predict their effect on the protein.

▶ Figure 13.33 Jennifer Doudna holding a model of CRISPR-Cas9.

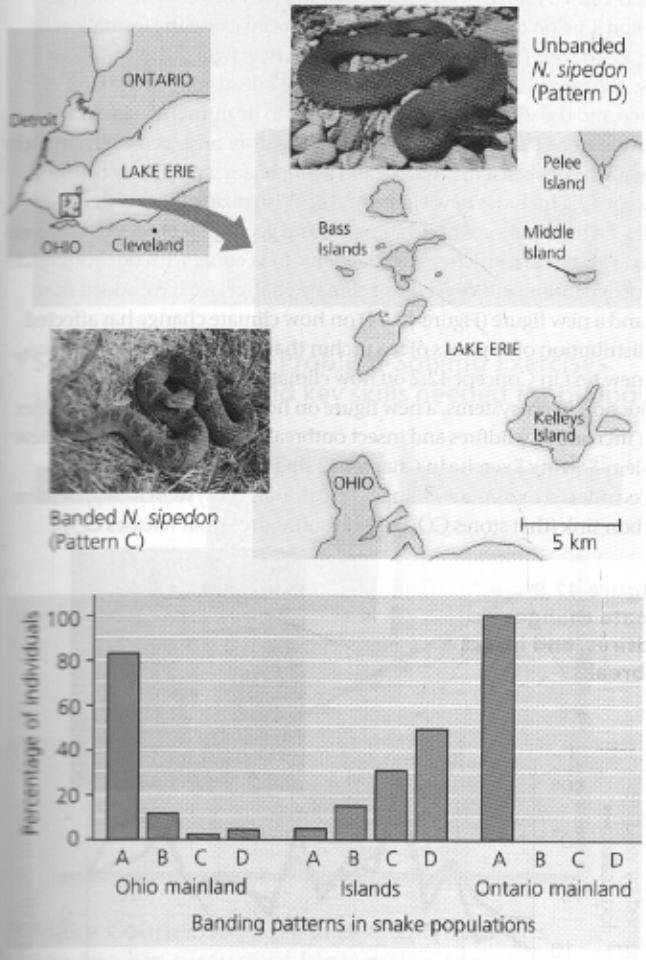
Chapters 15–18 are extensively updated, driven by exciting new discoveries based on DNA sequencing and gene-editing technology. Chapter 15 has updates on histone modifications, the percent of protein-coding genes expressed by a typical human cell, alternative splicing, functional RNAs, miRNAs, and siRNAs. A mention of CRISPR in bacteria has been added to the section on evolution. Concept 15.4 includes brief descriptions of both quantitative RT-PCR and RNA sequencing because these techniques are becoming more widely used. Chapter 16 includes updates on 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 16.21 ("Genomics, Cell Signaling, and Cancer") has been revised to reflect recent research on breast cancer subtypes. Chapter 17 updates include the Ebola, Chikungunya, and Zika viruses (Figure 17.10), new research on the structure of the influenza virus, and discovery of the largest virus known to date. A discussion has been added on mosquito transmission of viral diseases and the possibility of global climate change affecting mosquito ranges and therefore disease transmission. Chapter 18 begins with new photos of an elephant shark (*Callorhinchus milii*), which has the slowest-evolving vertebrate genome identified to date, and a tiger tail sea horse (*Hippocampus comes*), which has the fastest-evolving known fish genome. Also, 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 results from a 2015 study showing the similarity of certain yeast and human genes, underscoring the common origin of yeasts and humans.

UNIT 3 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, new Figure 20.5 ("Visualizing Phylogenetic Relationships") introduces how phylogenetic trees represent evolutionary relationships and what such trees do and do not convey, and new Figure 23.5 ("Visualizing the Scale of Geologic Time") explores some visual conventions used to represent the enormity of geologic time. The unit also features new material that connects evolutionary concepts and societal problems. Examples include text in Chapter 19 on the 2015 discovery of teixobactin, an antibiotic that is effective

against some hard-to-treat pathogens, a new discussion in Chapter 22 on the impact of climate change on hybrid zones, and a new Problem-Solving Exercise in Chapter 22 on how hybridization may have led to the spread of insecticide resistance genes in mosquitoes that transmit malaria. Additional changes include new text in Concept 19.3 emphasizing how populations can evolve over short periods of time, new content in Concept 20.1 emphasizing how sister groups provide a clear way to describe evolutionary relationships and how trees do not show a "direction" in evolution, a new example in Concept 20.5 of horizontal gene transfer from prokaryote species to a eukaryote lineage, a new table (Table 21.1) highlighting the five conditions required for a population to be in Hardy-Weinberg equilibrium, and new text and a new figure on **gene flow (Figure 21.12)**.

▼ Figure 21.12 Gene flow and local adaptation in the Lake Erie water snake (*Nerodia sipedon*).



UNIT 4 The Evolutionary History of Life

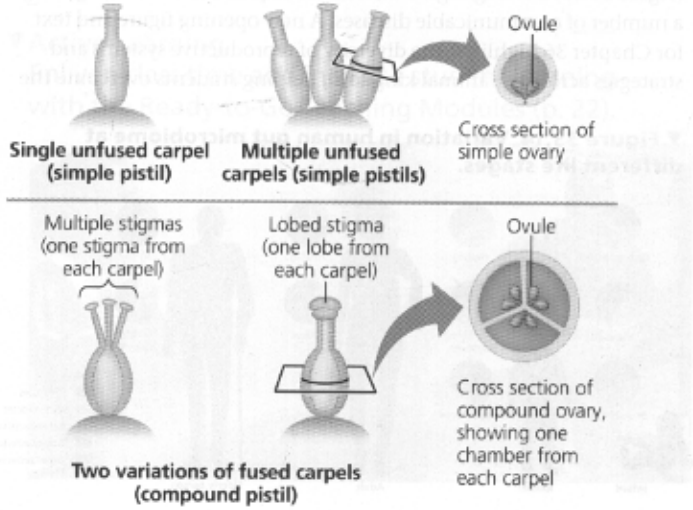
In keeping with our goal of improving how students interpret and create visual representations in biology, we have added a new figure (Figure 27.8, "Visualizing Animal Body Symmetry and Axes") that introduces some visual conventions and terminology used in describing animal bodies. Students are also provided many opportunities to practice their visual skills, with more than ten new Visual Skills Questions on topics ranging from interpreting phylogenetic trees to inferring which regions of a bacterial flagellum are hydrophobic. Other major content changes include new text in Concepts 24.4 and 25.1 on the 2015 discovery of the Lokiarchaeota, a group of archaea that may represent the sister group of the eukaryotes, a new Scientific Skills Exercise in Chapter 24 on calculating and interpreting means and standard errors using data on the effectiveness of a promising new antibiotic, teixobactin, and new text and a new figure (Figure 26.24) on the earliest known seed plants. A new Problem-Solving Exercise in Chapter 27 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 material in Concept 24.1 describing how researchers recently succeeded for the first time in constructing a "protocell" in which replication of a template strand of RNA could occur (a key step in our understanding of the origin of life), and new text and a new figure in Concept 27.6 describing the 2017 discovery of 315,000-year-old hominin fossils of ***Homo naledi*** **(Figure 27.37)**, a close relative of *Homo sapiens*.

▼ Figure 27.37 Fossils of hand bones and foot bones (top and side views) of *Homo naledi*.

UNIT 5 Plant Form and Function

A major aim in revising Chapter 28 was to help students better understand how primary and secondary growth are related. New Visualizing Figure 28.10 enables students to picture these two types of growth more effectively. New coverage of the primary meristems (protoderm, procambium, and ground meristem) helps students visualize the transition of meristematic to mature tissues. A new flowchart (Figure 28.21) summarizes growth in a woody shoot. In Chapter 29, new Figure 29.7 illustrates the fine branching of leaf veins to emphasize the relationship between transport and structure. In Chapter 30, a new chapter opener highlights the biomimetic inspiration for the invention of Velcro as an example of how basic research can impact people's lives in unexpected ways. A new figure clarifies how **the terms *carpel* and *pistil* are related (Figure 30.3)**. The text on flower structure and

▼ Figure 30.3 The relationship between the terms *carpel* and *pistil*.



the angiosperm life cycle figure identify carpels as megasporophylls and stamens as microsporophylls, correlating with the plant evolution discussion in Unit 5. New Figure 30.17 compares insect damage in non-*Bt* maize and *Bt* maize. In Chapter 31, the coverage of control of apical dominance is enhanced by new Figure 31.5 on effects of removing the apical bud and new text on the role of sugars. In Concept 31.3, a new Problem-Solving Exercise highlights how global climate change affects crop productivity. Figure 31.24 on defense responses against pathogens has been simplified and improved.

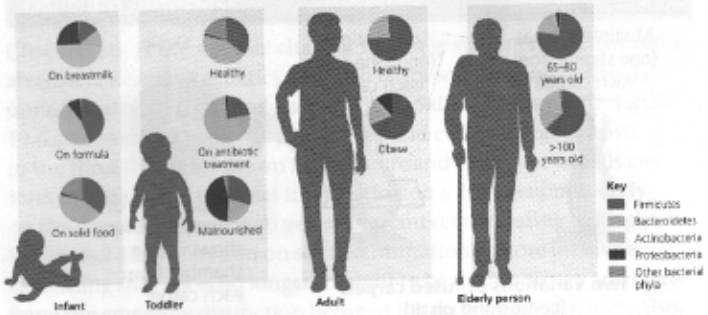
UNIT 6 Animal Form and Function

A major goal of the Unit 6 revision was to transform how students interact with and learn from representations of anatomy and physiology. For example, the art for homeostatic control systems in Chapter 32 (Figures 32.11, 32.15, and 32.24) and throughout the book has been revised to provide a clear and consistent presentation of the role of perturbation in triggering a response. In Chapter 34, Figure 34.10 on blood velocity and pressure has been revised to help students appreciate both time-dependent variation in systolic and diastolic pressure and location-dependent variation in mean pressure. In Chapter 36, Figure 36.12 on female reproductive cycles has been redesigned to make key events stand out and to highlight coordination of the ovarian and uterine cycles, and new Visualizing Figure 36.18 provides students with a clear and carefully paced introduction to the three-dimensional rearrangements that occur during gastrulation. In Chapter 37, new Visual Skills and Draw It Questions lead students to visualize ion movement through voltage-gated ion channels (Figure 37.10), engage with representations of action potential formation and propagation (Figure 37.12), and explore the commonalities and distinctions between spatial and temporal summation at synapses (Figure 37.18). In Chapter 38, the art illustrating the cellular responses of photoreceptors (Figure 38.27) has been transformed into two parallel drawings that highlight more effectively how enzyme-induced changes in second messenger concentration trigger changes in ion flow, membrane potential, and ultimately neurotransmitter production.

The Unit 6 revision also introduces new material and updates that are designed to promote student engagement and appreciation of biology as an active, vibrant science. For example, a new Problem-Solving Exercise in Chapter 32 taps into student interest in medical mysteries through a case study that explores the science behind laboratory testing and diagnosis.

New text and figures introduce students to recent discoveries regarding topics such as the **microbiome (Figure 33.14)** and to cutting-edge technology, including a method for the rapid, comprehensive characterization of viral exposure (Figure 35.19). The revision also addresses students misconceptions with, for instance, new art (Figure 35.18) that highlights the success of immunization in fighting a number of communicable diseases. A new opening figure and text for Chapter 36 highlight the diversity of reproductive systems and strategies across the animal kingdom, helping students overcome the misconception that reproduction inherently involves a male and a female. In Chapter 37, the discussion of the complementary roles of inactivation and voltage gating of ion channels during action potential formation has been revised for clarity (Concept 37.3). Finally, additional content updates help students appreciate the continued evolution of our understanding of biological phenomena, such as how animals detect magnetic fields (Concept 38.4) and how jellies move (Concept 39.2).

▼ Figure 33.14 Variation in human gut microbiome at different life stages.



UNIT 7 Ecology

Complementary goals of the Unit 7 revision were to strengthen our coverage of core concepts while also increasing our coverage of how human actions affect ecological communities. Revisions include new text in Concept 43.1 on the mechanisms by which acid precipitation harms aquatic and terrestrial organisms, new text and a new figure (Figure 41.24) in Concept 41.4 on the island equilibrium model (and how it relates to human-caused habitat fragmentation), and new material in Concepts 42.2 and 43.4 on eutrophication and how it can cause the formation of large "dead zones" in aquatic ecosystems. A new figure (Figure 43.21) shows the extent of the record-breaking 2017 dead zone in the Gulf of Mexico and the watershed that contributes to its nutrient load. In addition, Chapter 41 has a new chapter-opening story on a seemingly unlikely mutualism between a tiny wrasse and a much larger predatory fish, and Concept 42.4 includes new Figure 42.14, "Visualizing Biogeochemical Cycles," which explores how biological and geological processes are represented visually in nutrient cycle diagrams. In keeping with our book-wide goal of expanding our coverage of climate change, we have added new text and a new figure (Figure 40.14) on how climate change has affected the distribution of a species of sea urchin that decimates kelp communities, new text in Concept 42.2 on how climate change affects primary production in ecosystems, a new figure on how **climate change** relates to an increase in wildfires and insect outbreaks **(Figure 42.9)**, and a new Problem-Solving Exercise in Chapter 42 that explores how insect outbreaks induced by climate change can cause an ecosystem to switch from a carbon sink (that stores CO_2) to a carbon source (that releases CO_2).

▼ Figure 42.9 Climate change, wildfires, and insect outbreaks.