Biology inspires wonder. The image of the flock of starlings on our cover shows an astonishing behavior known as murmuration—mesmerizing patterns that emerge out of thousands of birds flying in unison. This fascinating behavior is an example of what motivates biologists to study the complexities of life.

Biology is dynamic. It is constantly changing as new insights lead to new ideas and new tools to test those ideas. Think of the use of drones and satellites to photograph penguin populations in Antarctica. Think of the developments in biological imaging and computation. Think of genome sequencing and its effect on our understanding of everything from human diseases to the tree of life. Think of the use of ice cores to understand past global climate.

Biology is a system. Biological systems are made up of different levels of organization—from molecules to ecosystems—that are interconnected and complex. Biologists are beginning to use integrated approaches to understand the complex properties of biological systems.

Biology is life. We face many challenges as humans including emerging diseases, feeding people in a sustainable way, population growth, degradation of natural systems, and climate change. We understand that humans are integrally connected to and dependent on all life on Earth.

Our goal—and challenge—in writing Life is to engage students in all these aspects of biology by motivating learning through active discovery. We focus on key concepts and contemporary examples that provide a foundation for further study. We have consulted and collaborated with faculty, students, and experts in the fields of biology and education. As you will see in the next several pages, in this, our Eleventh Edition, we engage students by explaining how biology affects their daily lives and how new knowledge is discovered. To help students master the concepts and principles, we introduce a number of new active learning activities.

Please read on.
The Vision of Life: The Science of Biology

With roots 10 editions deep, the Eleventh Edition blends carefully reviewed content and an emphasis on experiments with a contemporary approach to active learning. Throughout, we focus on three driving themes:

**Life is ENGAGING**
We want students to come away from the introductory biology course with a sense of wonder and an ability to pursue biological questions. To that end, we keep the writing lively, the examples modern and exciting, and the emphasis on how we know what we know.

To help students engage with the course, an Investigating Life thread weaves through each chapter. Each individual part of the thread appeals to students, inspires them to ask questions, and keeps them wanting to know, “What next?” The beauty of the thread is that it gives students an authentic scientific experience beyond just reading about someone’s research results.

**Life is ACTIVE**
With the help of the Advisory Board, we’ve developed a series of pedagogical features that integrate tools for instructors with those for student independent study. Students work their way toward real understanding of biological principles. We don’t just ask them to memorize information—we invite them to actively participate in the process of discovery.

For instructors wanting to make active learning a part of their classroom, we’ve created an Active Learning Guide, with start-up material, ideas, and a complete guide to all the Life activities that are ready to add to your in-class repertoire.

**Life is FOCUSED ON SKILLS**
We want students to feel comfortable as they learn to manipulate and interpret data. The various types of problem-solving exercises in Life help them develop practical, analytical, and quantitative skills—skills that will benefit them whether they continue in biology or not. Exercises vary in skill level, type, and approach, with answers in the back of the book.

The response to our Work with the Data boxes has been so consistently positive that we now include at least one in every chapter. This feature asks students to analyze data from original scientific experiments, and includes questions in the text plus, now, a corresponding set of alternative exercises online in LaunchPad. We also provide an appendix, Making Sense of Data: A Statistics Primer, to help students prepare for the quantitative work they’ll be doing.

Experience *Life* through LAUNCHPAD
With this edition’s LaunchPad, *Life* is more than ever a truly integrated text/media resource. LaunchPad gives students everything they need to prepare for class and exams, while giving instructors everything they need to set up a course, customize the content, craft presentations, assign homework, assess students, and guide the progress of individuals and the class as a whole.

“What makes this book stand out most among the competition is the way in which there is a continued sense of reinforcement for novice learners.”
—Claudette Davis, George Mason University
Investigating Life

The Investigating Life thread begins every chapter with a fascinating real-life story emerging from actual research. The story concludes with an Opening Question that is explored throughout the chapter’s Investigating Life thread. By the end of the chapter, students should be able to understand the answer to the Opening Question.

How Aspirin Works

Despite suffering from the “ague,” the Reverend Edward Stone was walking in the English countryside. Feverish, tired, with aching muscles and joints, he came across a willow tree. Although apparently unaware that many ancient healers used willow bark extracts to reduce fever, the clergyman knew of the tradition of natural remedies for various diseases. The willow reminded him of the bitter extracts from the bark of South American trees, then being sold (at high prices) to treat fevers, irritations, and it into tranquilized states.

In the 1960s and 1970s, aspirin use declined when other pain-reducing medications became available. But over this same time, clinical studies revealed aspirin’s beneficial effects. It is now clear that aspirin is an effective antiplatelet agent—preventing heart attacks and strokes caused by blood clots. Many people take a daily low dose of aspirin to prevent clotting disorders.

Fever, joint pain, headache, blood clots: What symptoms have in common? They all are mediated by prostaglandins and molecules related to them. Salicylic acid blocks the synthesis of prostaglandins. The biochemical mechanism by which aspirin works was described in 1971. As we will see, an understanding of this mechanism requires an understanding of prostaglandin synthesis and enzyme function—two subjects of this chapter.

Q: How do anti-inflammatory drugs work as enzyme inhibitors?

Experiment & Work with the Data

The chapter continually returns to the opening story and question: the Experiment describes the original research behind the story and the Work with the Data gives students the opportunity to analyze research results for themselves. Work with the Data includes questions in the book and an additional corresponding exercise online and assignable in LaunchPad.
Throughout the chapter, Media Links prompt students to go online for video clips, animations, activities, and simulations that correspond to what they’re reading. All of these items can be assigned in LaunchPad, and most are accompanied by assessments.
We have developed a series of learning tools under the guidance of an Advisory Board of 19 experts in science education and pedagogy. These features are woven into the chapters so seamlessly that active learning is the natural result. All of these features are aligned to the new Learning Outcomes, giving students a clear expectation of what they need to learn.

Focus Your Learning
Each chapter is now organized around Key Concepts. Focus Your Learning statements zero in on the essential ideas in each Key Concept. These statements guide students in their reading and prepare them for the upcoming Recaps and Apply What You’ve Learned exercise.

Recaps with Learning Outcomes
Recaps summarize each section and include related Learning Outcomes and thought-provoking questions (with answers in the back of the book). Learning Outcomes are aligned with the section’s Focus Your Learning statements, and they tell students how to show that they’ve mastered the material. The questions that follow are aligned with and reinforce the Learning Outcomes. This alignment helps students self-assess whether they should review the section or continue reading.

21.2 Phylogeny Can Be Reconstructed from Traits of Organisms
To illustrate how a phylogenetic tree is constructed, consider the eight vertebrate animals listed in Table 21.1: lamprey, perch, salamander, lizard, crocodile, pigeon, mouse, and chimpanzee. We will initially assume that any given derived trait arose only once during the evolution of these animals (that is, there has been no convergent evolution), and that no derived traits were lost from any of the descendant groups (there has been no evolutionary reversal). For simplicity, we have selected traits that are either present (+) or absent (−).

Focus Your Learning
• Modern phylogenetic methods employ the principle of parsimony and mathematical models (when appropriate) to analyze morphological, developmental, palaeontological, behavioral, and molecular data.

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Protected embryos</th>
<th>True roots</th>
<th>Persistent green sporophyte</th>
<th>Vascular cells</th>
<th>Stomata</th>
<th>Megaphylls (true leaves)</th>
<th>Seeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stonewort (outgroup)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Liverwort</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pine tree</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Bracken fern</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Club moss</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sphagnum moss</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Hornwort</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sunflower</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

1. Which two of these taxa are most closely related?
2. Plants that produce seeds are known as seed plants. What is the sister group to the seed plants among these taxa?
3. Which two traits evolved along the same branch of your reconstructed phylogeny?
4. Are there any homoplasies in your reconstructed phylogeny?
Simulations

Forty interactive simulations put the controls in students’ hands and give them the opportunity to learn by doing. Topics include:

- Lipid Bilayer Composition
- Genetic Drift
- Visual Receptive Fields
- Island Biogeography
- Population Growth

Life, Eleventh Edition features a significantly increased number of simulations compared to the previous edition.

Please log in to LaunchPad to review the entire library of simulations.

Apply What You’ve Learned

Chapters conclude with an exercise that challenges students to put their newly acquired knowledge into action. The exercise presents a summary of research that is relevant to the chapter material followed by questions that, like Recap questions, align to the relevant Focus Your Learning statements, which are listed at the start of the exercise. Answers are in the back of the book.

ACTIVITY 21.2: PHYLOGENY AND MOLECULAR EVOLUTION SIMULATION

Next, one portion of the seeds from each group was analyzed for nickel content. The other portion from each group was placed in nickel-free growth medium and tested for germination. The graph below shows seed germination success plotted against nickel content of the same seeds.

Questions

1. The researchers concluded that nickel is an essential micronutrient of barley. Do you agree with their conclusion? Explain your answer.

2. Analyze the data about the mass and number of seeds produced by the third-generation barley plants. What conclusion can you draw from these data? Is this consistent with your answer to Question 1 above? Explain.
Encouraging students to be active when they work with the book on their own is just the beginning. We are committed to active learning in any setting, including in the classroom, for any teacher who wants to try it. Perhaps the most powerful new tools for instructors in this edition are the Active Learning Guide and accompanying set of Active Learning Modules and Exercises.

**Active Learning Modules**

The new Active Learning Modules provide everything an instructor needs to successfully implement an active approach to teaching key topics. Each module includes many resources, including:

- Pre-class video specifically created for the module
- Pre-quiz and post-quiz
- Handout for in-class work
- Detailed in-class exercise
- Detailed instructor’s guide

These modules are easy to implement and are a great way to add more active learning to the classroom.

“A lot of books try to sell their active learning focus, but this one actually follows through in a meaningful way.”

—Carly Jordan, George Washington University
Active Learning Guide

The Active Learning Guide provides extensive resources and support for implementing active learning techniques in the classroom. This all-new guide provides instructors with a thorough introduction to the concepts, techniques, and benefits of active learning, along with chapter-by-chapter guidance on teaching using the many active learning resources we provide for *Life*, Eleventh Edition.

Part 1: Introduction to Active Learning
- What is active learning?
- Designing your course for active learning
- Using active learning in the classroom
- How to implement *Life*'s resources

Part 2: Chapter-by-Chapter Guidance
Each Active Learning Guide chapter contains:
- Overview of the textbook chapter
- The student resources available in LaunchPad for the chapter, with descriptions
- Specific concepts/content that are particularly well-suited to active learning techniques
- The chapter’s Active Learning Exercises and how to integrate them into class sessions
- The relevant Active Learning Modules (if applicable) and how to integrate them into the course
- Suggestions for additional active learning opportunities
- Links to specific additional online resources

Part 3: Appendices
- Guide to Using Learning Standards in Teaching and Course Development
- Overview of Bloom’s Taxonomy

“This textbook works well with any teaching style…. It is a great tool to help instructors transform their classroom into an active learning environment.”
— Robert Osuna, University at Albany, State University of New York

“The active learning modules included with this text take the ‘fear factor’ out of active learning.”
— Candice Damiani, University of Pittsburgh

Work with the Data

In the Work with the Data exercises, students analyze the results of an original scientific experiment, then work through a series of questions. In response to overwhelmingly positive feedback, the new edition includes at least one Work with the Data box in each chapter.

Online Companion Exercises

For additional practice, every Work with the Data exercise has a corresponding Online Companion in LaunchPad, addressing the same skills as its in-book equivalent.

"I especially like the “Work with the Data” exercises. Too often this sort of critical thinking is left to upper level courses."

—Susan Reigler, Indiana University Southeast
Apply What You’ve Learned

Exploring the same types of problems that scientists typically investigate, the Apply What You’ve Learned exercises allow students to hone both critical thinking and data analysis skills in fascinating contexts. Answers appear in the back of the book.

Apply What You’ve Learned

Review

22.4 Reproductive isolation is reinforced in sympatry through selection for prezygotic mechanisms that prevent hybridization, which results from postzygotic mechanisms that reduce the fitness of hybrids.

Evolutionary biologists are particularly interested in reinforcement’s role in speciation because this process directly connects natural selection to the origin of species.

Different Drosophila species vary in the concentrations of different hydrocarbons on their cuticles. These hydrocarbons often serve as reproductive signals, with females preferring to mate with males that have the suite of hydrocarbons from the females’ own species over those of other species. As they often are reproductive signals, the hydrocarbons may be the target of the selection involved in reinforcement.

Two species of Drosophila, D. serrata and D. birchii, are found on Australia’s east coast and overlap in range. D. serrata popula-

Questions

1. Based on the data, which hydrocarbon(s) show a pattern that is consistent with reinforcement? Explain your answer.
2. Suppose the allopatric populations of D. serrata were taken

Making Sense of Data: A Statistics Primer

This primer (an appendix in the text and also in LaunchPad), lays the proper groundwork for understanding statistics and data, providing helpful student support for all of the quantitative exercises in the new edition.

How Does Statistics Help Us Understand the Natural World?

Statistics is essential to scientific discovery. Most biological studies involve five basic steps, each of which requires statistics:

- **Step 1: Choose an Experimental Design**
  Clearly define the scientific question and the methods necessary to tackle the question.

- **Step 2: Collect Data**
  Gather information about the natural world through observations and experiments.

- **Step 3: Organize and Visualize the Data**
  Use tables, graphs, and other useful representations to gain intuition about the data.

- **Step 4: Summarize the Data**
  Summarize the data with a few key statistical calculations.

- **Step 5: Make Inferences from the Data**
  Use statistical methods to draw general conclusions from the data about the world and the ways it works.

**Step 1: Choose an Experimental Design**

We make observations and conduct experiments to gain knowledge about the world. Scientists come up with scientific ideas based on...
LaunchPad
LAUNCHPADWORKS.COM

Built to address the biggest classroom issues instructors face, LaunchPad gives students everything they need to prepare for class and exams, while giving instructors everything they need to quickly set up a course, shape the content to their syllabus, craft presentations and lectures, assign and assess homework, and guide the progress of individual students and the class as a whole.

All of the resources in LaunchPad for Life, Eleventh Edition have been created specifically to support this edition. The Activities and Animations were created using textbook art; all quiz and test questions are updated and aligned to the Eleventh Edition; everything is referenced to the textbook’s Key Concepts; and substantial new active learning resources support the use of the book in an active learning context.

LaunchPad’s enhanced question bank functionality makes it easier to search for and select questions from any of the Life question banks (Test Bank, Learning-Curve, Summative Quizzes). With the new filtering functionality, instructors can get the precise mix of questions they want by filtering for:

- Learning Outcome (new for the Eleventh Edition)
- Focus Your Learning statement
- Key Concept
- Bloom’s Level
- Difficulty (for LearningCurve questions)
- Source

Search Results
Click on a question below to preview the question.
Showing 25 questions out of 135 results.
Expand AI Add Checked

- A bacterial cell has been exposed to a powerful mutagen. The chromosomal...
- Suppose that a mutation appears in a small population of plants that changes...
- Drosophila melanogaster flies that have the Shaker mutation appear normal at...
- Which type of mutation involves two different nonhomologous chromosomes...
- The K-ras protein promotes cell proliferation and is often mutated in leukemia...

Question Preview
To add a question you must edit your assignment first. Once you add a question you will no longer receive publisher updates to that question. If a question has an image, click to enlarge.

1 pt A bacteria has been exposed to a powerful mutagen. DNA sequences in the untreated and treated cells show the following for a series of nucleotide triplets. (Note that the dots between the triplets indicate that the sequences for both cases are the same.)

Untreated: ... AAG ... GCA ... TAC ... CAA ... TGG
Treated: ... ATC ... CTA ... TAC ... CGA ... TTA

Based on this information, there have been _____ transitions and _____ transversions.

- 0: 5
- 2: 3
- 2: 5
- 3: 2
- 3: 3

Question Type: Multiple Choice
Source: Test Bank
Chapter: 15 Gene Mutation and Molecular Medicine
Key Concept: 15.1 Mutations Are Heritable Changes in DNA
Focus Your Learning: 15.2 Learning Outcome: 15.1.3.a Bloom's Level: Applying Cognitive Level: HOC
Question Order: 15017

Add Question

**NEW RELEASE!**

**LearningCurve**

LearningCurve's new streamlined user experience makes features such as the Study Plan, eBook, and Hints more prominent. Also new—all questions now feature text hints to guide the student's thinking.

**Instructor Customization**

LearningCurve organizes chapter quizzes by Key Concept and makes it easy for instructors to hide questions on concepts they are not covering. With this, each student's quizzes can focus on the exact content being taught.

LearningCurve adaptive quizzing gives each student individualized question sets and feedback based on their correct and incorrect responses. All the questions link back to the eBook to encourage students to read the book in preparation for class time and exams.
Life’s assessment resources have long been appreciated for their accuracy, clarity, and ease-of-use. For this edition, we have enriched our assessment program to offer instructors more of exactly what they want. Along with updating and revising all assessment banks and adding new questions at higher cognitive levels, we have fully aligned all in-book and online content for the Eleventh Edition to the new Learning Outcomes.

Learning Outcomes

The new Learning Outcomes in Life are the core of the book’s learning standards (Key Concepts, Focus Your Learning statements, and Learning Outcomes). Each chapter in this edition is structured around these standards. In the book, Learning Outcomes are aligned to Focus Your Learning statements, which are in turn aligned with Key Concepts. Learning Outcomes appear in the Recaps, where they show students what they should be able to do after reading a Key Concept section. Questions in the Recaps allow students to test themselves on those Learning Outcomes (and answers are in the back of the book).

Online, all Eleventh Edition assessment questions and resources are aligned to a more extensive set of Learning Outcomes available for instructors. This alignment across the book and all assessment pieces provides instructors a concrete way of assessing students on their mastery of the important material in each chapter.

Summative Quizzes

Each chapter has a Summative Quiz composed of 20 questions spanning the chapter’s Key Concepts. Quizzes are pre-built and ready to assign in LaunchPad. Summative Quizzes are completely customizable— instructors can add, revise, or remove questions to match their course content.

Learning Standards for Chapter 8: Energy, Enzymes, and Metabolism

<table>
<thead>
<tr>
<th>KEY CONCEPT</th>
<th>SUBHEAD</th>
<th>FOCUS YOUR LEARNING STATEMENT</th>
<th>LEARNING OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1 Physical Principles Underlie Biological Energy Transformations</td>
<td>There are two basic types of energy</td>
<td>8.1.1 Energy is the capacity for change in biological systems and takes one of two forms: potential or kinetic.</td>
<td>8.1.1.a Describe the forms of energy in biological systems. 8.1.1.b Differentiate between potential energy and kinetic energy.</td>
</tr>
<tr>
<td></td>
<td>There are two basic types of metabolism</td>
<td>8.1.2 Energy changes in living things often involve chemical reactions.</td>
<td>8.1.2.a Explain how to determine whether a reaction is anabolic or catabolic. 8.1.2.b Compare and contrast anabolic and catabolic reactions.</td>
</tr>
<tr>
<td></td>
<td>The first law of thermodynamics: Energy is neither created nor destroyed</td>
<td>8.1.3 Chemical transformations in living systems are governed by the laws of thermodynamics.</td>
<td>8.1.3.a Identify the meaning of the term “thermodynamics.” 8.1.3.b Explain how the first law of thermodynamics relates to biological systems.</td>
</tr>
<tr>
<td></td>
<td>The second law of thermodynamics: Disorder tends to increase</td>
<td>8.1.5 The second law of thermodynamics states that disorder is constantly increasing in the universe.</td>
<td>8.1.5.a Compare and contrast the first and second laws of thermodynamics. 8.1.5.b Explain the concept of free energy.</td>
</tr>
<tr>
<td></td>
<td>Chemical reactions release or consume energy</td>
<td>8.1.6 Chemical reactions in biological systems are either exergonic or endergonic.</td>
<td>8.1.6.a Differentiate between exergonic and endergonic reactions. 8.1.6.b Use an example to explain the concept of chemical equilibrium.</td>
</tr>
<tr>
<td></td>
<td>Chemical equilibrium and free energy are related</td>
<td>8.1.7 Chemical reactions in biological systems are often reversible.</td>
<td>8.1.7.a Predict the direction of reaction for a system at equilibrium when conditions are changed. 8.1.7.b Describe the change in free energy for a reaction given information about its point of equilibrium.</td>
</tr>
</tbody>
</table>

NEW

For each chapter, LearningCurve offers an extensive set of questions that are distinct from those in the Test Bank and Summative Quizzes. Questions are organized around Key Concepts, aligned to Learning Outcomes, and ranked by difficulty. Thus, students can master the material at a manageable pace, facing difficult questions only after answering easy and moderate questions correctly.

Sample from Full Set of Learning Outcomes for Chapter 8

**Test Bank**

The *Life Test Bank* has been significantly revised for the Eleventh Edition, to meet four goals:

- Update content to match the revised textbook chapters
- Align questions to the new Learning Outcomes
- Increase the number of questions with higher cognitive (Bloom’s) levels
- Develop a new section of short answer questions to allow for open-ended questions and problems that don’t fit the multiple choice or fill-in-the-blank framework

All questions are available in LaunchPad and are easily searchable by Chapter, Key Concept, Focus Your Learning statement, Learning Outcome, and Bloom’s level using LaunchPad’s new question bank tools.

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### Assessment in the Book and in LaunchPad

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>LAUNCHPAD ASSESSMENT RESOURCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Concepts</td>
<td>• All quiz and test questions are tagged by Key Concept and searchable in LaunchPad</td>
</tr>
<tr>
<td></td>
<td>• LearningCurve study plans and instructor reports are organized around the Key Concepts</td>
</tr>
<tr>
<td>Focus Your Learning Statements</td>
<td>• Questions in Recaps for students</td>
</tr>
<tr>
<td></td>
<td>• All quiz and test questions are tagged by Focus Your Learning statement and are searchable in LaunchPad</td>
</tr>
<tr>
<td>Learning Outcomes</td>
<td>All Recap, quiz, and test questions are aligned with Learning Outcomes and are searchable in LaunchPad</td>
</tr>
<tr>
<td>Work with the Data</td>
<td>Companion Work with the Data exercises in LaunchPad</td>
</tr>
<tr>
<td>Summative Quizzes</td>
<td>Each chapter includes a pre-built Summative Quiz in LaunchPad</td>
</tr>
<tr>
<td>Active Learning Modules</td>
<td>All new Active Learning Modules include a pre-quiz, and post-quiz in LaunchPad, plus additional assessment questions</td>
</tr>
<tr>
<td>Simulations</td>
<td>Companion quizzes assignable in LaunchPad</td>
</tr>
<tr>
<td>Animations</td>
<td>Pre-built quizzes in LaunchPad</td>
</tr>
<tr>
<td>Activities</td>
<td>All activities are now assignable and report on completion to the LaunchPad gradebook</td>
</tr>
<tr>
<td>Test Bank</td>
<td>An extensive test bank is provided for each chapter, in a variety of formats: LaunchPad question banks, Word documents, and in the Diploma test-creation program (software included)</td>
</tr>
</tbody>
</table>
The art in *Life*, Eleventh Edition surpasses the art in previous editions. The authors and artists have examined each and every figure in the text, refining them for clarity, readability, and beauty. Many figures now include a question.

**Figure 13.13 Many Proteins Collaborate in the Replication Complex**

Several proteins in addition to DNA polymerase are involved in DNA replication. The two molecules of DNA polymerase shown here are part of the same complex.

**Figure 58.9 Large Carnivores Are Declining, Changing Food Webs**

Examples of the effects of large-carnivore decline on the change in abundance of species in their food webs. The blue bars represent the direct effects and the red bars represent the indirect effects. The number of years refers to the time since the carnivore species ceased to exist at the study site.

“The figures [in Chapter 53] blew me away. They are sophisticated, elegant, and packed with information without being cluttered.”

— Jill DeVito, University of Texas, Arlington
Focus Figures

Throughout the new edition, students will find specially created figures that take them through an essential concept. These illustrations let students know that a particular concept is absolutely essential, needs their full attention, and gives them a more interactive experience with the material.

Each of these figures concludes with a thought-provoking question that can lead to further exploration as the student is working through the text—another way of encouraging students to be active learners. Answers are in the back of the book.
Life, Eleventh Edition Content Updates

**PART 1: The Science of Life and Its Chemical Basis**
- Streamlined and more focused description of electron orbitals
- Additional examples of functional groups and roles in biological molecules
- Additional examples of protein functions
- Reorganization and clearer presentation of the levels of protein structure
- Updated information on the search for evidence of conditions for life outside of Earth

**PART 2: Cells**
- Discovery of a new organelle, the tannosome, that encloses pigments
- New discussion of substructure and instability of microtubules
- Reorganization of discussion of membrane structure to feature connections with the cytoskeleton inside the cell
- Overview of membrane permeability of various substances
- Further discussion of the roles of receptor agonists and antagonists in human behavior and metabolism
- Clarification of the targets and roles of protein kinases

**PART 3: Cells and Energy**
- Clarification of the chemistry and role of ATP in energy metabolism
- New discussion of ribozymes along with protein enzymes
- Description of the mechanism of aspirin as an example of enzyme inhibition
- New description of feedback inhibition of the purine pathways and its role in arthritis
- Clearer description of electron transport and ATP synthesis, and their role in fat metabolism
- Clarification of the structure and function of photosynthetic reaction centers

**PART 4: Genes and Heredity**
- Revised and clarified discussion of DNA packaging into chromosomes
- More emphasis on human genetics (e.g., red hair)
- More examples of problem solving in genetics to clarify concepts
- Clarification of the aspects of DNA structure that allow specific interactions with other molecules
- Clarification of the functions of telomeres and telomerases
- Experimental and genetic evidence for the identification of a human disease-causing mutation and gene (e.g., breast cancer)
- More emphasis on the new field of epigenetics (e.g., behavior)
- Clearer description of the roles of small RNAs in gene regulation

**PART 5: Genomes**
- Consolidated two chapters on development and evolution to a single chapter with focus on molecular and evolutionary aspects
- Coverage of a new and powerful gene modification method: CRISPR
- Emphasis on evolutionary aspects of genome sequencing (e.g., cats)
- Updated information on the human genome sequence
- Reorganization and update of discussion of synthetic biology
- Updated discussion of stem cells and their applications, including veterinary and human medicine

**PART 6: The Patterns and Processes of Evolution**
- New Investigating Life thread about the evolution of echolocation, and ways moths have evolved to avoid detection by echolocation
- Updated information about the evolution of Darwin's finches, as an example of the relationship between speciation and geographic isolation
- Added studies about the evolution of flu viruses, cross-species transfers, and why the 1918 flu epidemic was so severe
- New experiments about the factors that influence the extinction of populations

**PART 7: The Evolution of Diversity**
- Updated studies that clarify the evolution of eukaryotes within the archaeans
- New experiments and information about the communication among bacteria through quorum sensing
- Added experiments and applications about biofuel production from algae
- New experiments and problems about the application of fungal diversity to study environmental change
- Updated information about the phylogeny of animals, and what it tells us about the evolution of nervous systems
- New information and experiments about the evolution of viviparity, and the advantages and disadvantages of viviparity versus oviparity

**PART 8: Flowering Plants: Form and Function**
- Clear illustrated summary of anatomical differences between monocots and dicots
- Experimental evidence for the role of plant vascular tissue in transporting substances in the stem (e.g., cyanogenic glycosides)
- Greater emphasis on the role of mycorrhizae in plant nutrition
- Discussion of the role of apomixis in plant reproduction and its potential applications
- Update on plant diseases and resistance (e.g., wheat rust)

**PART 9: Animals: Form and Function**
- Description of a previously unrecognized mammalian adaptation for heat loss and the development of a new technology that amplifies that adaptation to improve physical performance
- Graphic description of the neuromuscular coupling extending to the control of $\text{Ca}^{2+}$ release from the sarcoplasmic reticulum
- Investigation of the use of RNAi to prevent hypertrophic cardiomyopathy
- Fascinating investigations of the capacity of seals to spend most of their time underwater and not breathing
- Exceedingly clear presentations of the mechanisms of membrane potentials, action potentials, conduction of action potentials, and synaptic transmission
PART 10: Ecology

• More attention is given to the importance of scale and multiple levels of organization in ecology. Special emphasis has been placed on global change and the role of humans as part of Earth’s systems

• Inclusion of more quantitative and conceptual material with a focus on visualization (through figures) and active learning (through Work with the Data questions)

• Examples have been diversified; fewer insect examples and more marine, invasive species, and endangered species examples

• New content on the role of ecology in human society and how it differs from environmental science and environmentalism

• New content on the effects of Earth’s topography on physical processes such as temperature inversion, ocean upwelling, and rain shadow effects

• New content on disturbance and succession including the concept of alternative stable states

• New content on nutrient cycling at ecosystem and global scales, including decomposition, nutrient transformations, and the causes of climate change

• New content on the mechanisms behind species extinctions including the concept of extinction vortex

• New content on the causes and consequences of biodiversity loss including pollution, overharvesting, invasive species, emerging diseases, and the effects of climate change

Updates to the Media and Assessment Resources

Activities
- A new format for most activities, designed to better engage the student
- New functionality that reports to the LaunchPad gradebook upon activity completion

Simulations
- Twelve new simulations on topics such as Macromolecules, Active and Passive Transport, and Natural Selection
- Each simulation is now accompanied by an assignable quiz in LaunchPad

Animations
- A new video format that incorporates captions directly into the video

Work with the Data
- Each in-book Work with the Data exercise has an online companion exercise in LaunchPad, designed to give students practice with the same analytical skills

Active Learning Exercises
- Extensively revised and reformatted

New Active Learning Guide
- A thorough primer on active learning in biology
- Includes sections such as:
  - What is active learning?
  - Designing your course for active learning
  - Using active learning in the classroom
  - How to implement Life 11e resources
- Chapter-by-chapter ideas, suggestions, and resources

New Active Learning Modules
- Robust modules designed to provide all the support an instructor needs to teach selected topics in an active learning setting
- Each module includes a detailed instructor’s guide, a pre-quiz, a pre-class video, an in-class exercise, a post-quiz, and assessment questions

Test Bank
- All questions aligned to new Learning Outcomes
- A new set of short answer questions in each chapter
- Additional questions at higher Bloom’s Levels

LearningCurve
- Expanded question banks for each chapter
- New fill-in-the-blank questions
- Hints added to all questions
“This textbook fits nicely with the current focus on active learning and the AAAS Vision and Change report.”

—Michael Baltzley, Western Oregon University

“In most cases, I found the text to be exceptionally well-written and clear...The author(s) were particularly good at explaining ‘big’ concepts...The writing/presentation style of the author(s) was very readable....In particular, the author(s) use a number of ‘real-world’ examples to highlight the information in the text. I found that this made the text and information very relatable and easier to follow/understand.”

—Mike Shaughnessy, Northeastern State University

“The authors and publishing team are to be commended for producing a set of products that promise to promote active learning. The products of Life 11e contain numerous, novel features that distinguish them from similar products.”

—David Marcey, California Lutheran University

“Opening with an intriguing story with promise of future investigation is the way to go. Many freshmen, introductory biology courses have a large number of students interested in medicine/medical fields. When “real” scenarios can be used to supplement the material within the chapter and help a student make those applicable connections, the chapter is much more interesting and meaningful.”

—Melissa Reedy, University of Illinois, Urbana-Champaign

“Without question, my favorite element was the open-ended concept questions included in the section recaps. These questions are well-written, thought provoking, not easily answered or looked up, and require an understanding of the concepts rather than a memorization of flash card terms.”

—Brad Mehrten, University of Illinois, Urbana-Champaign

“I love that [Connect the Concepts] makes a direct connection to earlier text/figures; this emphasizes and encourages the integrative, rather than linear, process of learning biology.”

—Tess Killpack, Wellesley College

“I really like the extensive use of examples and the figures, recaps, problems, etc. I think this makes the chapter much more accessible to students and gives them a built-in way to test their understanding beyond simple memorization questions. These features are what make this chapter and the other ecology chapters in this text that I have reviewed stand out from other texts.”

—Amy Downing, Ohio Wesleyan University

“I did find the chapter engaging specifically because real case studies were used as part of the conceptual framework. This was one of the major points that biology educators were calling for at the Vision and Change forum a few years ago.”

—Andrew David, Clarkson University
PART ONE  The Science of Life and Its Chemical Basis
1  Studying Life
2  Small Molecules and the Chemistry of Life
3  Proteins, Carbohydrates, and Lipids
4  Nucleic Acids and the Origin of Life

PART TWO  Cells
5  Cells: The Working Units of Life
6  Cell Membranes
7  Cell Communication and Multicellularity

PART THREE  Cells and Energy
8  Energy, Enzymes, and Metabolism
9  Pathways that Harvest Chemical Energy
10 Photosynthesis: Energy from Sunlight

PART FOUR  Genes and Heredity
11 The Cell Cycle and Cell Division
12 Inheritance, Genes, and Chromosomes
13 DNA and Its Role in Heredity
14 From DNA to Protein: Gene Expression
15 Gene Mutation and Molecular Medicine
16 Regulation of Gene Expression

PART FIVE  Genomes
17 Genomes
18 Recombinant DNA and Biotechnology
19 Genes, Development, and Evolution

PART SIX  The Processes and Patterns of Evolution
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21 Reconstructing and Using Phylogenies
22 Speciation
23 Evolution of Genes and Genomes
24 The History of Life on Earth

PART SEVEN  The Evolution of Diversity
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