CollegeBoard

Name of textbook: *Biology: The Unity and Diversity of Life* **Edition:** 12th Edition
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Big Idea 1: The process of evolution drives the diversity and unity of life.

Essential knowledge	Chapters/sections	Illustrative examples covered
1.a.1 Natural selection is a major mechanism of evolution	Chapt 1 Sec 1.4, p.10 Chapt 17 Sec 17.3–17.9, p.264–273 Chapt 18 All sections, p. 276–299 Chapt 21 Sec 21.8, p. 346–347 Chapt 23 Sec 23.2, p. 372–373 Chapt 25 Sec 25.2, p. 406–407 Chapt 27 Sec 27.1, p.462–463 Chapt 30 Sec 30.2, p.510–511 Sec 30.6, p. 516–517 Chapt 23 Sec 23.8, p. 382–3 Chapt 37 Sec 37.1, p. 638–639 Chapt 40 Sec 40.1, p.702–703 Summary, p. 718–719 Chapt 44 Sec 44.3–44.7, p. 786–783 Chapt 45 Sec 45.5–45.6, p. 804–807 Summary, p. 815 Chapt 46 Sec 46.1–46.6, p.818–826	• Graphical analysis of allele frequencies in a population Chapt 18 Sec 18.3, p. 281 Fig 18.4 Sec 18.4, p. 282–3 Fig 18.5 Sec 18.5, p. 284–5 Fig 18.8, 18.11 Sec 18.7, p. 288–289 Fig 18.14 •Application of Hardy-Weinberg Equation Chapt 18 Sec 18.2, p. 280–2 Fig 18.3
1.a.2 Natural selection acts on phenotypic variations in populations	Chapt 1 Sec 1.4, p. 10 Chapt 17 Sec 17.3, p.264–265	•Flowering time in relation to global climate change Chapt 7 Sec 7.9, p. 119

Essential knowledge	Chapters/sections	Illustrative examples covered
	Chapt 18 All Sections, p. 276–299 Chapt 21 Sec 21.8, p. 347 Chapt 44 Sec 44.3, p. 786 Chapt 45 Sec 45.6, p. 806–807	•Peppered moth Chapt 18 Sec 18.4, p. 282–283 Fig 18.5, 18.6 •Sickle cell anemia Chapt 12 Sec 12.7 Table 12.1 Chapt 18 Sec 18.6, p. 287 Fig 18.13 •DDT resistance in insects Chapt 22 Sec 22.0, p. 351 Chapt 47 Sec 47.4, p. 846 Fig 47.9 •Artificial Selection Chapt 1 Sec 1.4, p. 10 Fig 1.8a Chapt 17 Sec 17.3, p. 264 •Overuse of antibiotics Chapt 6 Sec 6.5, p. 102 Chapt 16 Sec 16.6, p. 250 Chapt 18 Sec 18.4, p. 283 Chapt 21 Sec 21.8, p. 347 Chapt 38 Sec 38.2, p. 662 Fig 38.4
Sec 1.A.3 Evolutionary change is also driven by random processes	Chapt 18 Sec 18.7, p. 288–289	No recommended illustrative examples supplied in Curriculum Framework.
1.a.4 Biological evolution is supported by scientific evidence from many disciplines, including mathematics.	Chapt 17 All sections, p. 259–275 Chapt 18 Sec 18.2, p. 280–281 Sec 18.4, p. 282–283 Chapt 19 Sec 19.2–19.4, p. 304–309	• Graphical analysis of allele frequencies in a population Chapt 18 Sec 18.3, p. 281 Fig 18.4 Sec 18.4, p. 282–3 Fig 18.5 Sec 18.5, p. 284–5 Fig 18.8, 18.11

Essential knowledge	Chapters/sections	Illustrative examples covered
	Chapt 21 Sec 21.8, p. 346–347 Chapt 25 Sec 25.0, p. 402 Chapt 45 Sec 45.5, p. 804–805 Sec 45.6, p. 806–807 Chapt 46 Sec 46.1–46.7, p. 818–827	Sec 18.7, p. 288–289 Fig 18.14 •Analysis of sequence data sets Chapt 16 Sec 16.5, p. 248–249 Fig 16.10 Chapt 19 Sec 19.4, p. 308–309 Fig 19.9, 19.10 Chapt 26 Sec 26.15, p. 456–457 Fig 26.39, 36.40 Summary, p. 315 Data analysis exercise Fig 19.16 •Analysis of phylogenetic trees Chapt 19 Sec 19.5, p. 310–311 Fig 19.2 Sec 19.6, p. 312–313 Fig 19.14, 19.15 •Construction of phylogenetic trees based on sequence data Chapt 19 Sec 19.4, p. 308–309 Fig 19.10 Summary, p. 315 Data analysis exercise Fig 19.16
1.b.1 Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	Chapt 4 Sec 4.6, p. 62 Sec 4.7, p. 63 Sec 4.11, p. 68–69 Sec 4.13, p. 72–73 Summary, p. 75 Chapt 15 Sec 15.2, p. 232–233 Sec 15.3, p.234–235 Chapt 19 All sections, p. 300–315 Chapt 20 Sec 20.5, p. 326–327 Chapt 25 Sec 25.0–25.3, p. 402–408 Chapt 26 Sec 26.1, p. 434–435	•Cytoskeleton Chapt 4 Sec 4.6, p. 62 Sec 4.7, p. 63 Fig 4.15 Sec 4.13, p. 72–73 Fig 4.26, 4.28, 4.29 Summary, p. 75 Table 4.3 •Membrane-bound organelles Chapt 4 Sec 4.6, p. 62 Fig 4.14 Sec 4.7, p. 63 Fig 4.15 Sec 4.11, p. 68–69 Fig 4.20, 4.21 Summary, p. 75 Table 4.3

Essential knowledge	Chapters/sections	Illustrative examples covered
	Chapt 32 Sec 32.6, p. 546–547 Chapt 35 Sec 35.13, p. 613 Chapt 36 Sec 36.2, p. 620–621 Chapt 37 Sec 37.1, p. 638–639 Chapt 43 Sec 43.5, p. 766–767	Chapt 19 Sec 19.4, p. 308–309 Fig 19.9, 19.10 Sec 19.6, p. 313 Fig 19.15 Chapt 20 Sec 20.5, p. 326–327 Fig 20.11 •Linear chromosomes Chapt 4 Sec 4.8, p. 64–65 Chapt 9 Sec 9.1, p. 142–143 Fig 9.2, 9.3 •Endomembrane systems, including the nuclear envelope Chapt 4 Sec 4.6, p. 62 Fig 4.14 Sec 4.7, p. 63 Fig 4.15 Sec 4.8, p. 64–65 Fig 4.16, 4.17 Sec 4.9, p. 66–67 Fig 4.18 Chapt 20 Sec 20.5, p. 326–327 Fig 20.11
1.b.2 Phylogenetic trees and cladograms are graphical representations (models) of evolutionary history that can be tested.	Chapt 1 Sec 1.3, p 8–9 Chapt 19 Sec 19.1–19.2, p.302–305 Sec 19.4–19.6, p. 308–313 Summary, p. 314–315 Chapt 21 Sec 21.3, p.338 Sec 21.7, p. 344–345 Chapt 22 Sec 22.1, p. 352–353 Chapt 23 Sec 23.1, p. 370–371 Sec 23.8, p. 382–383 Chapt 24 Sec 24.1, p. 390–391 Chapt 25	Text does not discuss any of the provided illustrative examples in the context of phylogenetic trees. However, each example is discussed in the text in other contexts. These sections are presented below. •Number of heart chambers in animals Chapt 26 Sec 26.2, p. 436–438 Fig 26.5 Chapt 37 Sec 37.1, p. 638–639 Fig 37.2, 37.3 •Opposable thumbs Chapt 19 Sec 19.2, p. 304 Chapt 26 Sec 26.13, p. 452–3

Essential knowledge	Chapters/sections	Illustrative examples covered
	Sec 25.2, p. 407 Chapt 26 Sec 26.2, p. 436–437 Sec 26.7, p. 442–443 Appendix I	•Absence of legs in some sea mammals Chapt 17 Sec 17.7, p. 269 Fig 17.13
1.c.1 Speciation and extinction have occurred throughout the Earth's history.	Chapt 17 Sec 17.1–17.3, p. 260–265 Sec 17.5, p. 266–267 Sec 17.7–17.8, p. 269–271 Chapt 18 Sec 18.9–18.12, p. 290–297 Chapt 19 Sec 19.5, p. 310–311 Chapt 20 Sec 20.3, p. 322–323 Chapt 25 Sec 25.2, p. 406–407 Chapt 26 Sec 26.11, p. 448–449 Chapt 49 Sec 49.0–49.6, p. 890–900 Summary, p. 904–905	•Five major extinctions Chapt 17 Sec 17.0, p. 258 Fig 17.1 Sec 17.8, p. 270–271 Fig 17.14 Summary, p. 274–275 Impacts, Issues exercise Data analysis exercise Fig 7.18 Chapt 18 Sec 18.12, p. 297 Chapt 26 Sec 26.8, p. 443 Chapt 49 Sec 49.1, p. 892 Fig 49.2 •Human impact on ecosystems and species extinction rates Chapt 19 Sec 19.0, p. 300 Fig 19.1 Chapt 23 Sec 23.0, p. 368 Fig 23.1b Chapt 49 Sec 49.0, p. 890 Fig 49.1 Sec 49.1, p. 893 Fig 49.3, 49.4 Sec 49.2, p 894–895 Fig 49.5, 49.6 Sec 49.3, p. 896 Table 49.1 Sec 49.4, p. 896–897 Fig 49.7 Table 49.2 Sec 49.5, p. 898–899 Sec 49.6, p. 900 Fig 49.10, 49.11 Summary, p. 904–905 Impacts, Issues exercise Critical Thinking exercise

Essential knowledge	Chapters/sections	Illustrative examples covered
1.c.2 Speciation may occur when two populations become reproductively isolated from each other.	Chapt 18 Sec 18.9–18.11, p. 290–295	No recommended illustrative examples supplied in Curriculum Framework.
1.c.3 Populations of organisms continue to evolve.	Chapt 18 Sec 18.0–18.1, p. 276–279 Sec 18.1, p.278–279 Sec 18.4, p.282–283 Sec 18.7, p. 288–289 Chapt 21 Sec 21.0, p. 333 Sec 21.3, p. 338 Sec 21.8, p. 346–347 Chapt 22 Sec 22.0, p. 351 Chapt 25 Sec 25.9, p. 418 Chapt 26 Sec 26.2, p. 436–437 Sec 26.5, p. 440–441 Chapt 33 Sec 33.1, p. 554–555 Sec 33.10, p. 568–569 Chapt 37 Sec 37.1, p. 638–639 Chapt 38 Sec 38.12, p. 676–677 Chapt 39 Sec 39.3–39.4, p. 684–687 Sec 39.9, p. 696–697 Chapt 40 Sec 40.1, p. 702–703 Chapt 41 Sec 41.2, p. 722–723 Sec 41.3, p. 724–725	•Chemical resistance and emergent diseases Chapt 16 Summary, p. 256 Critical thinking exercise Chapt 18 Sec 18.0, p. 276 Fig 18.1; Sec 18.4, p.282–283 Summary, p. 299 Data analysis exercise Fig 18.27 Chapt 21 Sec 21.0, p. 332 Fig 21.1 Sec 21.2, p. 336–337 Fig 21.5 Sec 21.3, p. 338 Fig 21.7 Sec 21.8, p. 346–347 Fig 21.18, 21.19a Chapt 22 Sec 22.0, p. 350 Fig 22.1 Sec 22.2, p. 355 Sec 22.8, p. 361 Fig 22.19 Chapt 38 Sec 38.12, p. 676–677 Fig 38.23 Table 38.6 Chapt 42 Sec 42.10, p. 754–755 Fig 42.18 Table 42.4 Chapt 46 Sec 46.9, p. 831 Table 46.2 •Observed directional phenotypic change in a population Chapt 18 Sec 18.4, p.282–283 Fig 18.6 Sec 18.7, p. 289

Essential knowledge	Chapters/sections	Illustrative examples covered
		Chapt 45 Sec 45.6, p. 806–807 Fig 45.11, 45.12 Summary, p. 813 Critical thinking exercise Chapt 46 Sec 46.3, p. 821 •A eukaryotic example describing the evolution of a structure or process such as heart chambers, limbs, brain, and immune system Chapt 25 Sec 25.8, p. 416–417 Fig 25.23–25.25 Sec 25.9, p. 418 Fig 25.26 Chapt 26 Sec 26.2, p. 436–437 Sec 26.5, p. 440–441 Fig 26.12–26.14 Sec 26.9, p. 444–445 Fig 26.18 Chapt 33 Sec 33.1, p. 554–555 Fig 33.2 Sec 33.10, p. 568–569 Fig 33.20 Chapt 37 Sec 37.1, p. 638–639 Fig 37.2, 37.3a–c Chapt 39 Sec 39.3, p. 684–685 Fig 39.5–39.8 Sec 39.4, p. 686–687 Fig 39.9–39.12 Sec 39.9, p. 696–697 Fig 39.24, 39.25 Chapt 40 Sec 40.1, p. 702–703 Fig 40.2–40.4 Chapt 41 Sec 41.2, p. 722–723 Fig 41.3–41.5 Sec 41.3, p. 724–725 Fig 41.6–41.8

Essential knowledge	Chapters/sections	Illustrative examples covered
1.d.1 There are several hypotheses about the natural origin of life on Earth, each with supporting scientific evidence.	Chapt 19 Sec 19.6, p. 312–313 Chapt 20 All Sections, p.316–330 Chapt 21 Sec 21.1, p. 334–335 Sec 21.4, p. 339 Sec 21.6, p. 342–343	No recommended illustrative examples supplied in Curriculum Framework.
1.d.2 Scientific evidence from many different disciplines supports models of the origin of life.	Chapt 20 All Sections, p.316–330 Chapt 21 Sec 21.1, p. 334–335 Sec 21.4, p. 339 Sec 21.6, p. 342–343	No recommended illustrative examples supplied in Curriculum Framework.

Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.

Essential knowledge	Chapters/sections	Illustrative examples covered
2.a.1 All living systems require constant input of free energy.	Chapt 1 Sec 1.2, p. 6–7 Chapt 6 Sec 6.1, p. 94–95 Sec 6.2, p. 96–97 Sec 6.4, p. 100–101 Chapt 7 All sections, p. 106–121 Chapt 8 All sections, p. 122–138 Chapt 25 Sec 25.10, p. 419 Sec 25.15, p. 425 Chapt 29 All sections, p. 492–505 Chapt 31 Sec 31.1,p. 524 Sec 31.6, p. 534 Chapt 41 Sec 41.9, p. 733 Chapt 42	•Krebs Cycle Chapt 8 Sec 8.1, p. 124–125 Fig 8.3 Sec 8.3, p 128–129 Fig 8.5, 8.6 Sec 8.4, p. 130–131 Fig 8.8 Sec 8.7, p. 134–135 Fig 8.12 •Glycolysis Chapt 8 Sec 8.2, p. 126–127 Fig 8.4 Sec 8.4, p. 130–131 Fig 8.8 Sec 8.7, p. 134–135 Fig 8.12 •Calvin Cycle Chapt 7 Sec 7.3, p. 111 Fig 7.5 Sec 7.6, p. 115 Fig 7.10, 7.11

Essential knowledge	Chapters/sections	Illustrative examples covered
	Sec 42.1, p. 740 Chapt 45 Sec 45.5, p. 804–5 Chapt 47 Sec 47.1–47.3, p. 840–845 Chapt 48 Sec 48.8, p. 874 Sec 48.11 p. 877	Sec 7.7, p. 116–117 Fig 7.13 •Fermentation Chapt 8 Sec 8.5, p. 132–133 Fig 8.9, 8.10 Sec 8.6, p. 133 Fig 8.11 Sec 8.7, p. 134–135 Fig 8.12 •Endothermy and ectothermy Chapt 26 Sec 26.9, p. 444 Sec 26.10, p. 446 Sec 26.11, p. 448 Chapt 41 Sec 41.9, p. 733 Fig 41.14 Chapt 47 Sec 47.3, p. 845 •Seasonal reproduction in animals and plants Chapt 42 Sec 42.1, p. 740 Chapt 48 Sec 48.11 p. 877 Fig 48.21 •Life-history strategy (biennial plants, reproductive diapause) Chapt 25 Sec 25.10, p. 419 Sec 25.12, p. 421 Fig 25.31d Sec 25.15, p. 425 Fig 25.40 Sec 25.17, p. 426–427 Fig 25.41h–l Chapt 31 Sec 31.1,p. 524 Sec 31.6, p. 534 Chapt 45 Sec 45.5, p. 804–5 Chapt 48 Sec 48.8, p. 874 Fig 48.18 •Change in energy resource levels, such as sunlight, can affect the number and size of the trophic levels

Essential knowledge	Chapters/sections	Illustrative examples covered
		Chapt 47 Sec 47.3, p. 844–845 Fig 47.6
2.a.2 Organisms capture and store free energy for use in biological processes.	Chapt 6 Sec 6.4, p. 100–101 Chapt 7 All sections, p. 106–121 Chapt 8 All sections, p. 122–138 Chapt 20 Sec 20.3, p. 322–323 Chapt 21 Sec 21.4, p. 339 Sec 21.6, p. 342 Sec 21.7, p. 344	•$NADP^+$ in photosynthesis Chapt 7 Sec 7.3, p. 111 Fig 7.5d Sec 7.4, p. 112-113 Fig 7.6, 7.8 Sec 7.6, p. 115 Fig 7.10, 7.11 •Oxygen in cellular respiration Chapt 6 Sec 6.4, p. 100-101 Fig 6.16b Chapt 7 Sec 7.8, p. 118 Chapt 8 Sec 8.1, p. 124–125 Fig 8.3 Sec 8.4, p. 130–131 Fig 8.7, 8.8 Sec 8.8, p. 136 Fig 8.13 Summary, p. 138 Data analysis exercise Fig 8.14 Critical thinking exercise Chapt 20 Sec 20.3, p. 322–323
2.a.3 Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.	Chapt 2 Sec 2.5, p. 28–29 Chapt 3 All sections, p. 34–51 Chapt 4 Sec 4.2, p. 56–57 Chapt 8 Sec 8.8, p. 136 Chapt 27 Sec 27.2, p. 464 Chapt 28 Sec 28.5, p. 484–485 Chapt 29 Sec 29.2, p. 496–497 Sec 29.3, p. 498–499 Chapt 39	•Cohesion Chapt 2 Sec 2.5, p. 29 Fig 2.12 Chapt 29 Sec 29.3, p. 498–499 Fig 29.7 •Adhesion Chapt 2 Sec 2.5, p. 28–29 Fig 2.11 Chapt 8 Sec 8.8, p. 136 •High specific heat capacity Chapt 2 Sec 2.5, p. 29

Essential knowledge	Chapters/sections	Illustrative examples covered
	Sec 39.1, p. 683 Sec 39.5, p. 688–689 Sec 39.8, p. 694 Chapt 40 Sec 40.5, p 708–709 Chapt 47 Sec 47.6–47.7, p. 848–851 Sec 47.9 p. 854–855 Sec 47.10, p. 856–857 Chapt 48 Sec 48.3, p. 866–867 Sec 48.12, p. 878–879	Chapt 48 Sec 48.3, p. 866–867 Fig 48.9, 48.11 •Universal solvent supports reactions Chapt 2 Sec 2.5, p. 28–29 Fig 2.11 •Heat of vaporization Chapt 2 Sec 2.5, p. 29 Chapt 47 Sec 47.6, p. 848 Fig 47.11 •Heat of fusion Chapt 2 Sec 2.5, p. 29 Chapt 48 Sec 48.12, p. 878–879 Fig 48.25 •Root hairs Chapt 28 Sec 28.1, p. 476 Fig 28.2 Sec 28.5, p. 484–485 Fig 28.16a Chapt 29 Sec 29.2, p. 496–497 Fig 29.4 •Cells of the alveoli Chapt 39 Sec 39.5, p. 688–689 Fig 39.13 Sec 39.8, p. 694 •Cells of the villi and microvilli Chapt 40 Sec 40.5, p 708–709 Fig 40.9
2.b.1 Cell membranes are selectively permeable due to their structure.	Chapt 3 Sec 3.4, p. 42–43 Chapt 4 Sec 4.2, p. 56–57 Sec 4.8, p. 64–65 Chapt 5 Sec 5.1, p. 78–79 Sec 5.3–5.5, p. 82–87 Chapt 8	No recommended illustrative examples supplied in Curriculum Framework.

Essential knowledge	Chapters/sections	Illustrative examples covered
	Sec 8.8, p. 136 Chapt 20 Sec 20.2, p. 320–321 Chapt 27 Sec 27.2, p. 464–465 Chapt 29 Sec 29.2, p. 496–497 Sec 29.5, p. 502–503	
2.b.2 Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes.	Chapt 1 Sec 1.2, p. 6–7 Chapt 4 Sec 4.6, p. 62 Sec 4.8–4.9, p. 64–67 Sec 4.11–4.12, p. 68–71 Chapt 5 All sections, p. 76–91 Chapt 27 Sec 27.1–27.2, p. 462–465 Chapt 29 Sec 29.2, p.497 Chapt 31 Sec 31.3, p. 528–529 Chapt 33 Sec 33.3–33.7, p. 557–563 Sec 33.10, p. 568–569 Chapt 37 Sec 37.2, p. 640 Chapt 40 Sec 40.1, p. 702–703 Chapt 41 Sec 41.1, p. 722 Sec 41.3–41.5, p. 724–729	•Glucose transport Chapt 5 Sec 5.2, p. 80–81 Fig 5.5 Sec 5.4, p. 84 Fig 5.9 •Na^+/K^+ transport Chapt 5 Sec 5.4, p. 84–85 Fig 5.11 Chapt 33 Sec 33.3, p. 557 Fig 33.7 Sec 33.4, p. 558–559 Fig 33.8, 33.10
2.b.3 Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.	Chapt 4 Sec 4.6–4.11, p. 62–69 Chapt 7 Sec 7.3–7.7, p. 111–117 Chapt 8 Sec 8.0–8.4, p. 122–131 Sec 8.6, p. 133 Summary, p. 138 Chapt 20 Sec 20.4, p. 324–325 Sec 20.5, p. 326–327	•Endoplasmic Reticulum Chapt 4 Sec 4.9, p. 66 Fig 4.18b,d •Mitochondria Chapt 4 Sec 4.11, p. 68 Fig 4.20 Chapt 8 Sec 8.0, p. 122 Fig 8.1

Essential knowledge	Chapters/sections	Illustrative examples covered
		Sec 8.6, p. 133 Fig 8.11 Summary, p.138 Data analysis exercise Fig 8.14 Critical thinking exercise •Chloroplasts Chapt 4 Sec 4.11, p. 69 Fig 4.21 Chapt 7 Sec 7.3, p. 111 Fig 7.5 Sec 7.4, p. 112–113 Fig 7.7, 7.8 Sec 7.5, p. 114 Fig 7.9 Sec 7.6, p. 115 Fig 7.11 Sec 7.7, p. 116–117 Fig 7.13 •Golgi Chapt 4 Sec 4.9, p. 67 Fig 4.18e •Nuclear Envelope Chapt 4 Sec 4.8, p. 64–65 Fig 4.16, 4.17
2.c.1 Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes.	Chapt 1 Sec 1.2, p. 6–7 Chapt 3 Sec 3.6, p. 46–47 Fig 3.19 Chapt 7 Sec 7.7, p. 117 Chapt 6 Sec 6.4, p. 100–101 Chapt 12 Sec 12.4, p. 190–191 Fig 12.8 Chapt 15 Sec 15.4, p. 236–237 Chapt 23 Sec 23.2, p. 372–373 Chapt 27 Sec 27.0, p. 460	•Operons in gene regulation Chapt 15 Sec 15.4, p. 236–237 Fig 15.10, 15.11 •Temperature regulation in animals Chapt 27 Sec 27.0, p. 460 Fig 27.1 Sec 27.3, p. 466–467 Fig 27.8 Sec 27.4, p. 467 Summary, p. 472 Critical thinking exercise Chapt 41 Sec 41.9, p. 733 Fig 41.14 Sec 41.10, p. 734–735 Fig 41.15, 41.16

Essential knowledge	Chapters/sections	Illustrative examples covered
	Sec 27.2–27.5, p. 464–469 Summary, p. 462 Chapt 28 Sec 28.4, p. 482 Chapt 29 Sec 29.4, p. 500–509 Chapt 31 Sec 31.2, p. 526–527 Sec 31.4–31.6, p. 530–534 Chapt 33 Sec 33.0, p. 552 Sec 33.4, p. 558–559 Sec 33.6–33.7, p. 562–563 Chapt 35 All sections, p. 596–615 Chapt 37 Sec 37.9, p. 652 Chapt 38 Sec 38.11, p. 675 Chapt 39 Sec 39.9, p. 696–697 Chapt 41 Sec 41.6, p. 731 Sec 41.9–41.10, p. 733–735 Chapt 42 Sec 42.3, p. 745 Chapt 43 Sec 43.12, p. 776 Chapt 48 Sec 48.6, p. 871	Table 41.2, 41.3 •Plant responses to water limitations Chapt 7 Sec 7.7, p. 117 Fig 7.13c, 7.14 Chapt 23 Sec 23.2, p. 372–373 Fig 23.6 Chapt 27 Sec 27.5, p. 468–469 Fig 27.10 Chapt 28 Sec 28.4. p 482 Chapt 29 Sec 29.4, p. 500–509 Fig 29.8 Chapt 48 Sec 48.6 Fig 48.15a,b •Lactation in mammals Chapt 43 Sec 43.12, p. 776 Fig 43.20 •Onset of labor in childbirth Chapt 27 Sec 27.3, p. 467 Chapt 43 Sec 43.12, p. 776 Fig 43.19 •Ripening of fruit Chapt 31 Sec 31.2, p. 527 Table 31.2 Summary, p. 535 Impacts, issues exercise •Diabetes mellitus in response to decreased insulin Chapt 35 Sec 35.9, p. 609 •Dehydration in response to decreased anti-diuretic hormone (ADH) Chapt 35 Sec 35.2, p. 601 Sec 35.3, p. 602 Table 35.2 Chapt 41 Sec 41.6, p. 731 Fig 41.12

Essential knowledge	Chapters/sections	Illustrative examples covered
		•Graves' disease (hyperthyroidism) Chapt 35 Sec 35.6, p. 607 Chapt 38 Sec 38.11, p. 675 •Blood clotting Chapt 3 Sec 3.6, p. 46–47 Fig 3.19 Chapt 12 Sec 12.4, p. 190–191 Fig 12.8 Sec 12.7, p. 196–197 Table 12.1 Chapt 27 Sec 27.0, p. 460 Chapt 37 Sec 37.9, p. 652
2.c.2 Organisms respond to changes in their external environments.	Chapt 1 Sec 1.2, p. 6–7 Chapt 2 Sec 2.5, p. 29 Chapt 22 Sec 22.11, p. 365 Chapt 25 Sec 25.10, p. 419 Chapt 26 Sec 26.10, p. 447 Chapt 27 Sec 27.0, p. 460 Sec 27.5, p. 468–469 Sec 27.3, p. 466–467 Chapt 31 All sections, p. 522–536 Chapt 32 Sec 32.5, p. 545 Chapt 34 All sections, p. 576–595 Chapt 35 Sec 35.11, p. 611 Sec 35.13, p. 613 Chapt 41 Sec 41.3, p. 724–725 Sec 41.9–41.10, p. 733–735	•Photoperiodism and phototropism in plants Chapt 31 Sec 31.4, p. 531 Fig 31.12 Sec 31.5, p. 532–533 Fig 31.15–31.19 •Migration in animals (hibernation is not covered in this textbook) Chapt 26 Sec 26.10, p. 447 Chapt 34 Summary, p. 595 Critical thinking exercise Chapt 45 Sec 45.3, p. 800 •Other organisms (chemotaxis in bacteria, sexual reproduction in fungi) Chapt 25 Sec 25.10, p. 419 •Nocturnal and diurnal activity: circadian rhythms Chapt 27 Sec 27.5, p. 469 Fig 27.11 Chapt 31 Sec 31.5, p. 532–533 Fig 31.16 •Shivering and sweating in humans Chapt 2

Essential knowledge	Chapters/sections	Illustrative examples covered
	Chapt 44: All sections, p. 780–795 Chapt 45 Sec 45.3, p. 800	Sec 2.5, p. 29 Chapt 27 Sec 27.0, p. 460 Fig 27.1 Sec 27.3, p. 466–467 Fig 27.8 Chapt 41 Sec 41.10, p. 734–735 Table 41.2, 41.3
2.d.1 All biological systems from cells and organisms to populations, communities, and ecosystems are affected by complex biotic and abiotic interactions involving exchange of matter and free energy	Chapt 4 Sec 4.5, p. 61 Chapt 5 Sec 5.6, p. 89 Chapt 6 Sec 6.3, p. 99 Chapt 21 Sec 21.6–21.7, p. 342–345 Chapt 22 Sec 22.2, p. 355 Sec 22.5, p. 358 Sec 22.9, p. 362–363 Sec 22.11, p. 365 Chapt 24 Sec 24.6, p. 399 Chapt 26 Sec 26.9, p. 444 Chapt 27 Sec 27.5, p. 468–469 Chapt 29 Sec 29.2, p. 496 Sec 29.4, p. 500–501 Chapt 31 Sec 31.1, p. 524 Sec 31.3, p. 529 Sec 31.6, p. 534 Chapt 39 Sec 39.2, p. 683 Chapt 41 Sec 41.3, p. 724–725 Sec 41.9, p. 734 Sec 41.10, p. 735–736 Chapt 45 Sec 45.1, p. 798 Sec 45.3–45.7, p. 800–809 Chapt 46	At the cellular level •Cell density Chapt 22 Sec 22.5, p. 358 Fig 22.11 Sec 22.11, p. 365 Fig 22.26 •Biofilms Chapt 4 Sec 4.5, p. 61 Fig 4.13 •Temperature Chapt 6 Sec 6.3, p. 99 Fig 6.12 Chapt 21 Sec 21.6, p. 342 Sec 21.7, p. 344–345 Fig 21.17c,d •Sunlight Chapt 22 Sec 22.2, p. 355 Fig 22.6 Organisms: •Symbiosis Chapt 24 Sec 24.6, p. 399 Chapt 29 Sec 29.2, p. 496 Fig 29.4b–e Chapt 46 Sec 46.2, p. 819 Fig 46.3 •Predator-prey relationships Chapt 27 Sec 27.5, p. 468 Fig 27.9 Chapt 31

Essential knowledge	Chapters/sections	Illustrative examples covered
	Sec 46.1–46.5, p. 818–825 Sec 46.8–46.11, p. 828–835 Chapt 47 Sec 47.1, p. 840–841 Sec 47.2, p. 842–843 Sec 47.9–47.10, p.855–857 Chapt 48 Sec 48.6, p. 871 Sec 48.17, p. 886–887	Sec 31.3, p. 529 Fig 31.9 Chapt 45 Sec 45.6, p. 806–807 Fig 45.11, 45.12 Chapt 46 Sec 46.4, p. 822–823 Fig 46.9, 46.10 Sec 46.5, p. 824–825 Fig 46.11–46.13 •Water and nutrient availability, temperature, salinity, pH Chapt 5 Sec 5.6, p. 89 Fig 5.18 Chapt 22 Sec 22.9, p. 362–363 Fig 22.20 Chapt 26 Sec 26.9, p. 444 Chapt 27 Sec 27.5, p. 468–469 Fig 27.10 Chapt 29 Sec 29.4, p. 500–501 Fig 29.8, 29.9 Chapt 31 Sec 31.1, p. 524 Sec 31.6, p. 534 Fig 31.20 Chapt 41 Sec 41.3, p. 724–725 Fig 41.7, 41.8 Sec 41.9, p. 734 Fig 41.14 Sec 41.10, p. 735–736 Fig 41.15, 41.16 Table 41.2, 41.3 Chapt 48 Sec 48.6, p. 871 Fig 48.15a,b Sec 48.17, p. 887 Fig 48.36b Populations, Communities, Ecosystems: •Water and nutrient availability Chapt 45 Sec 45.4, p. 802–803 Chapt 46

Essential knowledge	Chapters/sections	Illustrative examples covered
		Sec 46.3, p. 820–821 Fig 46.6 Sec 46.8, p. 828–829 Fig 46.19b, 46.20b •Availability of nesting materials and sites Chapt 45 Sec 45.4, p. 802 Fig 45.7 Chapt 46 Sec 46.1, p. 818 •Food chains and food webs Chapt 47 Sec 47.1, p. 840–841 Fig 47.3 Sec 47.2, p. 842–843 Fig 47.4, 47.5 •Species diversity Chapt 46 Sec 46.9, p. 830–831 Fig 46.21 Sec 46.10, p. 832–833 Fig 46.22, 46.23 Sec 46.11, p. 834–835 Fig 46.24–46.26 •Population density Chapt 45 Sec 45.1, p. 798 Sec 45.3, p. 800–801 Fig 45.5, 45.6 Sec 45.4, p. 802–803 Fig 45.8, 45.9 Sec 45.5, p. 805 Sec 45.7, p. 808–809 Fig 45.13, 45.14 •Algal blooms Chapt 22 Sec 22.5, p. 358 Fig 22.11 Chapt 39 Sec 39.2, p. 683 Fig 39.4 Chapt 47 Sec 47.10, p. 856–857 Fig 47.22 Sec 47.9, p. 855 Chapt 48 Sec 48.17, p. 886–887 Fig 48.35

Essential knowledge	Chapters/sections	Illustrative examples covered
2.d.2 Homeostatic mechanisms reflect both common ancestry and divergence due to adaptation in different environments.	Chapt 25 Sec 25.1, p. 404–405 Sec 25.5–25.9, p. 410–418 Sec 25.18, p. 428–429 Chapt 26 Sec 26.1, p. 434–435 Sec 26.2, p. 437 Sec 26.5, p. 440–441 Sec 26.9–26.11, p. 444–449 Chapt 27 Sec 27.1, p. 462–463 Sec 27.5, p. 468–469 Chapt 33 Sec 33.1, p. 554–555 Sec 33.10, p. 568–569 Chapt 35 Sec 35.5, p. 605 Sec 35.7, p. 607 Chapt 37 Sec 37.1, p. 638–639 Chapt 38 Sec 38.1, p. 660–661 Chapt 39 Sec 39.3, p. 684–685 Sec 39.4, p. 686–687 Sec 39.9, p. 696–697 Chapt 40 Sec 40.1, p. 702–703 Chapt 41 Sec 41.2, p. 722–723 Sec 41.3, p. 724–725 Sec 41.9, p. 733 Sec 41.10, p. 734–735	•Digestive mechanisms in animals such as food vacuoles, gastrovascular cavities, one-way digestive systems Chapt 25 Sec 25.1, p. 404–405 Fig 25.4 Sec 25.5, p. 410–411 Fig 25.11, 25.14a,b Sec 25.6, p. 412–413 Fig 25.15 Sec 25.18, p. 428–429 Fig 25.42 Chapt 26 Sec 26.1, p. 434–435 Fig 26.2, 26.3 Chapt 40 Sec 40.1, p. 702–703 Fig 40.3, 40.4 •Respiratory systems of aquatic and terrestrial animals Chapt 39 Sec 39.3, p. 684–685 Fig 39.5–39.8 Sec 39.4, p. 686–687 Fig 39.9–39.12 •Nitrogenous waste production and elimination in aquatic and terrestrial animals Chapt 25 Sec 25.6, p. 412–413 Fig 25.15d Chapt 41 Sec 41.2, p. 722–723 Fig 41.3–41.5 Sec 41.3, p. 724–725 Fig 41.7, 41.8 •Excretory systems in flatworms, earthworms, and vertebrates Chapt 25 Sec 25.6, p. 412–413 Fig 25.15d Sec 25.7, p. 414–415 Fig 25.20 Chapt 26 Sec 26.2, p. 437 Chapt 41 Sec 41.2, p. 722–723 Fig 41.3–41.5 Sec 41.3, p. 724–725

Essential knowledge	Chapters/sections	Illustrative examples covered
		Fig 41.7, 41.8 •Osmoregulation in bacteria, fish, and protists Chapt 41 Sec 41.2, p. 724 Fig 41.7 •Circulatory systems in fish, amphibians, and mammals Chapt 37 Sec 37.1, p. 638–639 Fig 37.3
2.d.3 Biological systems are affected by disruptions to their dynamic homeostatis.	Chapt 1 Sec 1.2, p. 6–7 Chapt 8 Sec 8.0, p. 276 Chapt 22 Sec 22.5, p. 358 Chapt 27 Sec 27.0, p. 460 Sec 27.3–27.5, p. 466–469 Chapt 31 Sec 31.3, p. 528–529 Chapt 33 Sec 33.0, p. 552 Sec 33.6, p. 562 Sec 33.7, p. 563 Summary, p. 575 Chapt 35: Sec 35.6–35.12, p. 606–612 Chapt 37 Sec 37.9, p. 652–653 Chapt 38 All sections, p. 568–679 Chapt 39 Sec 39.9, p. 696–697 Chapt 41 Sec 41.8, p. 732 Sec 41.10, p. 734–735 Chapt 46 Sec 46.8–46.11, p. 829–835 Chapt 47 Sec 47.0, p. 838 Sec 47.6–47.10, p. 848–	•Physiological responses to toxic substances Chapt 8 Sec 8.0, p. 276 Fig 18.1 Chapt 22 Sec 22.5, p. 358 Fig 22.11 Chapt 33 Sec 33.0, p. 552 Fig 33.1 Sec 33.6, p. 562 Sec 33.7, p. 563 Fig 33.14 Summary, p. 575 Data analysis exercise Fig 33.29 Chapt 35 Sec 35.7, p. 607 Fig 35.11 •Dehydration Chapt 27 Sec 27.0, p. 460 Fig 27.1 Sec 27.4, p. 467 •Immunological responses to pathogens, toxins and allergens Chapt 38 All sections, p. 658–679 •Invasive and/or eruptive species Chapt 46 Sec 46.9, p. 830–831 Table 46.2 Sec 46.10, p. 832–833 Fig 46.22, 46.23 •Human impact Chapt 47

Essential knowledge	Chapters/sections	Illustrative examples covered
	857 Summary, p. 859 Chapt 48 Sec 48.7, p. 873 Chapt 49 All sections, p. 891–904	Sec 47.0, p. 838 Fig 47.1 Sec 47.7, p. 850–851 Sec 47.8, p. 852–853 Fig 47.16–47.18 Sec 47.9, p. 854–855 Fig 47.20 Sec 47.10, p. 856–857 Fig 47.22 Summary, p. 859 Data analysis exercise Fig 47.23 Chapt 49 All sections, p. 891–904 •Hurricanes, floods, earthquakes, volcanoes, fires Chapt 46 Sec 46.8, p. 829 Fig 46.20 Sec 46.11, p. 834–835 Fig 46.25 Chapt 47 Sec 47.0, p. 838 Fig 47.1 Chapt 48 Sec 48.7, p. 873 Fig 48.17 •Water limitation Chapt 47 Sec 47.6, p. 848–849 •Salination Chapt 47 Sec 47.6, p. 848–849
2.d.4 Plants and animals have a variety of chemical defenses against infections that affect dynamic homeostasis.	Chapt 27 Sec 27.5, p. 468–469 Chapt 28 Sec 28.4, p. 482–483 Chapt 31, Sec 31.3, p. 529 Summary, p. 536 Chapt 38 All sections, p. 658–679 Chapt 46 Sec 46.5, p. 824–824	•Plant defenses against pathogens Chapt 27 Sec 27.5, p. 468–469 Chapt 28 Sec 28.4, p. 482–483 Fig 28.13 Chapt 31 Sec 31.3, p. 529 Fig 31.9 Summary, p. 536 Data analysis exercise Fig 31.23 Chapt 46 Sec 46.5, p. 824–824

Essential knowledge	Chapters/sections	Illustrative examples covered
		•Vertebrate immune systems—non-specific and non-heritable defense mechanisms Chapt 38 All sections, p. 658–679
2.e.1 Timing and coordination of specific events are necessary for the normal development of an organism, and these events are regulated by a variety of mechanisms.	Chapt 15 Sec 15.2, p. 233 Sec 15.3, p. 234–235 Chapt 19 Sec 19.3, p. 306 Chapt 25 Sec 25.8, p. 416–417 Sec 25.13, p. 422 Sec 25.15, p. 424 Chapt 26 Sec 26.6, p. 441 Chapt 27 Sec 27.3, p. 466–467 Sec 27.6, p. 470–471 Chapt 28 Sec 28.1, p. 476–477 Chapt 30 Sec 30.1, p. 508 Sec 30.4–30.5, p. 514–515 Chapt 31 Sec 31.1–31.2, p. 524–527 Sec 31.5, p. 532–533 Sec 32.6, p. 534 Chapt 35 Sec 35.0, p. 596 Sec 35.2–35.4, p. 600–604 Sec 35.6– 35.7, p. 606–607 Sec 35.12, p. 612 Summary, p. 614–615 Chapt 38 All sections, p. 658–679 Chapt 42 Sec 42.1, p. 740–741 Chapt 43 All sections, p. 758–778	•Morphogenesis of fingers and toes Chapt 27 Sec 27.6, p. 470–471 Fig 27.14, Fig 27.14 Chapt 43 Sec 43.4, p. 765 •Immune function Chapt 38 Sec 38.4, p. 64 Fig 38.7

Essential knowledge	Chapters/sections	Illustrative examples covered
2.e.2 Timing and coordination of physiological events are regulated by multiple mechanisms.	Chapt 4 Sec 4.5, p. 61 Chapt 9 Sec 9.4, p. 148–149 Chapt 21 Sec 21.6, p. 342–343 Chapt 22 Sec 22.11, p. 365 Chapt 24 Sec 24.5, p. 396–397 Chapt 26 Sec 26.10, p. 447 Chapt 27 Sec 27.3, p. 466–467 Sec 27.6, p. 468–469 Chapt 29 Sec 29.2–29.5, p. 496–503 Chapt 30 Sec 30.4, p. 514 Chapt 31 Sec 31.0–31.6, p. 522–534 Chapt 32 Sec 32.7, p. 548–549 Chapt 33 Sec 33.10, p. 568–569 Chapt 34 Sec 34.3, p. 582 Summary, p. 595 Chapt 35 Sec 35.1, p. 598 Sec 35.3, p. 602–603 Sec 35.12, p. 612 Sec 35.13, p. 613 Summary, p. 614–615 Chapt 38 Sec 38.1–38.5, p. 660–667 Chapt 42 Sec 42.7–42.8, p. 750–751 Chapt 43 Sec 43.0, p. 758 Sec 43.2, p. 762–763 Sec 43.12, p. 776 Chapt 44 Sec 44.2, p. 784–785	•Jet lag in humans Chapt 35 Sec 35.12, p. 612 •Seasonal responses such as migration (hibernation and estivation are not covered in this book) Chapt 26 Sec 26.10, p. 447 Chapt 34 Summary, p. 595 Critical thinking exercise Chapt 45 Sec 45.3, p. 800 •Release and reaction to pheromones Chapt 34 Sec 34.3, p. 582 Chapt 35 Sec 35.1, p. 598 Chapt 44 Sec 44.0, p. 780 Sec 44.4, p. 786 Sec 44.7, p. 792 Sec 44.8, p. 793 •Visual displays in reproductive cycle Chapt 44 Sec 44.4, p. 786–787 Fig 44.10 Sec 44.5, p. 788–789 Fig 44.12 •Fruiting body formation in fungi, slime molds, and certain types of bacteria Chapt 21 Sec 21.6, p. 342–343 Fig 21.13d Chapt 22 Sec 22.11, p. 365 Fig 22.25b,c, 22.26 Chapt 24 Sec 24.5, p. 396–397 Fig 24.12, 24.13b–f •Quorum sensing in bacteria Chapt 4 Sec 4.5, p. 61 Fig 4.13

Essential knowledge	Chapters/sections	Illustrative examples covered
	Sec 44.0, p. 780 Sec 44.4, p. 786–787 Sec 44.5, p. 788–789 Sec 44.7, p. 792 Sec 44.8, p. 793 Chapt 45 Sec 45.3, p. 800	
2.E.3: Timing and coordination of behavior are regulated by various mechanisms and are important in natural selection.	Chapt 15 Sec 15.4, p. 236–237 Chapt 18 Sec 18.12, p. 296–297 Chapt 21 Sec 21.6–21.7, p. 342–345 Chapt 23 Sec 23.8, p. 382–383 Chapt 24 Sec 24.1, p. 390 Sec 24.4–24.6, p. 394–399 Chapt 26 Sec 26.10, p. 447 Chapt 29 Sec 29.2, p. 496 Chapt 30 Sec 30.2, p. 510–511 Summary, p. 520–521 Chapt 34 Summary, p. 595 Chapt 40 Sec 40.1, p. 703 Chapt 44 Sec 44.0–44.2, p. 780–785 Sec 44.4–44.5, p. 786–789 Sec 44.7, p. 792–793 Chapt 45 Sec 45.3, p. 800 Chapt 46 Sec 46.1–46.3, p. 818–821	•Migration Chapt 26 Sec 26.10, p. 447 Chapt 34 Summary, p. 595 Critical thinking exercise Chapt 45 Sec 45.3, p. 800 •Courtship Chapt 44 Sec 44.1, p. 783 Fig 44.4 Sec 44.4, p. 786–787 Fig 44.10 Sec 44.5, p. 788–789 Fig 44.12–44.13 •Availability of resources leading to fruiting body formation in fungi and certain types of bacteria Chapt 21 Sec 21.6, p. 342–343 Fig 21.13d Chapt 24 Sec 24.5, p. 396–397 Fig 24.12, 24.13b–f •Niche and resource partitioning Chapt 18 Sec 18.12, p. 296–297 Chapt 46 Sec 46.1, p. 818 Fig 46.2 Sec 46.3, p. 821 Fig 46.8 •Mutualistic relationships (lichens; bacteria in digestive tracts of animals; micorrhizae) Chapt 15 Sec 15.4, p. 236–237 Fig 15.11 Chapt 21 Sec 21.7, p. 344–345

Essential knowledge	Chapters/sections	Illustrative examples covered
		Fig 21.16a Chapt 24 Sec 24.1, p. 390 Sec 24.4, p. 394 Sec 24.6, p. 398–399 Fig 24.14, 24.15 Chapt 29 Sec 29.2, p. 496 Fig 29.4b Chapt 40 Sec 40.1, p. 703 Fig 40.4 Chapt 46 Sec 46.2, p. 819 •Biology of pollination Chapt 23 Sec 23.8, p. 382–383 Fig 32.22a–c Chapt 30 Sec 30.2, p. 510–511 Fig 30.5–30.7 Table 30.1 Summary, p. 520–521 Impacts, issues exercise Data analysis exercise Fig 30.17 Critical thinking exercise Chapt 46 Sec 46.2, p. 819 Fig 46.3

Big Idea 3: Living systems store, retrieve, transmit and respond to information essential to life processes.

Essential knowledge	Chapters/sections	Illustrative examples covered
3.A.1: DNA, and in some cases RNA, is the primary source of heritable information.	Chapt 1 Sec 1.2, p. 6–7 Chapt 6 Sec 6.3, p. 99 Sec 6.5, p. 102 Chapt 10 Sec 10.1, p. 156	•Addition of a poly-A tail, GTP cap, and excision of introns Chapt 14 Sec 14.3, p. 220 Fig 14.7 •Enzymatic reactions Chapt 6

Essential knowledge	Chapters/sections	Illustrative examples covered
	Chapt 13 Sec 13.0–13.4, p. 202–211 Summary, p. 212–213 Chapt 14 Sec 14.1–14.2, p. 216–219 Sec 14.4, p. 222–223 Summary, p. 226 Chapt 15 Sec 15.1–15.3, p. 230–235 Chapt 16 All sections, p. 240–256 Chapt 19 Sec 19.4, p. 308–309 Chapt 20 Sec 20.2, p. 321 Chapt 21 Sec 21.1, p. 334–335 Sec 21.3, p. 338–339 Chapt 26 Sec 26.15, p. 456–457 Chapt 38 Sec 38.12, p. 677	Sec 6.3, p. 99 Fig 6.12 Chapt 14 Sec 14.2, p. 218–219 Fig 14.5, 15.6 Chapt 15 Sec 15.1, p. 230–231 Fig 15.2 Sec 15.2, p. 232–233 Fig 15.5–15.7 •Synthesis Chapt 14 Sec 14.1, p. 216–217 Sec 14.4, p. 222–223 Fig 14.12 Summary, p. 226 Fig 14.6 Chapt 15 Sec 15.3, p. 234–235 Fig 15.9 •Electrophoresis Chapt 16 Sec 16.3, p. 246 Sec 16.4, p. 247 Fig 16.9 Chapt 38 Sec 38.12, p. 677 Fig 38.23 •Plasmid-based transformation Chapt 16 Sec 16.1, p. 242–243 Fig 16.3, 16.4 •Restriction enzyme analysis of DNA Chapt 16 Sec 16.1, p. 242 Fig 16.2 •Polymerase Chain Reaction (PCR) Chapt 16 Sec 16.2, p. 244–245 Fig16.6 •Genetically-modified foods Chapt 16 Sec 16.0, p. 240 Fig 16.1 Sec 16.6, p. 250 Sec 16.7, p. 250–251 Fig 16.13 Summary, p. 255

Essential knowledge	Chapters/sections	Illustrative examples covered
		Impacts, issues exercise •Transgenic animals Chapt 6 Sec 6.5, p. 102 Fig 6.19 Chapt 16 Sec 16.8, p. 252 Fig 16.14b,c, 16.15 •Cloned animals Chapt 13 Sec 13.0, p. 202 Fig 13.1 Sec 13.4, p. 210–211 Fig 13.9, 13.10 •Pharmaceuticals, such as human insulin or factor X Chapt 16 Sec 16.6, p. 250
3.A.2 In eukaryotes, heritable information is passed to the next generation via processes that include the cell cycle and mitosis, or meiosis plus fertilization.	Chapt 9 Sec 9.2–9.3, p. 144–147 Sec 9.5, p. 150–151 Chapt 10 Sec 10.1–10.5, p. 156–163 Summary, p. 167 Chapt 11 All sections, p. 168–183 Chapt 15 Sec 15.0, p. 228 Summary, p. 238–239	•Cancer results from disruptions in cell cycle control Chapt 9 Sec 9.5, p. 150–151 Fig 9.10–9.12 Chapt 15 Sec 15.0, p. 228 Fig 15.1 Summary, p. 238–239 Impacts, issues exercise Data analysis exercise Fig 15.12
3.A.3 The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring	Chapt 4 Sec 4.10, p. 68 Chapt 9 Sec 9.0–9.2, p. 140–145 Summary, p. 152–153 Chapt 10 Sec 10.2–10.5, p. 156–163 Summary, 167 Chapt 11 Sec 11.2–11.3, p. 172–175 Sec 11.5, p. 178–179 Chapt 12	•Sickle cell anemia Chapt 12 Sec 12.7, p. 196 Table 12.1 •Tay-Sachs Chapt 4 Sec 4.10, p. 68 Fig 4.19 •Huntington's disease Chapt 12 Sec 12.2, p. 188 Sec 12.7, p. 196 Table 12.1 •X-linked color blindness

Essential knowledge	Chapters/sections	Illustrative examples covered
	All sections, p. 184–201 Chapt 34 Sec 34.10, p. 592	Chapt 12 Sec 12.4, p. 191 Fig 12.9 Sec 12.7, p. 196 Table 12.1 Chapt 34 Sec 34.10, p. 592 •Trisomy 21/Down Syndrome Chapt 12 Sec 12.6, p. 194–195 Fig 12.14 Sec 12.7, p. 196 Table 12.1 •Klinefelter syndrome Chapt 12 Sec 12.6, p. 195 Sec 12.7, p. 196 Table 12.1 •Reproduction issues Chapt 12 Sec 12.7, p. 196–197 Fig 12.17, 12.18 Sec 12.8, p. 198–199 Fig 12.19, 12.20 • Civic issues Chapt 9 Sec 9.0, p. 140 Fig 9.1 Summary, p. 152–153 Impacts, issues exercise Data analysis exercise Fig 9.13
3.A.4 The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.	Chapt 11 Sec 11.4–11.5, p. 176–178 Chapt 12 Sec 12.1, p. 187 Sec 12.4, p. 190–191 Sec 12.6–12.7, p. 195–196 Summary, p. 201 Chapt 15 Sec 15.2, p. 232–233 Chapt 34 Sec 34.10, p. 592 Chapt 36 Sec 36.11, p. 633	•Sex-linked genes reside on sex chromosomes (X in humans) Chapt 12 Sec 12.4, p. 190–191 Fig 12.7–12.9 Sec 12.6, p. 195 Fig 12.15 Sec 12.7, p. 196 Table 12.1 Summary, p. 201 Critical thinking exercise Chapt 15 Sec 15.2, p. 232–233 Fig 15.5 Chapt 36

Essential knowledge	Chapters/sections	Illustrative examples covered
		Sec 36.11, p. 633 Fig 36.24 Chapt 34 Sec 34.10, p. 592 •In mammals and flies, the Y chromosome is very small and carries few genes Chapt 12 Sec 12.1, p. 187 •In mammals and flies, females are XX and males are XY; as such, X-linked recessive traits are always expressed in males Chapt 12 Sec 12.1, p. 187 Sec 12.4, p. 190–191 Fig 12.7 Chapt 34 Sec 34.10, p. 592
3.B.1 Gene regulation results in differential gene expression, leading to cell specialization.	Chapt 14 Sec 14.2, p. 218–219 Sec 14.4, p. 222–223 Chapt 15 All sections, p. 228–239 Chapt 16 Sec 16.5, p. 248–249	•Promoters Chapt 14 Sec 14.2, p. 218–219 Fig 14.5a Chapt 15 Sec 15.4, p. 236–237 Fig 15.11 •Terminators Chapt 14 Sec 14.4, p. 222–223 Fig 14.12f •Enhancers Chapt 15 Sec 15.1, p. 230–231 Fig 15.3
3.B.2 A variety of intercellular and intracellular signal transmissions mediate gene expression.	Chapt 12 Sec 12.1, p. 186–187 Chapt 15 Sec 15.3, p. 234–235 Chapt 19 Sec 19.3, p. 306 Chapt 31 Sec 31.2, p. 527 Sec 31.3, p. 528 Summary, p. 535 Chapt 42 Sec 42.0, p. 738 Chapt 43 Sec 43.4, p. 765	•Expression of the SRY gene triggers the male sexual development pathway in animals Chapt 12 Sec 12.1, p. 186–187 Fig 12.2 Chapt 42 Sec 42.0, p. 738 Fig 42.1 •Ethylene levels cause changes in the production of different enzymes, allowing fruit ripening Chapt 31 Sec 31.2, p. 527 Table 31.1, 31.2

Essential knowledge	Chapters/sections	Illustrative examples covered
		Summary, p. 535 Impacts, issues exercise •Gibberelin promotes seed germination in plants Chapt 31 Sec 31.2, p. 526 Table 31.1, 31.2 Sec 31.3, p. 528 Fig 31.7 •Morphogens stimulate cell differentiation and development Chapt 43 Sec 43.4, p. 765 •HOX genes play a role in development Chapt 15 Sec 15.3, p. 234–235 Fig 15.8, 15.9 Chapt 19 Sec 19.3, p. 306 Fig 19.7
3.C.1 Changes in genotype can result in changes in phenotype.	Chapt 1 Sec 1.2, p. 6–7 Chapt 6 Sec 6.5, p. 102 Chapt 10 Sec 10.1, p. 156 Chapt 11 Sec 11.0–11.3, p. 168–177 Chapt 18 Sec 18.0, p. 276 Sec 18.4, p. 283 Sec 18.6, p. 287 Summary, p. 299 Chapt 21 Sec 21.8, p. 347	•Antibiotic resistance mutations Chapt 6 Sec 6.5, p. 102 Fig 6.19 Chapt 18 Sec 18.4, p. 283 Chapt 21 Sec 21.8, p. 347 •Pesticide resistance mutations Chapt 18 Sec 18.0, p. 276 Fig 18.1 Summary, p. 299 Data analysis exercise Fig 18.27 •Sickle cell disorder and heterozygote advantage Chapt 18 Sec 18.6, p. 287 Fig 18.13
3.C.2 Biological systems have multiple processes that increase genetic variation.	Chapt 10 Sec 10.0–10.1, p. 154–156 Sec 10.4–10.5, p. 160–	No recommended illustrative examples supplied in Curriculum Framework.

Essential knowledge	Chapters/sections	Illustrative examples covered
	163 Chapt 18 Sec 18.1–18.8, p. 278–18.8	
3.C.3 Viral replication results in genetic variation, and viral infection can introduce genetic variation into the hosts.	Chapt 21 Sec 21.1–21.2, p. 334–337 Sec 21.5, p. 340–341	•Transduction in bacteria Chapt 21 Sec 21.5, p. 340–341
3.D.1 Cell communication processes share common features that reflect a shared evolutionary history.	Chapt 4 Sec 4.5, p. 61 Chapt 12 Sec 12.1, p. 186 Chapt 13 Sec 13.3, p. 208–209 Chapt 22 Sec 22.1, p. 365 Sec 21.6, p. 342 Chapt 35 Sec 35.5, p. 605 Sec 35.10–35.11, p.610–611	•Use of chemical messengers by microbes to communicate with other nearby cells and to regulate specific pathways in response to population density. Chapt 4 Sec 4.5, p. 61 Chapt 22 Sec 22.1, p. 365 •Response to external signals by bacteria that influences cell movement Chapt 21 Sec 21.6, p. 342 Fig 21.13c,d •Epinephrine stimulation of glycogen breakdown in mammals Chapt 35 Sec 35.5, p. 605 Table 35.3 •Temperature determination of sex in some vertebrate organisms Chapt 12 Sec 12.1, p. 186 •DNA repair mechanisms Chapt 13 Sec 13.3, p. 208–209
3.D.2 Cells communicate with each other through direct contact with other cells or from a distance via chemical signaling.	Chapt 3 Sec 3.2, p. 38–39 Chapt 4 Sec 4.7, p. 63 Sec 4.12, p. 70–71 Chapt 12 Sec 12.1, p. 186–187 Chapt 28 Sec 28.4, p. 483 Chapt 29 Sec 29.2, p. 497	•Immune cells interact by cell-cell contact, antigen-presenting cells, helper T-cells, killer T-cells Chapt 38 Sec 38.1, p. 660–661 Fig 38.3 Sec 38.5, p. 666–667 Fig 38.10 Sec 38.8, p. 672–673 Fig 38.17, 38.18

Essential knowledge	Chapters/sections	Illustrative examples covered
	Chapt 35 All sections, p. 596–615 Chapt 36 Sec 36.0, p. 616 Sec 36.3, p. 623 Chapt 38 Sec 38.1, p. 660–661 Sec 38.5, p. 666–667 Sec 38.8, p. 672–673 Sec 38.11, p. 675 Chapt 40 Sec 40.10, p. 716 Chapt 42 Sec 42.2–42.3, p. 743–745 Sec 42.6, p. 748–749 Sec 42.9, p. 752–753 Summary, p. 756–757 Chapt 43 Sec 43.7, p. 769 Sec 43.9, p. 771	•Plasmodesmata between plant cells that allow material to be transported from cell to cell Chapt 4 Sec 4.7, p. 63 Fig 4.15a Sec 4.12, p. 70–71 Fig 4.22c Chapt 28 Sec 28.4, p. 483 Chapt 29 Sec 29.2, p. 497 • Insulin Chapt 35 Sec 35.1, p. 598–599 Fig 35.2 Sec 35.5, p. 605 Table 35.3 Sec 35.8, p. 608 Fig 35.12 Sec 35.9, p. 609 Fig 35.13 Chapt 40 Sec 40.10, p. 716 •Human Grown Hormone Chapt 35 Sec 35.3, p. 602–603 Table 35.2 Sec 35.4, p. 604 Fig 35.7 •Thyroid hormones Chapt 35 Sec 35.3, p. 602–603 Table 35.2 Sec 35.6, p. 606–607 Fig 35.8–35.10 Sec 35.7, p. 607 Fig 35.11 Chapt 36 Sec 36.3, p. 623 Chapt 38 Sec 38.11, p. 675 •Testosterone and estrogen Chapt 3 Sec 3.2, p. 38–39 Fig 3.5 Chapt 12 Sec 12.1, p. 186–187

Essential knowledge	Chapters/sections	Illustrative examples covered
		Fig 12.2 Chapt 35 Sec 35.2, p. 600 Table 35.1 Sec 35.5, p. 605 Table 35.3 Sec 35.12, p. 612 Chapt 36 Sec 36.0, p. 616 Fig 36.1 Sec 36.3, p. 623 Chapt 42 Sec 42.2, p. 743 Sec 42.3, p. 745 Fig 42.7 Sec 42.6, p. 748–749 Fig 42.11 Sec 42.9, p. 752–753 Summary, p. 756–757 Impacts, issues exercise Data analysis exercise Fig 42.19 Chapt 43 Sec 43.7, p. 769 Sec 43.9, p. 771
3.D.3. Signal transduction pathways link signal reception with cellular response.	Chapt 5 Sec 5.0–5.4, p. 76–85 Summary, p. 90–91 Chapt 9 Sec 9.5, p. 151 Chapt 22 Sec 22.11 Chapt 27 Sec 27.6, p. 468 Sec 27.6, p. 471 Chapt 31 Sec 31.0, p. 522 Sec 31.2–31.6, p. 526–534 Summary, p. 535 Chapt 32 Sec 32.5, p. 545 Chapt 33 Sec 33.2–33.7, p. 556–563 Chapt 35	•Receptor tyrosine kinases Chapt 9 Sec 9.5, p. 151 Fig 9.9 •Secondary messengers such as: cyclic GMP, cyclic AMP, calcium ions, and inositol triphosphate Chapt 22 Sec 22.11 Fig 22.26 Chapt 33 Sec 33.5, p. 560–561 Fig 33.11 Chapt 35 Sec 35.2, p. 600–601

Essential knowledge	Chapters/sections	Illustrative examples covered
	Sec 35.2, p. 600–601 Chapt 41 Sec 41.6, p. 730–731	
3.D.4. Changes in signal transduction pathways can alter cellular response.	Chapt 9 Sec 9.5, p. 150–151 Chapt 15 Summary, p. 238 Chapt 16 Sec 16.10, p. 254 Chapt 18 Sec 18.0, p. 276 Summary, p. 299 Chapt 22 Sec 22.0, p. 351 Chapt 33 Sec 33.6, p. 562 Chapt 35 Sec 35.6, p. 606–607 Sec 35.9, p. 609 Sec 35.11, p. 611 Chapt 36 Sec 36.5, p. 625 Chapt 38 Sec 38.5, p. 667 Sec 38.9, p. 673 Sec 38.11–38.12, p.675–677 Chapt 42 Sec 42.9, p. 752–753 Chapt 47 Sec 47.4, p. 846	•Diabetes, heart disease, neurological disease, autoimmune disease, cancer, cholera Chapt 9 Sec 9.5, p. 150–151 Fig 9.9 Chapt 15 Summary, p. 238 Impacts, issues exercise Chapt 16 Sec 16.10, p. 254 Chapt 33 Sec 33.6, p. 562 Fig 33.13 Chapt 35 Sec 35.6, p. 606–607 Sec 35.9, p. 609 Sec 35.11, p. 611 Chapt 36 Sec 36.5, p. 625 Chapt 38 Sec 38.5, p. 667 Sec 38.11, p. 675 Fig 38.21 Sec 38.12, p. 676–677 Fig 38.22 •Effects of neurotoxins, poisons, pesticides Chapt 18 Sec 18.0, p. 276 Fig 18.1 Summary, p. 299 Data analysis exercise Fig 18.27 Chapt 22 Sec 22.0, p. 351 Chapt 47 Sec 47.4, p. 846 Fig 846 •Drugs (Hypertensives, Anesthetics, Antihistamines, and Birth Control drugs Chapt 38 Sec 38.9, p. 673 Chapt 42 Sec 42.9, p. 752–753

Essential knowledge	Chapters/sections	Illustrative examples covered
3.E.1. Individuals can act on information and communicate it to others.	Chapt 18 Sec 18.6, p. 286 Chapt 23 Sec 23.8, p. 382–383 Chapt 26 Sec 26.10, p. 447 Chapt 27 Sec 27.5, p. 468 Chapt 30 Sec 30.2, p. 510–511 Sec 30.6, p. 516–517 Summary, p. 520–521 Chapt 31 Sec 31.3, p. 529 Summary, p. 536 Chapt 33 Sec 33.8, p. 565 Chapt 34 Sec 34.1, p. 578 Summary, p. 595 Chapt 35 Sec 35.11, p. 611 Chapt 44 All sections, p. 780–795 Chapt 45 Sec 45.3, p. 800 Sec 45.5, p. 805 Chapt 46 Sec 46.5–46.7, p. 824–827	Organisms exchange information •Fight or flight response Chapt 33 Sec 33.8, p. 565 •Predator warnings Chapt 44 Sec 44.6, p. 790 Fig 44.15a Chapt 46 Sec 46.5, p. 824–825 Fig 46.12 •Protection of young Chapt 18 Sec 18.6, p. 286 Chapt 44 Sec 44.5, p. 789 Fig 44.14 Communication mechanisms •Herbivory responses Chapt 27 Sec 27.5, p. 468 Fig 27.9 Chapt 31 Sec 31.3, p. 529 Fig 31.9 Summary, p. 536 Data analysis exercise Fig 31.23 Chapt 46 Sec 46.5, p. 824 Fig 46.11 •Coloration in flowers Chapt 23 Sec 23.8, p. 382–383 Fig 23.22a–c Chapt 30 Sec 30.2, p. 510–511 Fig 30.5–30.7a Table 30.1 Chapt 34 Sec 34.1, p. 578 Fig 34.3 Signaling modalities •Bee dances Chapt 44 Sec 44.3, p. 787 Fig 44.11

Essential knowledge	Chapters/sections	Illustrative examples covered
		•Bird song Chapt 44 Sec 44.2, p. 784–785 •Pack behavior in animals Chapt 35 Sec 35.11, p. 611 Fig 35.15 Chapt 44 Sec 44.6, p. 790–791 Fig 44.16 •Herd, flock, and schooling behavior Chapt 44 Sec 44.6, p. 790–791 Fig 44.15–44.18 •Predator warning Chapt 1 Sec 1.7, p. 14–15 Fig 1.11 Chapt 44 Sec 44.6, p. 790 Fig 44.15a Chapt 46 Sec 46.5, p. 824–825 Fig 46.12 •Colony and swarming behavior in insects Chapt 44 Sec 44.0, p. 780 Fig 44.1 Sec 44.7, p. 792–793 Fig 44.19, 44.20 Summary, p. 794–795 Impacts, issues exercise Data analysis exercise Fig 44.21 •Coloration Chapt 23 Sec 23.8, p. 382–383 Fig 23.22a–c Chapt 30 Sec 30.2, p. 510–511 Fig 30.5–30.7a Table 30.1 Chapt 34 Sec 34.1, p. 578 Fig 34.3 Chapt 46 Sec 46.5, p. 824–825 Fig 46.12

Essential knowledge	Chapters/sections	Illustrative examples covered
		Influence of natural selection •Parent and offspring interactions Chapt 18 Sec 18.6, p. 286 Chapt 44 Sec 44.2, p. 784 Fig 44.5 Sec 44.5, p. 789 Fig 44.14 Chapt 45 Sec 45.5, p. 805 Fig 45.10 Chapt 46 Sec 46.6, p. 826 Sec 46.7, p. 827 Fig 46.18b •Migration patterns Chapt 26 Sec 26.10, p. 447 Chapt 34 Summary, p. 595 Critical thinking exercise Chapt 45 Sec 45.3, p. 800 •Courtship and mating behaviors Chapt 18 Sec 18.6, p. 286 Fig 18.12 Chapt 44 Sec 44.1, p. 783 Fig 44.4 Sec 44.2, p. 784 Sec 44.4, p. 786–7 Fig 44.10b Sec 44.5, p. 788–789 Fig 44.12, 44.13 •Foraging in bees and other animals Chapt 30 Sec 30.2, p. 510–511 Fig 30.5–30.7 Sec 30.6, p. 516–517 Fig 30.12f Summary, p. 520–521 Impacts, issues exercise Data analysis exercise Fig 30.17 Critical thinking exercise

Essential knowledge	Chapters/sections	Illustrative examples covered
		Chapt 44 Sec 44.0, p. 780 Fig 44.1 Sec 44.7, p. 792–793 Fig 44.19, 44.20 Cooperative behavior •Pack behavior in animals/ Herd, flock and schooling behavior in animals Chapt 35 Sec 35.11, p. 611 Fig 35.15 Chapt 44 Sec 44.6, p. 790–791 Fig 44.16 •Predator warning Chapt 44 Sec 44.6, p. 790 Fig 44.15 •Colony and swarming behavior in insects Chapt 44 Sec 44.0, p. 780 Fig 44.1 Sec 44.4, p. 786–787 Fig 44.11 Sec 44.7, p. 792–793 Fig 44.19, 44.20 Summary, p. 794–795 Impacts, issues exercise Data analysis exercise Fig 44.21
3.E.2. Animals have nervous systems that detect external and internal signals, transmit and integrate information, and produce responses.	Chapt 33 Sec 33.0, p. 552 Sec 33.5–33.12, p. 560–571 Chapt 35 Sec 35.1, p. 599 Sec 35.5, p. 605 Chapt 36 Sec 36.8, p. 631 Sec 36.11, p. 633 Chapt 35 Sec 35.10, p. 610 Sec 35.11, p. 611	•Acetylcholine Chapt 33 Sec 33.5, p. 561 Fig 33.11e,f Sec 33.6, p. 562 Sec 33.7, p. 563 Sec 33.8, p. 565 Sec 33.9, p. 567 Fig 33.18f Chapt 36 Sec 36.8, p. 631 Fig 36.19b Sec 36.11, p. 633 •Epinephrine Chapt 33 Sec 33.6, p. 562

Essential knowledge	Chapters/sections	Illustrative examples covered
		Chapt 35 Sec 35.10, p. 610 Sec 35.11, p. 611 •Norepinephrine Chapt 33 Sec 33.6, p. 562 Sec 33.7, p. 563 Fig 33.14 Sec 33.8, p. 565 Chapt 35 Sec 35.10, p. 610 Sec 35.11, p. 611 •Dopamine Chapt 33 Sec 33.6, p. 562 Sec 33.7, p. 563 Fig 33.14 •Serotonin Chapt 33 Sec 33.0, p. 552 Sec 33.6, p. 562 Sec 33.7, p. 563 Fig 33.14 •GABA Chapt 33 Sec 33.6, p. 562 Sec 33.7, p. 563 Chapt 36 Sec 36.11, p. 633 Fig 36.25 •Functions of brain regions Chapt 33 Sec 33.10, p. 568–569 Fig 33.19, 33.20b Sec 33.11, p. 570–571 Fig 33.21–33.23 Sec 33.12, p. 572 Fig 33.27

Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.

Essential knowledge	Chapters/sections	Illustrative examples covered
4.A.1: The subcomponents of biological molecules and their sequence determine the properties of that molecule.	Chapt 2 Sec 2.4–2.5, p. 26–29 Chapt 3 All sections, p. 34–51 Chapt 13 Sec 13.2, p. 206–207	No recommended illustrative examples supplied in Curriculum Framework.
4.A.2: The structure and function of subcellular components, and their interactions, provide essential cellular processes.	Chapt 4 Sec 4.2, p. 56–57 Sec 4.6–4.11, p. 62–69 Chapt 7 All sections, p. 106–121 Chapt 8 Sec 8.0, p. 122 Sec 8.3–8.4, p. 128–131	No recommended illustrative examples supplied in Curriculum Framework.
4.A.3: Interactions between external stimuli and regulated gene expression result in specialization of cells, tissues and organs.	Chapt 9 Sec 9.5, p. 150 Fig 9.9 Chapt 11 Sec 11.6, p. 179 Chapt 15 All sections, p. 228–239	No recommended illustrative examples supplied in Curriculum Framework.
4.A.4: Organisms exhibit complex properties due to interactions between their constituent parts.	Chapt 28 Sec 28.1, p. 476–477 Sec 28.3–28.5, p. 480–485 Chapt 29 Sec 29.0, p. 492 Sec 29.3–29.5, p. 498–503 Summary, p. 504–505 Chapt 32 Sec 32.1, p. 540 Chapt 33 Sec 33.1, p. 554–555 Sec 33.9–33.10, p. 566–569 Chapt 34 Sec 34.4, p. 583 Chapt 36 Sec 36.8, p. 630–631	Interactions between organs •Stomach and small intestines Chapt 40 Sec 40.4, p. 706–707 Fig 40.7, 40.8 Table 40.1 •Kidney and bladder Chapt 41 Sec 41.3, p. 424–425 Fig 41.8 Sec 41.4, p. 726–727 Fig 41.9 •Root, stem, and leaf Chapt 28 Sec 28.1, p. 476–477 Fig 28.2, 28.3 Sec 28.3, p. 480–481 Fig 28.10c, 28.11

Essential knowledge	Chapters/sections	Illustrative examples covered
	Sec 36.10–36.11, p.632–633 Chapt 37 Sec 37.2, p. 640 Sec 37.5, p. 644–645 Chapt 39 Sec 39.1, p. 682–683 Sec 39.4–39.5, p. 686–689 Sec 39.7, p. 692–693 Sec 39.9, p. 696–697 Summary, p. 699 Chapt 40 Sec 40.4, p. 706–707 Chapt 41 Sec 41.3–41.4, p. 424–427	Sec 28.4, p. 483 Fig 28.14, 28.15 Sec 28.5, p. 484–485 Fig 28.16 Chapt 29 Sec 29.0, p. 492 Fig 29.1 Sec 29.3, p. 498–499 Fig 29.6, 29.7 Sec 29.4, p. 500–501 Fig 29.8, 29.9 Sec 29.5, p. 502–503 Fig 29.10, 29.12 Summary, p. 504–505 Impacts, issues exercise Data analysis exercise Fig 29.14 Critical thinking exercise Interactions between organ systems •Respiratory and circulatory Chapt 37 Sec 37.2, p. 640 Fig 37.4 Sec 37.5, p. 644–645 Fig 37.10–37.12 Chapt 39 Sec 39.1, p. 682–683 Fig 39.2 Sec 39.4, p. 686 Fig 39.10 Sec 39.5, p. 688–689 Fig 39.13c Sec 39.7, p. 692–693 Fig 39.19–39.21 Sec 39.9, p. 696–697 Fig 39.24 Summary, p. 699 Critical thinking exercise •Nervous and muscular Chapt 33 Sec 33.1, p. 554–555 Fig 33.3 Sec 33.9, p. 566–567 Fig 33.18 Sec 33.10, p. 568–569 Fig 33.19 Chapt 34

Essential knowledge	Chapters/sections	Illustrative examples covered
		Sec 34.4, p. 583 Chapt 36 Sec 36.8, p. 630–631 Fig 36.19 Sec 36.10, p. 632 Fig 36.22 Sec 36.11, p. 633 Fig 36.25 •Plant vascular and leaf Chapt 28 Sec 28.4, p. 483 Fig 28.14, 28.15 Chapt 29 Sec 29.3, p. 498–499 Fig 29.7
4.A.5: Communities are composed of populations of organisms that interact in complex ways.	Chapt 17 Sec 17.3, p. 264–265 Chapt 44 Summary, p. 795 Chapt 45 All sections, p. 796–815 Chapt 46 All sections, p. 816–837 Chapt 47 Sec 47.1–47.4, p. 840–846 Sec 47.8, p. 852–853 Summary, p. 859 Chapt 49 Sec 49.2, p. 895	•Predator/prey relationships spreadsheet model Chapt 46 Sec 46.4, p. 822–823 Fig 46.9, 46.10 •Symbiotic relationship Chapt 46 Sec 46.2, p. 819 Fig 46.3 Sec 46.6, p. 826–827 Fig 46.14–46.17 Sec 46.7, p. 827 Fig 46.18 •Graphical representation of field data Chapt 44 Summary, p. 795 Data analysis exercise Fig 44.21 Chapt 45 Sec 45.3, p. 801 Fig 45.6 Sec 45.4, p. 803 Fig 45.9 Sec 45.6, p. 807 Fig 45.12 Sec 45.7, p. 809 Fig 45.14 Sec 45.8, p. 810–811 Fig 45.15, 45.16 Sec 45.9, p. 812–813 Fig 45.17, 45.18 Summary, p. 815

Essential knowledge	Chapters/sections	Illustrative examples covered
		Data analysis exercise Fig 45.20 Chapt 46 Sec 46.3, p. 821 Fig 46.6 Sec 46.4, p. 823 Fig 46.9, 46.10 Sec 46.9, p. 831 Fig 46.21 Sec 46.11, p. 835 Fig 46.24, 46.25 Summary, p. 837 Data analysis exercise Fig 46.27 •Introduction of species Chapt 46 Sec 46.9, p. 830–831 Table 46.2 Sec 46.10, p. 832–833 Fig 46.22, Fig 46.23 Summary, p. 837 Impacts, issues exercise Data analysis exercise Fig 46.27 Critical thinking exercise Chapt 49 Sec 49.2, p. 895 •Global climate change models Chapt 47 Sec 47.8, p. 852–853 Fig 47.16, 47.18 Summary, p. 859 Data analysis exercise Fig 47.23
4.A.6: Interactions among living systems and with their environment result in the movement of matter and energy.	Chapt 1 Sec 1.2, p. 6 Chapt 45 Sec 45.3–45.4, p. 800–804 Chapt 47 Sec 47.0–47.4, p. 838–846 Chapt 48 Sec 48.4–48.16, p. 868–885 Chapt 49 All sections, p. 890–905	No recommended illustrative examples supplied in Curriculum Framework.

Essential knowledge	Chapters/sections	Illustrative examples covered
4.B.1: Interactions between molecules affect their structure and function.	Chapt 5 Sec 5.2, p. 80–81 Chapt 6 Sec 6.3–6.5, p. 98–102 Summary, p. 103–104 Chapt 8 Sec 8.4, p. 130–131	No recommended illustrative examples supplied in Curriculum Framework.
4.B.2: Cooperative interactions within organisms promote efficiency in the use of energy and matter.	Chapt 4 Sec 4.0, p. 52 Sec 4.4–4.13, p. 60–73 Chapt 5 Sec 5.1–5.2, p. 78–81 Chapt 21 Sec 21.6, p. 342–343 Sec 21.7, p. 344–345 Chapt 28 Sec 28.4, p. 482–483 Sec 28.5, p. 484–485 Sec 28.6, p. 486 Chapt 29 Sec 29.2–29.5, p. 496–503 Chapt 32 Sec 32.1, p. 540 Sec 32.6, p. 546–547 Chapt 37 All sections, p. 636–657 Chapt 39 All sections, p. 680–699 Chapt 40 Sec 40.1–40.7, p. 702–711 Chapt 41 Sec 41.0–41.8, p. 720–732	•Exchange of gases Chapt 29 Sec 29.4, p. 500–501 Fig 29.8 Chapt 39 All sections, p. 680–699 •Circulation of fluids Chapt 28 Sec 28.4, p. 482–483 Fig 28.14, 28.15 Sec 28.5, p. 484–485 Fig 28.16 Sec 28.6, p. 486 Fig 28.19 Chapt 29 Sec 29.2, p. 496–497 Fig 29.4, 29.5 Sec 29.3, p. 498–490 Fig 29.6, 29.7 Sec 29.5, p. 502–503 Fig 29.10, 29.12 Chapt 37 All sections, p. 636–657 •Digestion of food Chapt 40 Sec 40.1, p. 702–703 Fig 40.3, 40.4 Sec 40.2, p. 704–705 Fig 40.5 Sec 40.3, p. 705 Fig 40.6 Sec 40.4, p. 706–707 Fig 40.7, 40.8 Sec 40.5, p. 708–709 Fig 40.9, 40.10 Sec 40.6, p. 710 Fig 40.11 Sec 40.7, p. 711 Fig 40.12

Essential knowledge	Chapters/sections	Illustrative examples covered
		•Excretion of wastes Chapt 41 Sec 41.0, p. 720 Fig 41.1 Sec 41.1, p. 722 Sec 41.2, p. 722–723 Fig 41.3–41.5 Sec 41.3, p. 724–725 Fig 41.7, 41.8 Sec 41.4, p. 726–727 Fig 41.9, 41.10 Sec 41.5, p. 728–729 Fig 41.11 Sec 41.6, p. 730–731 Fig 41.12 Sec 41.7, p. 731 Sec 41.8, p. 732 Fig 41.13 •Bacterial community in the rumen of animals Chapt 21 Sec 21.6, p. 343 Fig 21.14a Sec 21.7, p. 344–345 (Archaeans) Fig 21.16a Chapt 40 Sec 40.1, p. 702–703 Fig 40.4 •Bacterial community in and around deep sea vents Chapt 21 Sec 21.6, p. 342 Sec 21.7, p. 345 (Archaeans) Fig 21.17c,d
4.B.3: Interactions between and within populations influence patterns of species distribution and abundance.	Chapt 18 Sec 18.1, p. 278 Chapt 46 All sections, p. 816–837 Chapt 49 Sec 49.2, p. 895	•Loss of keystone species Chapt 46 Sec 46.9, p. 830–831 Fig 46.21 •Kudzu Chapt 46 Sec 46.10, p. 833–834 Fig 46.22 Chapt 49 Sec 49.2, p. 895 •Dutch elm disease Chapt 46 Sec 46.9, p. 831 Table 46.2

Essential knowledge	Chapters/sections	Illustrative examples covered
4.B.4: Distribution of local and global ecosystems changes over time.	Chapt 17 Sec 17.0, p. 259 Sec 17.8–17.9, p. 270–273 Chapt 18 Sec 18.10, p. 292 Chapt 22 Sec 22.8, p. 361 Chapt 26 Sec 26.8, p. 443 Sec 26.11, p. 449 Chapt 45 Summary, p. 815 Chapt 46 Sec 46.9–46.10, p. 831–834 Chapt 47 Sec 47.4, p. 846 Sec 47.6, p. 848–849 Sec 47.9–47.10, p. 855–857 Chapt 48 Sec 48.0, p. 860 Sec 48.2, p. 864–865 Sec 48.9, p. 875 Sec 48.11, p. 877 Sec 48.15–48.17, p.882–887 Chapt 49 All sections, p. 890–905	•Logging, slash and burn agriculture, urbanization, mono-cropping, infrastructure development (dams, transmission lines, roads), and global climate change threaten ecosystems and life on earth Chapt 47 Sec 47.4, p. 846 Fig 47.9 Sec 47.6, p. 848–849 Fig 47.12, 47.13 Sec 47.9, p. 855 Fig 47.20 Sec 47.10, p. 857 Fig 47.22 Chapt 48 Sec 48.2, p. 864–865 Fig 48.7, 48.8 Sec 48.9, p. 875 Fig 48.19 Sec 48.11, p. 877 Sec 48.15, p. 882–883 Fig 48.30 Chapt 49 Sec 49.0, p. 890 Sec 49.2, p. 895 Fig 49.5, 49.6 Sec 49.5, p. 898–899 Fig 49.8, 49.9 Sec 49.6, p. 900 Fig 49.10, 49.11 Sec 49.7, p. 901 Fig 49.12 Summary, p. 904–905 Impacts, issues exercise Data analysis exercise Fig 49.15 Critical thinking exercise •An introduced species can exploit a new niche free of predators or competitors, thus exploiting new resources Chapt 26 Sec 26.11, p. 449 Chapt 46 Sec 46.10, p. 833–834 Fig 46.22 Chapt 49 Sec 49.2, p. 895

Essential knowledge	Chapters/sections	Illustrative examples covered
		•Dutch elm disease Chapt 46 Sec 46.9, p. 831 Table 46.2 •Potato blight Chapt 22 Sec 22.8, p. 361 •El Niño Chapt 45 Summary, p. 815 Data analysis exercise Chapt 48 Sec 48.0, p. 860 Fig 48.1 Sec 48.16, p. 885 Sec 48.17, p. 886–887 Fig 48.34–48.36 •Continental Drift Chapt 17 Sec 17.9, p. 272–273 Fig 17.15–17.17 Chapt 18 Sec 18.10, p. 292 Fig 18.20 Chapt 26 Sec 26.11, p. 448–449 Fig 26.24 Chapt 46 Sec 46.9, p. 831 •Meteor impact on dinosaurs Chapt 17 Sec 17.0, p. 259 Fig 17.1 Sec 17.8, p. 270–271 Chapt 26 Sec 26.8, p. 443
4.C.1: Variation in molecular units provides cells with a wider range of functions.	Chapt 5 Sec 5.1–5.5, p. 78–87 Chapt 7 Sec 7.1–7.2, p. 109–110 Sec 7.4, p. 112 Chapt 18 Sec 18.6, p. 287 Chapt 38 Sec 38.6–38.7, p. 668–671	•Different types of phospholipids in cell membranes Chapt 5 Sec 5.1, p. 78–79 Fig 5.2 •Chlorophylls Chapt 7 Sec 7.1, p. 109 Fig 7.3 Table 7.1 Sec 7.2, p. 110

Essential knowledge	Chapters/sections	Illustrative examples covered
		Fig 7.4c Sec 7.4, p. 112 •MHC Proteins Chapt 38 Sec 38.5, p. 666 Fig 38.9 Sec 38.7, p. 670–671 Fig 38.14 •Molecular diversity of antibodies in response to an antigen Chapt 38 Sec 38.6, p. 668–669 Fig 38.12, 38.13 Sec 38.7, p. 670–671
4.C.2: Environmental factors influence the expression of the genotype in an organism.	Chapt 11 Sec 11.6, p. 179 Sec 11.7, p. 180 Chapt 12 Sec 12.1, p. 186 Chapt 15 Sec 15.4, p. 236–237 Chapt 32 Sec 32.7, p. 549	•Height and weight in humans Chapt 11 Sec 11.7, p. 180 Fig 11.19 •Sex determination in reptiles Chapt 12 Sec 12.1, p. 186 •Effect of adding lactose to a Lac+ bacterial culture Chapt 15 Sec 15.4, p. 236–237 Fig 15.11 •Effect of increased UV on melanin production in animals Chapt 32 Sec 32.7, p. 549 •Darker fur in cooler regions of the body in certain mammal species Chapt 11 Sec 11.6, p. 179 Fig 11.16 •Alterations in timing of flowering due to climate change Chapt 7 Sec 7.9, p. 119
4.C.3: The level of variation in a population affects population dynamics.	Chapt 18 Sec 18.2, p. 280–281 Sec 18.7, p. 288–289 Chapt 22 Sec 22.8, p. 361	•Potato blight causing the potato famine Chapt 22 Sec 22.8, p. 361

Essential knowledge	Chapters/sections	Illustrative examples covered
4.C.4: The diversity of species within an ecosystem may influence the stability of the ecosystem.	Chapt 46 Sec 46.11, p. 834	No recommended illustrative examples supplied in Curriculum Framework.

Sections of the text book that do not have to be covered in an AP Biology course:

Chapt 1: Sec 1.5–1.8 Critical thinking about science, how science works, etc.
Chapt 2: Sec 2.1–2.4 Atoms and electrons
Unit IV: Biodiversity, an overview of all major taxonomic groups. Many examples within this section relate to the Essential Knowledge Statements in this guide and are noted above. However, the overall focus of the section, Biodiversity, is not included in the AP Biology curriculum. The final chapter of this unit, 27: Plants and Animals—Common Challenges, is included.