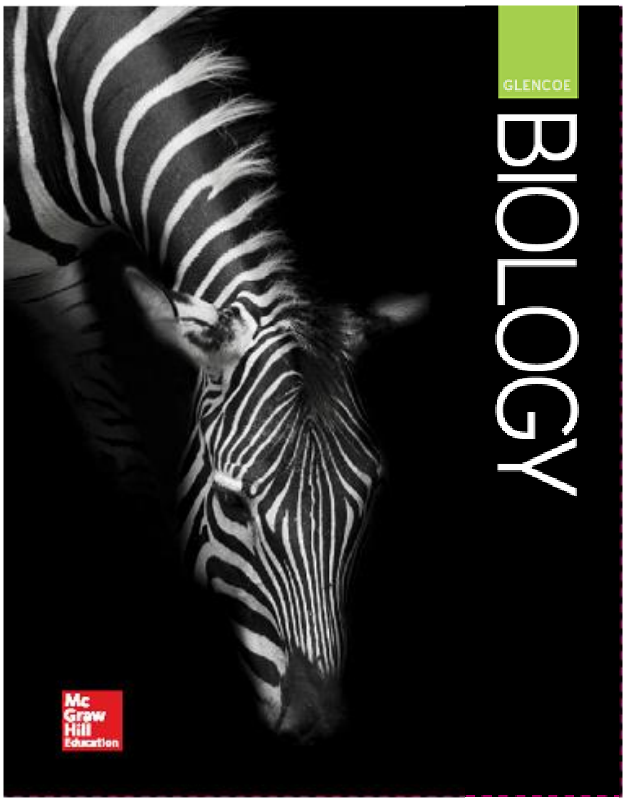
College- and Career-Readiness
Standards for Science
Biology



© 2017

STANDARDS	PAGE REFERENCES
Biology	
BIO.1 Cells as a System **Conceptual Understanding:** Biologists have determined that organisms share unique characteristics that differentiate them from non-living things. Organisms range from very simple to extremely complex.	

Codes used for Teacher Edition pages are the initial caps of headings on that page.

STANDARDS	PAGE REFERENCES
BIO.1A Students will demonstrate an understanding of the characteristics of life and biological organization.	
BIO.1A.1 *Ask questions to differentiate between living and non-living things.*	**Student Edition:** 6-10 *Launch Lab* 180 *MiniLab* 8 **Teacher Wraparound Edition:** DC 6, 7; DE 7
BIO.1A.2 *Describe the tenets of cell theory and the contributions of Schwann, Hooke, Schleiden, and Virchow.*	**Student Edition:** 182-183 *Section Assessment* 186 (#3)
BIO.1A.3 *Using specific examples, explain how cells can be organized into complex tissues, organs, and organ systems in multicellular organisms.*	**Student Edition:** 632-638, 694 *Section Assessment* 638 (#1-#6) **Teacher Wraparound Edition:** ITC 935; MI 936; WS 694
BIO.1A.4 *Use evidence from current scientific literature to support whether a virus is living or non-living.*	**Student Edition:** 525-527 **Teacher Wraparound Edition:** DC 526; MI 525
Conceptual Understanding: Organisms are composed of four primary macromolecules: carbohydrates, lipids, proteins, and nucleic acids. Metabolism is the sum of all chemical reactions between molecules within cells. Cells continuously utilize materials obtained from the environment and breakdown these materials to synthesize their own macromolecules for cellular structures and functions. These metabolic reactions require enzymes for catalysis.	
BIO.1B Students will analyze the structure and function of the macromolecules that make up cells.	
BIO.1B.1 *Develop and use models to compare and contrast the structure and function of carbohydrates, lipids, proteins, and nucleic acids (DNA and RNA) in organisms.*	**Student Edition:** 166-171 *Section Assessment* 171 (#2) **Teacher Wraparound Edition:** DC 171; DE 171
BIO.1B.2 *Design and conduct an experiment to determine how enzymes react given various environmental conditions (i.e., pH, temperature, and concentration). Analyze, interpret, graph, and present data to explain how those changing conditions affect the enzyme activity and the rate of the reactions that take place in biological organisms.*	**Student Edition:** 159-160, 164-165 *BioLab: Design Your Own* 173 *Data Analysis Lab* 164 *MiniLab* 159 **Teacher Wraparound Edition:** FA 160

STANDARDS	PAGE REFERENCES
Conceptual Understanding: Cells are the basic units of all organisms, both prokaryotes and eukaryotes. Prokaryotic and eukaryotic cells differ in key structural features, but both are capable of performing all functions necessary for life.	
BIO.1C Students will relate the diversity of organelles to a variety of specialized cellular functions.	
BIO.1C.1 *Develop and use models to explore how specialized structures within cells (e.g., nucleus, cytoskeleton, endoplasmic reticulum, ribosomes, Golgi apparatus, lysosomes, mitochondria,* chloroplast, centrosomes, and vacuoles) interact to carry out the functions necessary for organism survival.	**Student Edition:** 191-200 *Section Assessment* 200 (#3) **Teacher Wraparound Edition:** DC 191; SP 196; WS 193
BIO.1C.2 *Investigate to compare and contrast prokaryotic cells and eukaryotic cells, and plant, animal,* and fungal cells.	**Student Edition:** 185-186, 192, 577, 632-633, 694 *Launch Lab* 514 *MiniLab* 634 *Section Assessment* 186 (#5) **Teacher Wraparound Edition:** AC 192; DC 632; SP 192
BIO.1C.3 *Contrast the structure of viruses with that of cells, and explain why viruses must use living* cells to reproduce.	**Student Edition:** 525-530 **Teacher Wraparound Edition:** MI 525; WS 527
Conceptual Understanding: The structure of the cell membrane allows it to be a selectively permeable barrier and maintain homeostasis. Substances that enter or exit the cell must do so via the cell membrane. This transport across the membrane may occur through a variety of mechanisms, including simple diffusion, facilitated diffusion, osmosis, and active transport.	
BIO.1D Students will describe the structure of the cell membrane and analyze how the structure is related to its primary function of regulating transport in and out of cells to maintain homeostasis.	
BIO.1D.1 *Plan and conduct investigations to prove that the cell membrane is a semi-permeable, allowing it to maintain homeostasis with its environment through active and passive transport processes.*	**Student Edition:** 185, 187-190, 201-207 *BioLab* 209 *MiniLab* 203 **Teacher Wraparound Edition:** CT 204

STANDARDS	PAGE REFERENCES
BIO.1D.2 *Develop and use models to explain how the cell deals with imbalances of solute concentration across the cell membrane (i.e., hyperosmotic, hypoosmotic, and isotonic conditions, sodium/potassium pump).*	**Student Edition:** 201-207 *BioLab* 209 *MiniLab* 203 *Section Assessment* 207 (#3) **Teacher Wraparound Edition:** AC 202; DE 203; WS 206
Conceptual Understanding: Cells grow and reproduce through a regulated cell cycle. Within multicellular organisms, cells repeatedly divide for repair, replacement, and growth. Likewise, an embryo begins as a single cell that reproduces to form a complex, multicellular organism through the processes of cell division and differentiation.	
BIO.1E Students will develop and use models to explain the role of the cell cycle during growth, development, and maintenance in multicellular organisms.	
BIO.1E.1 *Construct models to explain how the processes of cell division and cell differentiation produce and maintain complex multicellular organisms.*	**Student Edition:** 246-247, 248-252, 253-254 *Section Assessment* 247 (#4) **Teacher Wraparound Edition:** DC 249; DE 249; SP 252
BIO.1E.2 *Ask questions to describe the changes that occur to a cell during replication. Define problems that might occur if the cell does not progress through the cycle correctly (cancer).*	**Student Edition:** 254-255 *Launch Lab* 242 *Section Assessment* 252 (#6), 257 (#7) **Teacher Wraparound Edition:** CT 254, 256
BIO.1E.3 *Relate the processes of cellular reproduction to asexual reproduction in simple organisms (i.e., budding, vegetative propagation, regeneration, binary fission). Explain why the DNA of the daughter cells is the same as the parent cell.*	**Student Edition:** 247, 276, 520, 549, 662-663 *Section Assessment* 667 (#2) **Teacher Wraparound Edition:** DE 662
BIO.1E.4 Enrichment: *Use an engineering design process to investigate the role of stem cells in regeneration and asexual reproduction, then develop applications of stem cell research to solve human medical conditions.**	**Student Edition:** 256-257 *Biology & Society* 258 *Cutting-Edge Biology* 1010 *Section Assessment* 257 (#5) **Teacher Wraparound Edition:** WS 257

STANDARDS	PAGE REFERENCES
BIO.2 Energy Transfer **Conceptual Understanding:** Organisms require energy in order to perform life functions. Cells are transformers of energy, continuously utilizing a complex sequence of reactions in which energy is transferred from one form to another, for example, from light energy to chemical energy to kinetic energy. Emphasis is on illustrating the inputs and outputs of matter and the transfer and transformation of energy in photosynthesis and cellular respiration. Assessment is limited to identification of the phases (i.e., glycolysis, citric acid cycle, and electron transport chain) in cellular respiration as well as light and light-independent reactions of photosynthesis and does not include specific biochemical reactions within the phases.	
BIO.2 Students will explain that cells transform energy through the processes of photosynthesis and cellular respiration to drive cellular functions.	
BIO.2.1 *Use models to demonstrate that ATP and ADP are cycled within a cell as a means to transfer energy.*	**Student Edition:** 221 *Section Assessment* 221 (#4) **Teacher Wraparound Edition:** CT 221; DE 220
BIO.2.2 *Develop models of the major reactants and products of photosynthesis to demonstrate the transformation of light energy into stored chemical energy in cells. Emphasize the chemical processes in which bonds are broken and energy is released and new bonds are formed and energy is stored.*	**Student Edition:** 41, 43, 220, 222-226, 233 *BioLab: Design Your Own* 235 *MiniLab* 220 **Teacher Wraparound Edition:** DC 232; FA 227; MI 41; WS 224
BIO.2.3 *Develop models of the major reactants and products of cellular respiration (aerobic and anaerobic) to demonstrate the transformation of the chemical energy stored in food to the available energy of ATP. Emphasize the chemical processes in which bonds are broken and energy is released and new bonds are formed and energy is stored.*	**Student Edition:** 220, 228-233 *MiniLab* 220 **Teacher Wraparound Edition:** AC 228
BIO.2.4 *Conduct scientific investigations or computer simulations to compare aerobic and anaerobic* cellular respiration in plants and animals, using real world examples.	The following pages can be used to meet this standard. **Student Edition:** 231-232 *Assessment* 239 (#42) *Section Assessment* 233 (#4, #6)
BIO.2.5 Enrichment: *Investigate variables (e.g., nutrient availability, temperature, etc.) that affect anaerobic respiration and current real-world applications of fermentation.*	**Student Edition:** *MiniLab* 580

STANDARDS	PAGE REFERENCES
BIO.2.6 Enrichment: *Use an engineering design process to manipulate factors involved in fermentation to optimize energy production.**	The following pages can be used to meet this standard. **Student Edition:** 231-232 *Assessment* 239 (#42) *MiniLab* 580 *Section Assessment* 233 (#4, #6)
BIO.3 Reproduction and Heredity **Conceptual Understanding:** Somatic cells contain homologous pairs of chromosomes, one member of each pair obtained from each parent, that form a diploid set of chromosomes in each cell. These chromosomes are similar in genetic information but may contain different alleles of these genes. For sexual reproduction, an offspring must inherit a haploid set from each parent. Haploid gametes are formed by meiosis, a specialized cell division in which the chromosome number is reduced by half. During meiosis, members of a homologous pair may exchange information and then are randomly sorted into gametes resulting in genetic variation in sex cells.	
BIO.3A Students will develop and use models to explain the role of meiosis in the production of haploid gametes required for sexual reproduction.	
BIO.3A.1 *Model sex cell formation (meiosis) and combination (fertilization) to demonstrate the maintenance of chromosome number through each generation in sexually reproducing populations. Explain why the DNA of the daughter cells is different from the DNA of the parent cell.*	**Student Edition:** 270-276 *Section Assessment* 276 (#7) **Teacher Wraparound Edition:** DC 275, 276
BIO.3A.2 *Compare and contrast mitosis and meiosis in terms of reproduction.*	**Student Edition:** 276 *Launch Lab* 268 **Teacher Wraparound Edition:** DC 272, 276
BIO.3A.3 *Investigate chromosomal abnormalities (e.g., Down syndrome, Turner's syndrome, and Klinefelter's syndrome) that might arise from errors in meiosis (nondisjunction) and how these abnormalities are identified (karyotypes).*	**Student Edition:** 311-314 *Section Assessment* 315 (# **Teacher Wraparound Edition:** CT 313; DC 312; FA 315; WS 313

STANDARDS	PAGE REFERENCES
Conceptual Understanding: Offspring inherit DNA from their parents. The genes contained in the DNA (genotype) determine the traits expressed in the offspring's phenotype. Alleles of a gene may demonstrate various patterns of inheritance, including dominance, codominance, etc. These patterns of inheritance may be followed through multiple generations within families.	
BIO.3B Students will analyze and interpret data collected from probability calculations to explain the variation of expressed traits within a population.	
BIO.3B.1 *Demonstrate Mendel's law of dominance and segregation using mathematics to predict phenotypic and genotypic ratios by constructing Punnett squares with both homozygous and heterozygous allele pairs.*	**Student Edition:** 278-282 *BioLab: Design Your Own* 287 *MiniLab* 280 *Section Assessment* 262 (#1-#3) **Teacher Wraparound Edition:** FA 282
BIO.3B.2 *Illustrate Mendel's law of independent assortment using Punnett squares and/or the product rule of probability to analyze dihybrid crosses.*	**Student Edition:** 280-282 *BioLab: Design Your Own* 287 *MiniLab* 280 *Section Assessment* 262 (#2, #3, #5) **Teacher Wraparound Edition:** FA 282
BIO.3B.3 *Investigate traits that follow non-Mendelian inheritance patterns (e.g., incomplete dominance, codominance, multiple alleles in human blood types, and sex-linkage).*	**Student Edition:** 302-309 *Data Analysis Lab* 303 *Section Assessment* 310 (#1, #3) **Teacher Wraparound Edition:** CT 207; DC 303, 308; SP 304
BIO.3B.4 *Analyze and interpret data (e.g., pedigrees, family, and population studies) regarding Mendelian and complex genetic traits (e.g., sickle-cell anemia, cystic fibrosis, muscular dystrophy, color-blindness, and hemophilia) to determine patterns of inheritance and disease risk.*	**Student Edition:** 299-301, 307-308 *Section Assessment* 301 (#1), 310 (#3) *MiniLab* 300 **Teacher Wraparound Edition:** CT 299; DC 299

STANDARDS	PAGE REFERENCES
Conceptual Understanding: Gene expression results in the production of proteins and thus determines the phenotypes of the organism. Changes in the DNA occur throughout an organism's life. Mutations are a source of genetic variation that may have a positive, negative, or no effect on the organism.	
BIO.3C Students will construct an explanation based on evidence to describe how the structure and nucleotide base sequence of DNA determines the structure of proteins or RNA that carry out essential functions of life.	
BIO.3C.1 *Develop and use models to explain the relationship between DNA, genes, and chromosomes in coding the instructions for the traits transferred from parent to offspring.*	**Student Edition:** 270-271, 278, 329-332, 336-337 **Teacher Wraparound Edition:** DC 332; MI 336
BIO.3C.2 *Evaluate the mechanisms of transcription and translation in protein synthesis.*	**Student Edition:** 336-341 *Assessment* 354 (#28, #30), 355 (#41) *Section Assessment* 341 (#1-#4) **Teacher Wraparound Edition:** DC 340; DE 339; FA 341; WS 336
BIO.3C.3 *Use models to predict how various changes in the nucleotide sequence (e.g., point mutations, deletions, and additions) will affect the resulting protein product and the subsequent inherited trait.*	**Student Edition:** 345-349 *Section Assessment* 349 (#4) **Teacher Wraparound Edition:** DC 347; FA 349
BIO.3C.4 *Ask questions to determine how DNA technology benefits society. Engage in scientific argument from evidence the ethical issues surrounding the use of DNA technology (e.g., cloning, transgenic organisms, stem cell research, and the Human Genome Project, gel electrophoresis).*	**Student Edition:** 256-257, 363, 370-371, 372-379 *Assessment* 385 (#33) *BioDiscoveries* 286 *BioLab* 381 *Biology & Society* 258, 350, 680 *In the Field* 380 *Section Assessment* 371 (#6), 379 (#2-#4) **Teacher Wraparound Edition:** DC 257, 363, 364; RS 370, 372, 374
BIO.3C.5 Enrichment: *Investigate current biotechnological applications in the study of the genome (e.g., transcriptome, proteome, individualized sequencing, and individualized gene therapy).*	**Student Edition:** 372-379 *BioLab* 381 *Data Analysis Lab* 376 *Section Assessment* 379 (#2-#4) **Teacher Wraparound Edition:** MI 372

STANDARDS	PAGE REFERENCES
BIO.4 Adaptations and Evolution **Conceptual Understanding:** Evolution is a key unifying principle in biology. Differentiating between organic and chemical evolution, and the analysis of the gradual changes in populations over time helps students understand common features and differences between species and thus the relatedness between species. There are several factors that affect how natural selection acts on populations within their environments leading to speciation, extinction, and the current diversity of life on earth.	
BIO.4 Students will analyze and interpret evidence to explain the unity and diversity of life.	
BIO.4.1 *Use models to differentiate between organic and chemical evolution, illustrating the steps leading to aerobic heterotrophs and photosynthetic autotrophs.*	**Student Edition:** 401-407 *Data Analysis Lab* 406 *Section Assessment* 407 (#1-#6) **Teacher Wraparound Edition:** DC 405, 407; DE 406
BIO.4.2 *Evaluate empirical evidence of common ancestry and biological evolution, including comparative anatomy (e.g., homologous structures and embryological similarities), fossil record, molecular/biochemical similarities (e.g., gene and protein homology), and biogeographic distribution.*	**Student Edition:** 423-428 *Assessment* 446 (#18, #20) *In the Field* 408 *Section Assessment* 430 (#1-#5) **Teacher Wraparound Edition:** DE 424, 426; MI 423; RS 425; SP 423, 426
BIO.4.3 *Construct cladograms/phylogenetic trees to illustrate relatedness between species.*	**Student Edition:** 492-498 *BioLab* 505 *MiniLab* 500 *Section Assessment* 499 (#4) **Teacher Wraparound Edition:** RS 496
BIO.4.4 *Design models and use simulations to investigate the interaction between changing environments and genetic variation in natural selection leading to adaptations in populations and differential success of populations.*	**Student Edition:** 420-421, 434-436 *BioLab* 443 *Launch Lab* 416 **Teacher Wraparound Edition:** AC 421
BIO.4.5 *Ask questions to explain Darwin's theory that genetic variation, competition, overproduction, and unequal reproductive success act as driving forces of natural selection and evolution.*	**Student Edition:** 418-422 *Chapter Assessment* 445 (#6, #8) *Section Assessment* 422 (#3, #5) **Teacher Wraparound Edition:** DC 421; DE 420; FA 422; RS 419

STANDARDS	PAGE REFERENCES
BIO.4.6 *Construct explanations for the mechanisms of speciation (e.g., geographic and reproductive isolation).*	**Student Edition:** 437-438 *Section Assessment* 441 (#4) **Teacher Wraparound Edition:** DC 438; DE 438; SP 437
BIO.4.7 Enrichment: *Construct explanations for how various disease agents (bacteria, viruses, chemicals) can influence natural selection.*	**Student Edition:** 433, 435 *Data Analysis Lab* 435 **Teacher Wraparound Edition:** DC 433
BIO.5 Interdependence of Organisms and Their Environments **Conceptual Understanding:** Complex interactions within an ecosystem affect the numbers and types of organisms that survive. Fluctuations in conditions can affect the ecosystem's function, resources, and habitat availability. Ecosystems are subject to carrying capacities and can only support a limited number of organisms and populations. Factors that can affect the carrying capacities of populations are both biotic and abiotic.	
BIO.5 Students will Investigate and evaluate the interdependence between living organisms and their environment.	
BIO.5.1 *Illustrate levels of ecological hierarchy, including organism, population, community, ecosystem, biome, and biosphere.*	**Student Edition:** 34-37 *Section Assessment* 40 (#2) **Teacher Wraparound Edition:** DC 36; SP 36, 37
BIO.5.2 *Analyze models of the cycling of matter (e.g., carbon, nitrogen, phosphorus, and water) between abiotic and biotic factors in an ecosystem and evaluate the ability of these cycles to maintain the health and sustainability of the ecosystem.*	**Student Edition:** 45-49 *Assessment* 55 (#37) *Section Assessment* 49 (#2, #4) **Teacher Wraparound Edition:** DC 45, 46; FA 49; SP 47
BIO.5.3 *Analyze and interpret quantitative data to construct an explanation for the effects of greenhouse gases on the carbon dioxide cycle and global climate.*	**Student Edition:** 66, 67 **Teacher Wraparound Edition:** DC 67
BIO.5.4 *Develop and use models to describe the flow of energy and amount of biomass through food chains, food webs, and food pyramids.*	**Student Edition:** 41-44 *Chapter Assessment* 54 (#26) *MiniLab* 42 *Section Assessment* 44 (#2, #5, #6) **Teacher Wraparound Edition:** FA 44

STANDARDS	PAGE REFERENCES
BIO.5.5 *Ask questions to evaluate symbiotic relationships (e.g., mutualism, parasitism, and commensalism) and other co-evolutionary (e.g., predator-prey, cooperation, competition, and mimicry) relationships within specific environments.*	**Student Edition:** 38-40, 429, 439, 587-589 *MiniLab* 429 *Section Assessment* 41 (#5) **Teacher Wraparound Edition:** CT 439; DC 40; RS 588
BIO.5.6 *Analyze and interpret population data, both density-dependent and density-independent, to define limiting factors. Use graphical representations (growth curves) to illustrate the carrying capacity within ecosystems.*	**Student Edition:** 94-99, 100-105 *BioLab* 107 *Data Analysis Lab* 98 *MiniLab* 101 *Section Assessment* 99 (#2, #4-#6) **Teacher Wraparound Edition:** CT 105; DC 94, 97, 101; SP 99, 102; WS 95, 96
BIO.5.7 *Ask questions to define factors involved in primary and secondary ecological succession using local, real world examples.*	**Student Edition:** 62-64 *Assessment* 85 (#12) *Data Analysis Lab* 63 *Section Assessment* 64 (#4) **Teacher Wraparound Edition:** DC 62, 63; RS 64
BIO.5.8 Enrichment: *Use an engineering design process to create a solution that addresses changing ecological conditions (e.g., climate change, invasive species, loss of biodiversity, human population growth, habitat destruction, biomagnification, or natural phenomena).*	**Student Edition:** *MiniLab* 120 *Section Assessment* 121 (#6), 128 (#5) **Teacher Wraparound Edition:** DC 133
BIO.5.9 Enrichment: *Use an engineering design process to investigate and model current technological uses of bio-mimicry to address solutions to real-world problems.*	The following pages can be used to meet this standard. **Student Edition:** 134-135 *Chapter Assessment* 141 (#37) **Teacher Wraparound Edition:** DE 134