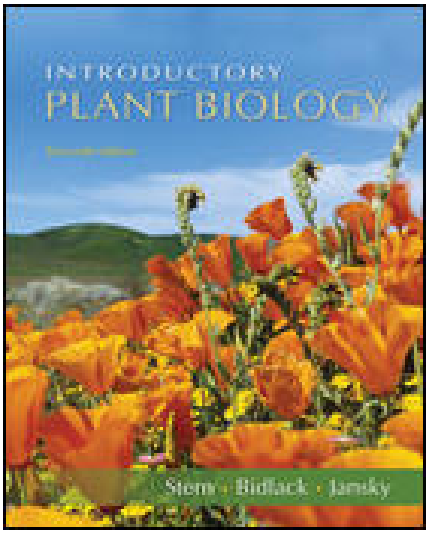
Science Content Standards:
Biology/Life Sciences
Investigation and Experimentation
Grades 9-12

McGraw-Hill Higher Education



INTRODUCTORY PLANT BIOLOGY

STANDARDS	PAGE REFERENCES
Biology/Life Sciences	
Cell Biology	
1. The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells. As a basis for understanding this concept:	
a. Students know cells are enclosed within semi permeable membranes that regulate their interaction with their surroundings.	**Student Edition:** 36-37
b. Students know enzymes are proteins that catalyze biochemical reactions without altering the reaction equilibrium and the activities of enzymes depend on the temperature, ionic conditions, and the pH of the surroundings.	**Student Edition:** 26-27, 166-167, 183, 227-228
c. Students know how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.	**Student Edition:** 33, 50-51, 295-297, 303, 309-314, 314 *Ecological Review* 314 *P.S.I.* 311-312
d. Students know the central dogma of molecular biology outlines the flow of information from transcription of ribonucleic acid (RNA) in the nucleus to translation of proteins on ribosomes in the cytoplasm.	**Student Edition:** 230-232, 233

STANDARDS	PAGE REFERENCES
e. Students know the role of the endoplasmic reticulum and Golgi apparatus in the secretion of proteins.	**Student Edition:** 38-41
f. Students know usable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide.	**Student Edition:** 41-42, 166, 166-167, 167-180 *Ecological Review* 177 *Note to the Reader* 168 *Overview* 166 *P.S.I.* 176
g. Students know the role of the mitochondria in making stored chemical-bond energy available to cells by completing the breakdown of glucose to carbon dioxide.	**Student Edition:** 42, 180-183
h. Students know most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors.	**Student Edition:** 15-18, 21-27
i. * Students know how chemiosmotic gradients in the mitochondria and chloroplast store energy for ATP production.	**Student Edition:** 176, 184-185
j. * Students know how eukaryotic cells are given shape and internal organization by a cytoskeleton or cell wall or both.	**Student Edition:** 33, 44
Genetics	
2. Mutation and sexual reproduction lead to genetic variation in a population. As a basis for understanding this concept:	
a. Students know meiosis is an early step in sexual reproduction in which the pairs of chromosomes separate and segregate randomly during cell division to produce gametes containing one chromosome of each type.	**Student Edition:** 216-217, 217-219 *Overview* 216
b. Students know only certain cells in a multi cellular organism undergo meiosis.	**Student Edition:** 216-217 *Overview* 216
c. Students know how random chromosome segregation explains the probability that a particular allele will be in a gamete.	**Student Edition:** 217-218, 242-243

STANDARDS	PAGE REFERENCES
d. Students know new combinations of alleles may be generated in a zygote through the fusion of male and female gametes (fertilization).	**Student Edition:** 219-220
e. Students know why approximately half of an individual's DNA sequence comes from each parent.	**Student Edition:** 219-220, 242-243
f. Students know the role of chromosomes in determining an individual's sex.	**Student Edition:** 216-217
g. Students know how to predict possible combinations of alleles in a zygote from the genetic makeup of the parents.	**Student Edition:** 235-241
3. A multi cellular organism develops from a single zygote, and its phenotype depends on its genotype, which is established at fertilization. As a basis for understanding this concept:	
a. Students know how to predict the probable outcome of phenotypes in a genetic cross from the genotypes of the parents and mode of inheritance (autosomal or X-linked, dominant or recessive).	**Student Edition:** 235-242, 242-244
b. Students know the genetic basis for Mendel's laws of segregation and independent assortment.	**Student Edition:** 235-239
c. * Students know how to predict the probable mode of inheritance from a pedigree diagram showing phenotypes.	The following references discuss how genotypes affect phenotypes and can be used to meet this objective. **Student Edition:** 241-242
d. * Students know how to use data on frequency of recombination at meiosis to estimate genetic distances between loci and to interpret genetic maps of chromosomes.	**Student Edition:** 242-243
4. Genes are a set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism. As a basis for understanding this concept:	
a. Students know the general pathway by which ribosomes synthesize proteins, using tRNAs to translate genetic information in mRNA.	**Student Edition:** 230-232, 233
b. Students know how to apply the genetic coding rules to predict the sequence of amino acids from a sequence of codons in RNA.	**Student Edition:** 231-232

STANDARDS	PAGE REFERENCES
c. Students know how mutations in the DNA sequence of a gene may or may not affect the expression of the gene or the sequence of amino acids in an encoded protein.	**Student Edition:** 232-234
d. Students know specialization of cells in multi cellular organisms is usually due to different patterns of gene expression rather than to differences of the genes themselves.	**Student Edition:** 230
e. Students know proteins can differ from one another in the number and sequence of amino acids.	**Student Edition:** 23-26, 232
f. * Students know why proteins having different amino acid sequences typically have different shapes and chemical properties.	**Student Edition:** 23-26
5. The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells. As a basis for understanding this concept:	
a. Students know the general structures and functions of DNA, RNA, and protein.	**Student Edition:** 23-26, 226-234 *P.S.I.* 229-230
b. Students know how to apply base-pairing rules to explain precise copying of DNA during semi conservative replication and transcription of information from DNA into mRNA.	**Student Edition:** 228-231 *P.S.I.* 229-230
c. Students know how genetic engineering (biotechnology) is used to produce novel biomedical and agricultural products.	**Student Edition:** 249-258
d. * Students know how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, ligation, and transformation) is used to construct recombinant DNA molecules.	**Student Edition:** 253-258
e. * Students know how exogenous DNA can be inserted into bacterial cells to alter their genetic makeup and support expression of new protein products.	**Student Edition:** 253-257

STANDARDS	PAGE REFERENCES
Ecology	
6. Stability in an ecosystem is a balance between competing effects. As a basis for understanding this concept:	
a. Students know bio diversity is the sum total of different kinds of organisms and is affected by alterations of habitats.	**Student Edition:** 491-493, 499-507 *Ecological Review* 507 *Overview* 499 *P.S.I.* 494, 508
b. Students know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.	**Student Edition:** 488, 488-490, 490-491, 491-495 *P.S.I.* 494, 508
c. Students know how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration, and death.	Populations are discussed in the following references and may be used to meet this objective. **Student Edition:** 476-479
d. Students know how water, carbon, and nitrogen cycle between abiotic resources and organic matter in the ecosystem and how oxygen cycles through photosynthesis and respiration.	**Student Edition:** 173-175, 480, 480-483
e. Students know a vital part of an ecosystem is the stability of its producers and decomposers.	**Student Edition:** 476-479
f. Students know at each link in a food web some energy is stored in newly made structures but much energy is dissipated into the environment as heat. This dissipation may be represented in an energy pyramid.	**Student Edition:** 476-478
g. * Students know how to distinguish between the accommodation of an individual organism to its environment and the gradual adaptation of a lineage of organisms through genetic change.	**Student Edition:** 269-270, 270-272, 272, 272-274, 264-276, 276-277, 475-476 *Ecological Review* 276 *Overview* 475

STANDARDS	PAGE REFERENCES
7. The frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time. As a basis for understanding this concept:	
a. Students know why natural selection acts on the phenotype rather than the genotype of an organism.	**Student Edition:** 270-271
b. Students know why alleles that are lethal in a homozygous individual may be carried in a heterozygote and thus maintained in a gene pool.	Homozygous recessive and heterozygous organisms and their phenotypes are discussed in the following references and may be used to meet this objective. **Student Edition:** 239-242
c. Students know new mutations are constantly being generated in a gene pool.	**Student Edition:** 271
d. Students know variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions.	**Student Edition:** 270
e. * Students know the conditions for Hardy-Weinberg equilibrium in a population and why these conditions are not likely to appear in nature.	**Student Edition:** 244, 249
f. * Students know how to solve the Hardy-Weinberg equation to predict the frequency of genotypes in a population, given the frequency of phenotypes.	The Hardy-Weinberg equation is discussed in the following reference. **Student Edition:** 244
8. Evolution is the result of genetic changes that occur in constantly changing environments. As a basis for understanding this concept:	
a. Students know how natural selection determines the differential survival of groups of organisms.	**Student Edition:** 270 *Ecological Review* 276
b. Students know a great diversity of species increases the chance that at least some organisms survive major changes in the environment.	The following references discuss the loss of diversity and can be used to meet this objective. **Student Edition:** 491-492
c. Students know the effects of genetic drift on the diversity of organisms in a population.	**Student Edition:** 271-272
d. Students know reproductive or geographic isolation affects speciation.	**Student Edition:** 272-273

STANDARDS	PAGE REFERENCES
e. Students know how to analyze fossil evidence with regard to biological diversity, episodic speciation, and mass extinction.	**Student Edition:** 267-268, 268-269, 269-270, 491-492, 507-508
f. * Students know how to use comparative embryology, DNA or protein sequence comparisons, and other independent sources of data to create a branching diagram (cladogram) that shows probable evolutionary relationships.	**Student Edition:** 283-287, 287-289, 289-290
g. * Students know how several independent molecular clocks, calibrated against each other and combined with evidence from the fossil record, can help to estimate how long ago various groups of organisms diverged evolutionarily from one another.	**Student Edition:** 287-289
Physiology	
9. As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment. As a basis for understanding this concept:	
a. Students know how the complementary activity of major body systems provides cells with oxygen and nutrients and removes toxic waste products such as carbon dioxide.	Not applicable to Plant Biology.
b. Students know how the nervous system mediates communication between different parts of the body and the body's interactions with the environment.	Not applicable to Plant Biology.
c. Students know how feedback loops in the nervous and endocrine systems regulate conditions in the body.	Not applicable to Plant Biology.
d. Students know the functions of the nervous system and the role of neurons in transmitting electrochemical impulses.	Not applicable to Plant Biology.
e. Students know the roles of sensory neurons, interneurons, and motor neurons in sensation, thought, and response.	Not applicable to Plant Biology.

STANDARDS	PAGE REFERENCES
f. * Students know the individual functions and sites of secretion of digestive enzymes (amylases, proteases, nucleases, lipases), stomach acid, and bile salts.	Not applicable to Plant Biology.
g. * Students know the homeostatic role of the kidneys in the removal of nitrogenous wastes and the role of the liver in blood detoxification and glucose balance.	Not applicable to Plant Biology.
h. * Students know the cellular and molecular basis of muscle contraction, including the roles of actin, myosin, Ca^{+2} , and ATP.	Not applicable to Plant Biology.
i. * Students know how hormones (including digestive, reproductive, osmoregulatory) provide internal feedback mechanisms for homeostasis at the cellular level and in whole organisms.	Not applicable to Plant Biology.
10. Organisms have a variety of mechanisms to combat disease. As a basis for under-standing the human immune response:	
a. Students know the role of the skin in providing nonspecific defenses against infection.	Not applicable to Plant Biology.
b. Students know the role of antibodies in the body's response to infection.	Not applicable to Plant Biology.
c. Students know how vaccination protects an individual from infectious diseases.	Not applicable to Plant Biology.
d. Students know there are important differences between bacteria and viruses with respect to their requirements for growth and replication, the body's primary defenses against bacterial and viral infections, and effective treatments of these infections.	The following references discuss bacteria and viruses. **Student Edition:** 292-294, 294-297, 297-303, 303-307, 307, 307-309, 309-314, 314 *Ecological Review* 314 *Overview* 293 *P.S.I.* 311-312

STANDARDS	PAGE REFERENCES
e. Students know why an individual with a compromised immune system (for example, a person with AIDS) may be unable to fight off and survive infections by microorganisms that are usually benign.	Not applicable to Plant Biology.
f. * Students know the roles of phagocytes, B-lymphocytes, and T-lymphocytes in the immune system.	Not applicable to Plant Biology.
Investigation & Experimentation	
1. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:	
a. Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.	**Student Edition:** *P.S.I.* 49-50, 146, 187, 229, 311, 470-471, 508 Also see the Laboratory Manual for *Introductory Plant Biology*
b. Identify and communicate sources of unavoidable experimental error.	**Student Edition:** See the Laboratory Manual for *Introductory Plant Biology.*
c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.	**Student Edition:** See the Laboratory Manual for *Introductory Plant Biology.*
d. Formulate explanations by using logic and evidence.	**Student Edition:** *P.S.I.* 49-50, 146, 187, 470-471, 508 Also see the Laboratory Manual for *Introductory Plant Biology.*
e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.	**Student Edition:** See the Laboratory Manual for *Introductory Plant Biology.*
f. Distinguish between hypothesis and theory as scientific terms.	**Student Edition:** 7-8
g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.	**Student Edition:** 267-268

STANDARDS	PAGE REFERENCES
h. Read and interpret topographic and geologic maps.	Not applicable to Plant Biology.
i. Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).	**Student Edition:** 268-269, 483-488, 488, 488-490, 490-491, 491, 491-495 *Ecological Review* 484 *P.S.I.* 494
j. Recognize the issues of statistical variability and the need for controlled tests.	**Student Edition:** 7 Also see the Laboratory Manual for *Introductory Plant Biology*
k. Recognize the cumulative nature of scientific evidence.	**Student Edition:** 267-268, 268-269, 269-270 *P.S.I.* 187, 508 Also see the Laboratory Manual for *Introductory Plant Biology*
l. Analyze situations and solve problems that require combining and applying concepts from more than one area of science.	**Student Edition:** See the Laboratory Manual for *Introductory Plant Biology*
m. Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.	**Student Edition:** 249-258, 488, 488-490, 490-491, 491, 491-495 *P.S.I.* 187, 494, 508
n. n. Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e.g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).	**Student Edition:** 267, 267-268, 268-269