



Health Science and Medical Technology Industry Sector

Career Pathways

- ◆ Biotechnology Research and Development
- ◆ Diagnostic Services
- ◆ Health Informatics
- ◆ Support Services
- ◆ Therapeutic Services



Health Science and Medical Technology Industry Sector

The standards in the Health Science and Medical Technology sector represent the academic and technical skills and knowledge students need to pursue a full range of career opportunities in this sector, from entry level to management, including technical and professional career specialties. The standards tell what workers need to know and be able to do to contribute to the delivery of safe and effective health care.

The career pathways are grouped into functions that have a common purpose and require similar attributes. The career pathways are Biotechnology Research and Development, Diagnostic Services, Health Informatics, Support Services, and Therapeutic Services. Standards for each career path build on and continue the foundation standards with more complexity, rigor, and career specificity.

FOUNDATION STANDARDS

1.0 Academics

Students understand the academic content required for entry into postsecondary education and employment in the Health Science and Medical Technology sector.

(The standards listed below retain in parentheses the numbering as specified in the mathematics, science, and history–social science content standards adopted by the State Board of Education.)

1.1 Mathematics

Specific applications of Measurement and Geometry standards (grade seven):

- (1.1) Compare weights, capacities, geometric measures, times, and temperatures within and between measurement systems (e.g., miles per hour and feet per second, cubic inches to cubic centimeters).
- (1.2) Construct and read drawings and models made to scale.
- (1.3) Use measures expressed as rates (e.g., speed, density) and measures expressed as products (e.g., person-days) to solve problems; check the units of the solutions; and use dimensional analysis to check the reasonableness of the answer.

Specific applications of Mathematical Reasoning standards (grade seven):

- (1.1) Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, identifying missing information, sequencing and prioritizing information, and observing patterns.
- (1.2) Formulate and justify mathematical conjectures based on a general description of the mathematical question or problem posed.
- (1.3) Determine when and how to break a problem into simpler parts.

1.2 Science

Specific applications of Focus on Life Sciences standards (grade seven):

- (1.a) Students know cells function similarly in all living organisms.
- (5.a) Students know plants and animals have levels of organization for structure and function, including cells, tissues, organs, organ systems, and the whole organism.
- (5.b) Students know organ systems function because of the contributions of individual organs, tissues, and cells. The failure of any part can affect the entire system.
- (5.c) Students know how bones and muscles work together to provide a structural framework for movement.
- (5.d) Students know how the reproductive organs of the human female and male generate eggs and sperm and how sexual activity may lead to fertilization and pregnancy.
- (5.e) Students know the function of the umbilicus and placenta during pregnancy.
- (5.g) Students know how to relate the structures of the eye and ear to their functions.

Specific applications of Biology/Life Sciences standards (grades nine through twelve):

- (1.a) Students know cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings.
- (1.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.
- (1.c) Students know how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.
- (1.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.
- (1.e) Students know the role of the endoplasmic reticulum and Golgi apparatus in the secretion of proteins.
- (1.f) Students know usable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide.
- (1.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.
- (1.h) Students know most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors.

- (1.i) Students know how chemiosmotic gradients in the mitochondria and chloroplast store energy for ATP production.
- (1.j) Students know how eukaryotic cells are given shape and internal organization by a cytoskeleton or cell wall or both.
- (2.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.
- (2.b) Students know only certain cells in a multicellular organism undergo meiosis.
- (2.c) Students know how random chromosome segregation explains the probability that a particular allele will be in a gamete.
- (2.d) Students know new combinations of alleles may be generated in a zygote through the fusion of male and female gametes (fertilization).
- (2.e) Students know why approximately half of an individual's DNA sequence comes from each parent.
- (2.f) Students know the role of chromosomes in determining an individual's sex.
- (2.g) Students know how to predict possible combinations of alleles in a zygote from the genetic makeup of the parents.
- (3.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).
- (3.b) Students know the genetic basis for Mendel's laws of segregation and independent assortment.
- (3.c) Students know how to predict the probable mode of inheritance from a pedigree diagram showing phenotypes.
- (3.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.
- (4.a) Students know the general pathway by which ribosomes synthesize proteins, using tRNAs to translate genetic information in mRNA.
- (4.b) Students know how to apply the genetic coding rules to predict the sequence of amino acids from a sequence of codons in RNA.
- (4.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.
- (4.d) Students know specialization of cells in multicellular organisms is usually due to different patterns of gene expression rather than to differences of the genes themselves.
- (4.e) Students know proteins can differ from one another in the number and sequence of amino acids.
- (4.f) Students know why proteins having different amino acid sequences typically have different shapes and chemical properties.
- (5.d) Students know how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, ligation, and transformation) is used to construct recombinant DNA molecules.

- (5.e) Students know how exogenous DNA can be inserted into bacterial cells to alter their genetic makeup and support expression of new protein products.
- (9.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.
- (9.b) Students know how the nervous system mediates communication between different parts of the body and the body's interactions with the environment.
- (9.c) Students know how feedback loops in the nervous and endocrine systems regulate conditions in the body.
- (9.d) Students know the functions of the nervous system and the role of neurons in transmitting electrochemical impulses.
- (9.e) Students know the roles of sensory neurons, interneurons, and motor neurons in sensation, thought, and response.
- (9.f) Students know the individual functions and sites of secretion of digestive enzymes (amylases, proteases, nucleases, lipases), stomach acid, and bile salts.
- (9.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.
- (9.h) Students know the cellular and molecular basis of muscle contraction, including the roles of actin, myosin, Ca^{+2} , and ATP.
- (9.i) Students know how hormones (including digestive, reproductive, osmoregulatory) provide internal feedback mechanisms for homeostasis at the cellular level and in whole organisms.
- (10.a) Students know the role of the skin in providing nonspecific defenses against infection.
- (10.b) Students know the role of antibodies in the body's response to infection.
- (10.c) Students know how vaccination protects an individual from infectious diseases.
- (10.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.
- (10.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.
- (10.f) Students know the roles of phagocytes, B-lymphocytes, and T-lymphocytes in the immune system.

1.3 *History–Social Science*

Specific applications of United States History and Geography: Continuity and Change in the Twentieth Century standards (grade eleven):

- (11.8) Students analyze the economic boom and social transformation of post-World War II America.
- (11.8.1) Trace the growth of service sector, white collar, and professional sector jobs in business and government.

- (11.8.7) Describe the effects on society and the economy of technological developments since 1945, including the computer revolution, changes in communication, advances in medicine, and improvements in agricultural technology.
- (11.8.8) Discuss forms of popular culture, with emphasis on their origins and geographic diffusion (e.g., jazz and other forms of popular music, professional sports, architectural and artistic styles).
- (11.11) Students analyze the major social problems and domestic policy issues in contemporary American society.
 - (11.11.3) Describe the changing roles of women in society as reflected in the entry of more women into the labor force and the changing family structure.
 - (11.11.6) Analyze the persistence of poverty and how different analyses of this issue influence welfare reform, health insurance reform, and other social policies.
 - (11.11.7) Explain how the federal, state, and local governments have responded to demographic and social changes such as population shifts to the suburbs, racial concentrations in the cities, Frostbelt-to-Sunbelt migration, international migration, decline of family farms, increases in out-of-wedlock births, and drug abuse.

2.0 Communications

Students understand the principles of effective oral, written, and multimedia communication in a variety of formats and contexts.

(The standards listed below retain in parentheses the numbering as specified in the English–language arts content standards adopted by the State Board of Education.)

2.1 Reading

Specific applications of Reading Comprehension standards (grades nine and ten):

- (1.1) Identify and use the literal and figurative meanings of words and understand word derivations.
- (1.2) Distinguish between the denotative and connotative meanings of words and interpret the connotative power of words.
- (1.3) Identify Greek, Roman, and Norse mythology and use the knowledge to understand the origin and meaning of new words (e.g., the word *narcissistic* drawn from the myth of Narcissus and Echo).
- (2.1) Analyze the structure and format of functional workplace documents, including the graphics and headers, and explain how authors use the features to achieve their purposes.
- (2.2) Prepare a bibliography of reference materials for a report using a variety of consumer, workplace, and public documents.
- (2.3) Generate relevant questions about readings on issues that can be researched.
- (2.7) Critique the logic of functional documents by examining the sequence of information and procedures in anticipation of possible reader misunderstandings.

Specific applications of Reading standards (grades eleven and twelve):

- (1.2) Apply knowledge of Greek, Latin, and Anglo-Saxon roots and affixes to draw inferences concerning the meaning of scientific and mathematical terminology.
- (2.3) Verify and clarify facts presented in other types of expository texts by using a variety of consumer, workplace, and public documents.

2.2 Writing

Specific applications of Writing Strategies and Applications standards (grades nine and ten):

- (1.5) Synthesize information from multiple sources and identify complexities and discrepancies in the information and the different perspectives found in each medium (e.g., almanacs, microfiche, news sources, in-depth field studies, speeches, journals, technical documents).
- (2.3) Write expository compositions, including analytical essays and research reports:
 - a. Marshal evidence in support of a thesis and related claims, including information on all relevant perspectives.
 - b. Convey information and ideas from primary and secondary sources accurately and coherently.
 - c. Make distinctions between the relative value and significance of specific data, facts, and ideas.
 - d. Include visual aids by employing appropriate technology to organize and record information on charts, maps, and graphs.
 - e. Anticipate and address readers' potential misunderstandings, biases, and expectations.
 - f. Use technical terms and notations accurately.
- (2.5) Write business letters:
 - a. Provide clear and purposeful information and address the intended audience appropriately.
 - b. Use appropriate vocabulary, tone, and style to take into account the nature of the relationship with, and the knowledge and interests of, the recipients.
 - c. Highlight central ideas or images.
 - d. Follow a conventional style with page formats, fonts, and spacing that contribute to the documents' readability and impact.
- (2.6) Write technical documents (e.g., a manual on rules of behavior for conflict resolution, procedures for conducting a meeting, minutes of a meeting):
 - a. Report information and convey ideas logically and correctly.
 - b. Offer detailed and accurate specifications.
 - c. Include scenarios, definitions, and examples to aid comprehension (e.g., troubleshooting guide).
 - d. Anticipate readers' problems, mistakes, and misunderstandings.

Specific applications of Writing Strategies and Applications standards (grades eleven and twelve):

- (1.5) Use language in natural, fresh, and vivid ways to establish a specific tone.
- (1.6) Develop presentations by using clear research questions and creative and critical research strategies (e.g., field studies, oral histories, interviews, experiments, electronic sources).
- (1.7) Use systematic strategies to organize and record information (e.g., anecdotal scripting, annotated bibliographies).
- (1.8) Integrate databases, graphics, and spreadsheets into word-processed documents.
- (2.3) Write reflective compositions:
 - a. Explore the significance of personal experiences, events, conditions, or concerns by using rhetorical strategies (e.g., narration, description, exposition, persuasion).
 - b. Draw comparisons between specific incidents and broader themes that illustrate the writer's important beliefs or generalizations about life.
 - c. Maintain a balance in describing individual incidents and relate those incidents to more general and abstract ideas.
- (2.4) Write historical investigation reports:
 - a. Use exposition, narration, description, argumentation, exposition, or some combination of rhetorical strategies to support the main proposition.
 - b. Analyze several historical records of a single event, examining critical relationships between elements of the research topic.
 - c. Explain the perceived reason or reasons for the similarities and differences in historical records with information derived from primary and secondary sources to support or enhance the presentation.
 - d. Include information from all relevant perspectives and take into consideration the validity and reliability of sources.
 - e. Include a formal bibliography.
- (2.5) Write job applications and résumés:
 - a. Provide clear and purposeful information and address the intended audience appropriately.
 - b. Use varied levels, patterns, and types of language to achieve intended effects and aid comprehension.
 - c. Modify the tone to fit the purpose and audience.
 - d. Follow the conventional style for that type of document (e.g., résumé, memorandum) and use page formats, fonts, and spacing that contribute to the readability and impact of the document.
- (2.6) Deliver multimedia presentations:
 - a. Combine text, images, and sound and draw information from many sources (e.g., television broadcasts, videos, films, newspapers, magazines, CD-ROMs, the Internet, electronic media-generated images).
 - b. Select an appropriate medium for each element of the presentation.

- c. Use the selected media skillfully, editing appropriately and monitoring for quality.
- d. Test the audience's response and revise the presentation accordingly.

2.3 *Written and Oral English Language Conventions*

Specific applications of English Language Conventions standards (grades nine and ten):

- (1.1) Identify and correctly use clauses (e.g., main and subordinate), phrases (e.g., gerund, infinitive, and participial), and mechanics of punctuation (e.g., semicolons, colons, ellipses, hyphens).
- (1.2) Understand sentence construction (e.g., parallel structure, subordination, proper placement of modifiers) and proper English usage (e.g., consistency of verb tenses).
- (1.3) Demonstrate an understanding of proper English usage and control of grammar, paragraph and sentence structure, diction, and syntax.
- (1.4) Produce legible work that shows accurate spelling and correct use of the conventions of punctuation and capitalization.
- (1.5) Reflect appropriate manuscript requirements, including title page presentation, pagination, spacing and margins, and integration of source and support material (e.g., in-text citation, use of direct quotations, paraphrasing) with appropriate citations.

Specific applications of English Language Conventions standards (grades eleven and twelve):

- (1.1) Demonstrate control of grammar, diction, and paragraph and sentence structure and an understanding of English usage.
- (1.2) Produce legible work that shows accurate spelling and correct punctuation and capitalization.

2.4 *Listening and Speaking*

Specific applications of Speaking Applications standards (grades nine and ten):

- (2.1) Deliver narrative presentations:
 - a. Narrate a sequence of events and communicate their significance to the audience.
 - b. Locate scenes and incidents in specific places.
 - c. Describe with concrete sensory details the sights, sounds, and smells of a scene and the specific actions, movements, gestures, and feelings of characters.
 - d. Pace the presentation of actions to accommodate time or mood changes.
- (2.2) Deliver expository presentations:
 - a. Marshal evidence in support of a thesis and related claims, including information on all relevant perspectives.
 - b. Convey information and ideas from primary and secondary sources accurately and coherently.

- c. Make distinctions between the relative value and significance of specific data, facts, and ideas.
 - d. Include visual aids by employing appropriate technology to organize and display information on charts, maps, and graphs.
 - e. Anticipate and address the listener's potential misunderstandings, biases, and expectations.
 - f. Use technical terms and notations accurately.
- (2.3) Apply appropriate interviewing techniques:
- a. Prepare and ask relevant questions.
 - b. Make notes of responses.
 - c. Use language that conveys maturity, sensitivity, and respect.
 - d. Respond correctly and effectively to questions.
 - e. Demonstrate knowledge of the subject or organization.
 - f. Compile and report responses.
 - g. Evaluate the effectiveness of the interview.
- (2.5) Deliver persuasive arguments (including evaluation and analysis of problems and solutions and causes and effects):
- a. Structure ideas and arguments in a coherent, logical fashion.
 - b. Use rhetorical devices to support assertions (e.g., by appeal to logic through reasoning; by appeal to emotion or ethical belief; by use of personal anecdote, case study, or analogy).
 - c. Clarify and defend positions with precise and relevant evidence, including facts, expert opinions, quotations, expressions of commonly accepted beliefs, and logical reasoning.
 - d. Anticipate and address the listener's concerns and counterarguments.

Specific applications of Speaking Applications standards (grades eleven and twelve):

- (2.4) Deliver multimedia presentations:
- a. Combine text, images, and sound by incorporating information from a wide range of media, including films, newspapers, magazines, CD-ROMs, online information, television, videos, and electronic media-generated images.
 - b. Select an appropriate medium for each element of the presentation.
 - c. Use the selected media skillfully, editing appropriately and monitoring for quality.
 - d. Test the audience's response and revise the presentation accordingly.

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- 2.5 Know and understand medical terminology to interpret, transcribe, and communicate information and observations necessary for workers in the health care industry.
 - 2.6 Know and understand the use of organizational channels and networks as a necessary means of communications.
 - 2.7 Understand the importance of verbal and nonverbal communication in the health care industry.

3.0 Career Planning and Management

Students understand how to make effective decisions, use career information, and manage personal career plans:

- 3.1 Know the personal qualifications, interests, aptitudes, knowledge, and skills necessary to succeed in careers.
- 3.2 Understand the scope of career opportunities and know the requirements for education, training, and licensure.
- 3.3 Develop a career plan that is designed to reflect career interests, pathways, and postsecondary options.
- 3.4 Understand the role and function of professional organizations, industry associations, and organized labor in a productive society.
- 3.5 Understand the past, present, and future trends that affect careers, such as technological developments and societal trends, and the resulting need for lifelong learning.
- 3.6 Know important strategies for self-promotion in the hiring process, such as job applications, résumé writing, interviewing skills, and preparation of a portfolio.

4.0 Technology

Students know how to use contemporary and emerging technological resources in diverse and changing personal, community, and workplace environments:

- 4.1 Understand past, present, and future technological advances as they relate to a chosen pathway.
- 4.2 Understand the use of technological resources to gain access to, manipulate, and produce information, products, and services.
- 4.3 Understand the influence of current and emerging technology on selected segments of the economy.
- 4.4 Understand the impact of enhanced technology, bioethics, epidemiology, and socioeconomics on the health care delivery system.
- 4.5 Know how to interpret technical materials and medical instrumentation used for health care practices and policies.

5.0 Problem Solving and Critical Thinking

Students understand how to create alternative solutions by using critical and creative thinking skills, such as logical reasoning, analytical thinking, and problem-solving techniques:

- 5.1 Understand the systematic problem-solving models that incorporate input, process, outcome, and feedback components.
- 5.2 Use critical thinking skills to make informed decisions and solve problems.
- 5.3 Examine multiple options for completing work tasks by applying appropriate problem-solving strategies and critical thinking skills to work-related issues.

6.0 Health and Safety

Students understand health and safety policies, procedures, regulations, and practices, including the use of equipment and handling of hazardous materials:

- 6.1 Know the policies, procedures, and regulations regarding health and safety in the workplace, including employers' and employees' responsibilities.
- 6.2 Understand critical elements for health and safety practices related to storing, cleaning, and maintaining tools, equipment, and supplies.
- 6.3 Understand the importance and use of standard precautions and infection control, as appropriate.
- 6.4 Understand the principles of body mechanics and ergonomics in providing patient care.
- 6.5 Understand the rules and regulations of the Occupational Safety and Health Administration and the Centers for Disease Control and Prevention.

7.0 Responsibility and Flexibility

Students know the behaviors associated with the demonstration of responsibility and flexibility in personal, workplace, and community settings:

- 7.1 Understand the qualities and behaviors that constitute a positive and professional work demeanor.
- 7.2 Understand the importance of accountability and responsibility in fulfilling personal, community, and workplace roles.
- 7.3 Understand the need to adapt to varied roles and responsibilities.
- 7.4 Understand that individual actions can affect the larger community.
- 7.5 Know how to interact appropriately and respectfully in various employment situations that involve persons from diverse ethnic, generational, cultural, religious, and economic groups and persons of different genders and sexual orientation.
- 7.6 Know and appreciate cultural differences and provide culturally competent care to patients and clients.
- 7.7 Understand and demonstrate methods for promoting health and wellness.

8.0 Ethics and Legal Responsibilities

Students understand professional, ethical, and legal behavior consistent with applicable laws, regulations, and organizational norms:

- 8.1 Know the major local, district, state, and federal regulatory agencies and entities that affect the industry and how they enforce laws and regulations.
- 8.2 Understand the concept and application of ethical and legal behavior consistent with workplace standards.
- 8.3 Understand the role of personal integrity and ethical behavior in the workplace.
- 8.4 Understand the ways in which ethical considerations affect emerging technologies and their impact on society.

- 8.5 Understand and maintain the Patients' Bill of Rights, patients' and clients' confidentiality, and the Health Insurance Portability and Accountability Act of 1996.

9.0 Leadership and Teamwork

Students understand effective leadership styles, key concepts of group dynamics, team and individual decision making, the benefits of workforce diversity, and conflict resolution:

- 9.1 Understand the characteristics and benefits of teamwork, leadership, and citizenship in the school, community, and workplace settings.
- 9.2 Understand the ways in which preprofessional associations, such as the Health Occupations Students of America, and competitive career development activities enhance academic skills, promote career choices, and contribute to employability.
- 9.3 Understand how to organize and structure work individually and in teams for effective performance and the attainment of goals.
- 9.4 Know multiple approaches to conflict resolution and their appropriateness for a variety of situations in the workplace.
- 9.5 Understand how to interact with others in ways that demonstrate respect for individual and cultural differences and for the attitudes and feelings of others.

10.0 Technical Knowledge and Skills

Students understand the essential knowledge and skills common to all pathways in the Health Science and Medical Technology sector:

- 10.1 Understand the process for determining mission statements, goals, objectives, and strategic plans for a health care organization and understand the process for using appropriate policies, procedures, and processes as defined by the scope of practice of a specific health care organization.
- 10.2 Understand how the health care delivery systems models can be affected by cost, managed care, technology, an aging population, access to care, alternative therapies, and lifestyle and behavior changes.
- 10.3 Understand the purpose and function of a systems-theory approach, both in the health care organization and in the treatment of patients and clients, as a process for viewing a system as a whole before examining its parts.
- 10.4 Understand the interconnected components of a health care system.
- 10.5 Understand the nature of the interdependency of health care professionals within a given health care delivery system.
- 10.6 Know cardiopulmonary resuscitation and first-aid practices.
- 10.7 Understand the processes used to evaluate alternative health practices.

11.0 Demonstration and Application

Students demonstrate and apply the concepts contained in the foundation and pathway standards.

PATHWAY STANDARDS

A. Biotechnology Research and Development Pathway

The standards for the Biotechnology Research and Development Pathway apply to occupations and functions in biotechnology research and development that apply primarily to human health. The standards specify the knowledge and skills common to occupations in this pathway.

A1.0 Students know the role of the biotechnology industry and biotechnology product development in curing diseases:

- A1.1 Understand the role of the biotechnology industry and its impact on society.
 - A1.2 Understand the role of biotechnology product development in curing genetic, environmental, and behavioral diseases.
 - A1.3 Understand the legal and ethical issues regarding the use of biotechnology to cure diseases.
 - A1.4 Understand the relationship between biochemistry and biotechnology product development.
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A2.0 Students know the fundamentals of mathematical and scientific concepts related to biotechnology:

- A2.1 Understand basic mathematical concepts related to the field, such as the calculation of percentages and ratios and the difference between standard deviation and various measures of central tendency.
 - A2.2 Understand the basic structure of a chromosome and the difference between a dominant homozygous trait and a heterozygous trait.
 - A2.3 Know the basic structures and functions of cells and how this knowledge is used in biotechnology.
 - A2.4 Understand the central theory of molecular biology.
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A3.0 Students understand the role of recombinant DNA and genetic engineering, bioprocessing, monoclonal antibody production, separation and purification of biotechnology products, nanotechnology, bioinformatics, genomics, proteomics, and transcriptomics in biotechnical product development:

- A3.1 Understand recombinant DNA, genetic engineering, monoclonal antibody production, separation and purification of biotechnology products, and bioprocessing.
- A3.2 Understand how the fields of nanotechnology, bioinformatics, genomics, proteomics, and transcriptomics influence new and emerging career opportunities.

A4.0 Students understand the principles of solution preparation, contamination control, measurement and calibration, and emergency laboratory response:

- A4.1 Understand how molarity relates to solution preparation.
- A4.2 Know how to calculate the molarity of a given solution and how to measure the pH of that solution.
- A4.3 Know how to prepare a serial dilution of a microbial culture.
- A4.4 Understand the importance and requirements of using sterile techniques in a laboratory.
- A4.5 Understand the appropriate responses to a laboratory accident.

A5.0 Students understand biotechnology product design and development, laboratory procedures, product licensure, and the regulatory process for product development and clinical trials:

- A5.1 Understand the process of developing biotechnology products in an industrial setting.
- A5.2 Understand the role of preclinical and clinical trials in biotechnology product development.
- A5.3 Know the role of quality assurance in clinical trials.

A6.0 Students understand the ethical, moral, legal, and cultural issues related to the use of biotechnology research and product development:

- A6.1 Understand the relationship between morality and ethics in the development of biotechnology health care products.
- A6.2 Know the differences between personal, professional, and organizational ethics.
- A6.3 Understand the necessity for accurate documentation and recordkeeping in biotechnology research and product development.
- A6.4 Understand the need for ethical policies and procedures in institutions engaged in biotechnology research and product development.