



**SANTA CLARA COUNTY OFFICE OF EDUCATION  
SANTA CLARA COUNTY REGIONAL OCCUPATIONAL PROGRAM  
Serving Santa Clara and San Benito Counties**



**1. COURSE TITLE – CAREER TECHNICAL EDUCATION PATHWAY/SECTOR**

Biotechnology – Biotechnology Research and Development/Health Science and Medical Technology

**2. CBEDS TITLE**

Biotechnology Services

**3. CBEDS NUMBER**

4288

**4. JOB TITLES**

O*NET	TITLE
19-4021.00	Biotech Technician/Biotech Research Asst.
19-4092.00	Forensic Lab Technician
29-2012.00	Laboratory Technician
19-1021.00	Biochemists and Biophysicists/Researcher

**5. COURSE DESCRIPTION**

This course prepares students for careers involving laboratory sciences and the biotechnology industry (Health Services Cluster). Students learn procedures and laboratory skills, which will make them effective lab technicians, Topics covered include DNA manipulation and micropipetting, proper washing and sterilizing procedures, plating and culturing techniques. Sound laboratory instruction and safety will be stressed. Students will learn to read protocols and do technical writing, use resources and work in team-based learning. Background material regarding DNA methods and usefulness, science and societal issues will be considered, and each student will produce a portfolio. Career paths and opportunities for further education will be explored through associations with industry mentors and field trips to local lab sites.

**6. HOURS**

Classroom Theory/Applied	270
Community Classroom/Coop Voc Ed	90
<b>TOTAL HOURS</b>	<b>360</b>

**7. RECOMMENDED PREREQUISITE**

<b>Required</b>	Must be 16 years of age or older, a junior or senior in high school, an out-of-school youth, or an adult.
<b>Recommended</b>	Completion of: Algebra, Biology and Chemistry

**8. DATE REVISED August 31, 2007  
UPDATED**



<b>B. Career Technical Skills</b>								
<b>Class Hours</b>	<b>CC/CVE Hours</b>	<b>CONTENT AREA SKILLS</b>			<b>Foundation Standards</b>	<b>Mention - M Reinforced - R Taught - T</b>	<b>CTE Pathway Standards</b>	<b>Mention - M Reinforced - R Taught - T</b>
10	0	<b>I. Orientation to Biotechnology</b>			* See attached pages that follow			
			A. Listen to a historical overview of Biotechnology	4.0:4.1-4.4	M	A1.0	T	
			B. Discuss emerging technologies		R	A5.0	R	
			C. Generalize about careers in the industry			A6.0		
			1. Future employment areas and opportunities	3.0:3.1-3.6	T			
			2. Real-life work scenarios		M			
			D. Biotechnology Career Investigation and Preparation		R			
20	0	<b>II. Biotechnology and Human Body</b>						
			A. Review the body structure and its functions	Life Science	M	A1.2	T	
			B. Talk about diseases and disorders	1.2:1.a,	R	A1.3	R	
			C. Learn and apply relevant medical terminology	5.a-d				
10	5	<b>III. Safety</b>						
			A. Learn and practice safety rules and procedures	6.0: 6.1-3	T	A4.5	T	
			1. Emergency guidelines		R		R	
			B. Learn and use general laboratory terms					
			C. Identify equipment					

Career Technical Skills						
Class Hours	CC/CVE Hours	CONTENT AREA SKILLS	Foundation Standards	Mention - M Reinforced - R Taught - T	CTE Pathway Standards	Mention - M Reinforced - R Taught - T
10	15	<b>IV. The Laboratory</b>				
		<ul style="list-style-type: none"> <li>A. Become familiar with the laboratory design</li> <li>B. Review Scientific Method and Experimental Design</li> <li>C. Learn selected research techniques               <ul style="list-style-type: none"> <li>1. Practice selected research techniques safely</li> <li>2. Use the computer as an aid</li> </ul> </li> <li>D. Demonstrate proper care of chemicals and equipment               <ul style="list-style-type: none"> <li>1. Learn appropriate labeling and storage of chemicals</li> <li>2. Learn safe care of equipment used                   <ul style="list-style-type: none"> <li>▪ Water baths</li> <li>▪ Incubators</li> <li>▪ Microfuges</li> <li>▪ Electronic balances</li> <li>▪ Micropipettes</li> </ul> </li> <li>3. Aseptic conditions</li> <li>4. Learn and practice sterile technique</li> </ul> </li> <li>E. Learn about selection of an appropriate model organism               <ul style="list-style-type: none"> <li>1. Identify advantages and limitations of experimentation with model organisms</li> <li>2. Safe culturing, handling, use, and disposal of selected model organisms</li> </ul> </li> </ul>	5.0: 5.1-5.3 9.0: 9.1, 9.3-9.5  6.0: 6.1-6.3  8.0: 8.2-8.4  Life Science 1.2: 1.c	T R	A4.0	T R
5	5	<b>V. Measurement</b>				
		<ul style="list-style-type: none"> <li>A. Mass               <ul style="list-style-type: none"> <li>1. Operate an electronic balance correctly</li> <li>2. Calculate net weight with a tare</li> </ul> </li> <li>B. Volume               <ul style="list-style-type: none"> <li>1. Measure using a micropipette</li> </ul> </li> <li>C. Estimate and measure length</li> <li>D. Measure density</li> <li>E. Use a spectrophotometer               <ul style="list-style-type: none"> <li>1. Measure wavelength transmittance</li> <li>2. Read results</li> </ul> </li> </ul>	M1.1	T R	A2.1	T R

Career Technical Skills						
Class Hours	CC/CVE Hours	CONTENT AREA SKILLS	Foundation Standards	Mention - M Reinforced - R Taught - T	CTE Pathway Standards	Mention - M Reinforced - R Taught - T
15	0	<b>VI. Chemistry</b>				
		<p>A. B. Periodic table</p> <ol style="list-style-type: none"> <li>1. Explain how it is used as scientific tool</li> <li>2. Use periodic table data as reference for reagent preparation.</li> </ol> <p>C. Apply the concepts of</p> <ol style="list-style-type: none"> <li>1. Molarity</li> <li>2. Normality</li> <li>3. Percent composition</li> </ol> <p>D. Understand concentration conversions</p> <ol style="list-style-type: none"> <li>1. Learn math calculations necessary for buffer preparation</li> <li>2. Practice calculations for buffer preparation</li> <li>3. Verify buffer formulation</li> </ol> <p>E. Understand preparation of selected solutions and media</p> <p>F. Identify appropriate buffer and gel combinations</p>	<p>M1.1</p> <p>Chemistry: Periodic Table (1a-d)</p> <p>Chemistry: Acids/Bases (5d)</p> <p>Chemistry: Solutions (6a, 6d)</p> <p>Chemistry: Organic (10a,c)</p>	R	A4.0	T R

<b>Career Technical Skills</b>						
Class Hours	CC/CVE Hours	CONTENT AREA SKILLS	Foundation Standards	Mention - M Reinforced - R Taught - T	CTE Pathway Standards	Mention - M Reinforced - R Taught - T
15	20	<b>VII. Techniques using Glassware, Plastics and Metal Equipment</b>				
		<ul style="list-style-type: none"> <li>A. Use materials produced by basic scientific glassblowing techniques                             <ul style="list-style-type: none"> <li>1. Fire polishing</li> <li>2. Glass tube bending</li> </ul> </li> <li>B. Learn sterile technique for handling sterilized glass and plastic ware                             <ul style="list-style-type: none"> <li>1. Petri dishes</li> <li>2. Bacteriology loops</li> </ul> </li> <li>C. Learn safe use of Bunsen burner or bacti-incinerator for sterilizing bacteriology loops</li> <li>D. Learn safe use of an Autoclave for sterilization                             <ul style="list-style-type: none"> <li>1. Glassware, plastics and metal items</li> <li>2. Bacteriology loops</li> <li>3. Media and solutions</li> </ul> </li> <li>E. Practice proper glassware and equipment washing techniques</li> </ul>			A4.0	T R
20	15	<b>VIII. Bacteriological Lab Methods</b>				
		<ul style="list-style-type: none"> <li>A. Culture selected of model organisms successfully</li> <li>B. Differentiate and use various types of media</li> <li>C. Demonstrate proper preparation of media</li> <li>D. Demonstrate                             <ul style="list-style-type: none"> <li>1. Pouring plates</li> <li>2. Inoculating and culturing techniques</li> </ul> </li> <li>E. Operate a microscope                             <ul style="list-style-type: none"> <li>1. Practice slide preparation</li> <li>2. Use selected stains</li> </ul> </li> </ul>			A2. 3,4 A3.0 A4.0 A5.0	T R

Career Technical Skills						
Class Hours	CC/CVE Hours	CONTENT AREA SKILLS	Foundation Standards	Mention - M Reinforced – R Taught – T	CTE Pathway Standards	Mention - M Reinforced – R Taught – T
22	30	<b>IX. Biotechnology</b>				
		<p>A. Discuss a historical overview of ancient and modern biotechnology</p> <p>B. Explore the advancements of Biotechnology in major areas of industry</p> <ol style="list-style-type: none"> <li>1. Medical</li> <li>2. Agricultural and mining uses</li> <li>3. Environmental</li> <li>4. Pharmaceutical</li> <li>5. Medical devices</li> </ol> <p>C. Review background information</p> <ol style="list-style-type: none"> <li>1. DNA, RNA, and proteins</li> </ol> <p>D. Discuss and debate ELSI topics related to biotechnology (Ethical, Legal, Social Issues)</p> <ol style="list-style-type: none"> <li>1. Examples include:                             <ul style="list-style-type: none"> <li>▪ Principles of genetic engineering</li> <li>▪ Plasmids</li> <li>▪ Cloning</li> </ul> </li> </ol> <p>E. Demonstrate frequently used laboratory procedures in biotechnology</p> <ol style="list-style-type: none"> <li>1. Basic bacteriology techniques</li> <li>2. Solution Preparation and use</li> <li>3. Introduction to DNA extraction and analysis</li> <li>4. Use of micro measurement tools (micropipettes)</li> <li>5. Safe use of gel electrophoresis equipment for DNA analysis (horizontal and vertical gels)</li> <li>6. DNA restriction analysis</li> <li>7. Learn preparation and procedures for PCR (copying DNA)</li> <li>8. Perform PCR from selected protocols</li> <li>9. Bacterial Transformation with competent cells</li> <li>10. Protein Separation and Purification</li> <li>11. Use of chromatography to separate</li> <li>12. Use of spectrophotometer</li> <li>13. Determination of pH using various methods</li> <li>14. Basic immunology principles and techniques</li> <li>15. Computer use as needed for data collection and analysis</li> </ol>	<p>S 9-12 1.2 1.a-h; 1.j, 2a-g; 3a-c; 4a-f, 5d,e; 9a-l; 10a-f</p> <p>MG1.1</p> <p>C2.0(2.1 :2.1, 2.7) (2.2: 2.6) (2.3: 1.1,2) (2.4: 2.4)</p> <p>H1.3:11.8.7 &amp; 11.11</p> <p>5.0: 5.1-5.3</p> <p>8.0:8.2-8.2</p>	<p>M R</p> <p>T R</p> <p>M R</p> <p>T R</p>	<p>A1.0 A6.0</p>	<p>T R</p>

Career Technical Skills						
Class Hours	CC/CVE Hours	CONTENT AREA SKILLS	Foundation Standards	Mention - M Reinforced - R Taught - T	CTE Pathway Standards	Mention - M Reinforced - R Taught - T
80	0	<b>X. Individual Student Projects and Research (Lab)</b>				
		A. Define and discuss importance of professional bioethics, honesty and integrity <ol style="list-style-type: none"> <li>1. Learn to develop classroom behavior embodying professional bioethics, honesty, and integrity.</li> <li>2. Contribute to a productive professional classroom environment through appropriate collegial and independent work</li> </ol> B. Maintain a laboratory notebook <ol style="list-style-type: none"> <li>1. In accordance with legal guidelines</li> <li>2. Using clear, neat technical writing techniques</li> <li>3. Use notebook for reference and communication purposes</li> </ol> C. Record experimental results in lab notebook regularly <ol style="list-style-type: none"> <li>1. Raw data and observations</li> <li>2. Organize data into tables, charts and graphs</li> <li>3. Data analysis</li> <li>4. Error analysis</li> <li>5. Determination of next steps</li> </ol> D. Research as needed for interdisciplinary ELSI discussions or other projects <ol style="list-style-type: none"> <li>1. Identify a topic</li> <li>2. Perform adequate background research</li> <li>3. Cite sources appropriately</li> <li>4. Communicate Information to peers</li> </ol>	C2.0 (2.2: 2.6, 1.6-8) (2.6)  7.0: 7.1- 7.7  8.0: 8.2- 8.2  9.0:9.1, 9.3-4	T R	A1.0 A6.0	T R
<b>270</b>	<b>90</b>	<b>Total Hours</b>				

## C. Expected Student Proficiencies

### ATTITUDE AND WORK HABITS

- Works both independently and collaboratively
- Attends regularly and on time
- Practices good safety procedures
- Solves problems, thinks critically and makes good decisions
- Plans work and takes initiative
- Demonstrates leadership and the willingness to help train others

### THE LABORATORY

- General laboratory terms, safety rules and procedures
- The laboratory design and research techniques
- Care of chemicals and equipment and model organisms

### MEASUREMENT

- Mass, volume, length, density, and wavelength transmittance
- Using electronic balance, tare, micropipettes, spectrophotometer

### CHEMISTRY

- Periodic table
- Molarity, Normality, and percentage composition
- Determination of solution concentration

### TECHNIQUES USING BASIC SCIENTIFIC EQUIPMENT

- Basic scientific equipment: glassware, plastics and metal
- Bunsen burner use
- Bacteriology loops and Autoclaving

### BACTERIOLOGICAL LAB METHODS

- Identify and prepare different types of media for model organisms
- Bacterial and other cultures and conditions for growth
- Pouring plates, inoculating and culturing methods
- Operate a microscope using safe techniques, slides, and stains

### BIOTECHNOLOGY

- Principles of genetic engineering, plasmids, and cloning
- Biotechnology in medicine, agriculture, environment, medical devices, and pharmaceuticals
- Investigation and analysis of DNA and proteins
- Introductory immunology

### INDIVIDUAL AND GROUP PROJECTS AND RESEARCH (LAB)

- Implement laboratory experiment using selected protocols
- Perform error analysis and interpret results
- Record and organize data for personal reference and communication to others
- Determine next steps for research
- Perform background research and record findings
- Report results use technical writing techniques



11. FOUNDATION (ACADEMIC) STANDARDS ALIGNED	* CAHSEE Test Item
<b>1.0 Academics</b>	
Students understand the academic content required for entry into postsecondary education and employment in the Engineering and Design sector. <i>(The standards listed below retain in parentheses the numbering as specified in the mathematics, science, history–social science, and visual and performing arts content standards adopted by the State Board of Education.)</i>	
<b>Math</b>	
*	(1.1) Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, identifying missing information, sequencing and prioritizing information, and observing patterns.
*	(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.
<b>Science</b>	
<p>(1.a) Students know cells are enclosed within semi permeable 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.</p> <p>(1.h) Students know most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors.</p> <p>(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.</p> <p>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.</p> <p>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.</p> <p>(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.</p>	
<b>History/Social Science</b>	
<p>(11.8.1) Trace the growth of service sector, white collar, and professional sector jobs in business and government.</p> <p>(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.</p>	

**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.)*

**Reading**

- (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.
- (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.

**Writing**

- \* 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.
- (2.6) 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.
- (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.
- (2.5) 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.

**Written & Oral English Language Conventions**

- \* (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.

**Listening & Speaking**

- (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.

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.

## **2.5 Multimedia**

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.

(2.4) 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.

## **3.0 CAREER PLANNING & 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 & 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 & 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 & 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 & LEGAL RESPONSIBILITY**

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

**9.0 LEADERSHIP & 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 & SKILLS**

- 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 & APPLICATION**

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

## 12. 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.

*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.

*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.

## LEGEND FOR REFERENCE OF ACADEMIC STANDARDS

Parenthetical notation preceding the content standard item refers to the grade level for the standard. i.e. (8) refers to grade 8, (9-10) refers to grades 9 & 10.

Example: (8) W2.1 refers to the Eighth Grade Writing Standard Item 2.1

### English-Language Arts:

R Reading  
W Writing  
WOC Written & Oral Conventions  
LS Listening & Speaking

CRP: Connections, Relationships,  
Proficient

CRA: Connections, Relationships,  
Advanced

### Mathematics:

NS Number Sense  
AF Algebra & Functions  
SDP Statistics, Data Analysis & Probability  
MR Mathematical Reasoning  
MG Measurement & Geometry  
AI Algebra I  
G Geometry  
AII Algebra II  
P&S Probability & Statistics  
APP&S Advanced Placement Probability &  
Statistics  
C Calculus

### ELA: English-Language Arts with in VPA

ELA- LRA: Literary Response and Analysis

ELA-WSA: Writing Strategies &  
Applications

ELA-WOELC: Written & Oral English  
Language Conventions

### Sectors

AME Arts, Media and Entertainment  
BTC Building Trades and Construction  
ECDFS Education, Child Development &  
Family Services  
EU Energy & Utilities  
ED Engineering & Design  
FID Fashion and Interior Design  
FAB Finance and Business  
HSMT Health Science & Medical Technology  
HTR Hospitality, Tourism & Recreation  
IT Information Technology  
MPD Manufacturing and Product  
Development  
MSS Marketing, Sales, & Services  
PS Public Services  
T Transportation

### Science:

PH Physics  
CH Chemistry  
ES Earth Science  
I&E Investigation and Experimentation

### History-Social Science:

WH World History, Culture and Geography  
USH United States History and Geography  
AD American Democracy  
ECON Economics

### Visual and Performing Arts:

APP: Artistic Perception Proficient Level  
APA: Artistic Perception Advanced  
CEP: Creative Expression Proficient  
CEA: Creative Expression Advanced  
HCCP: Historical & Cultural Proficient  
HCCA: Historical & Cultural Advanced  
AVP: Aesthetic Valuing Proficient  
AVA: Aesthetic Valuing Advanced