



## Health Science Career Cluster Biotechnology Research and Development Pathway Knowledge and Skill Statements

The Pathway Knowledge and Skills Chart describes what all/most learners/workers need to know and be able to do to demonstrate competence within a career pathway. Following the pathway description, there are four sets of knowledge and skill expectations:

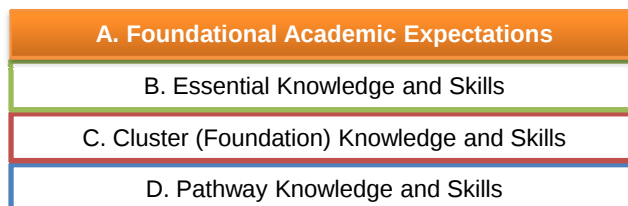


### PATHWAY DESCRIPTION

*Biotechnology Research and Development Pathway:* Careers in the Biotechnology Research and Development pathway involve bioscience research and development as it applies to human health. These scientists may study diseases to discover new treatments or invent medical devices used to directly assist patients or to improve the accuracy of diagnostic tests.

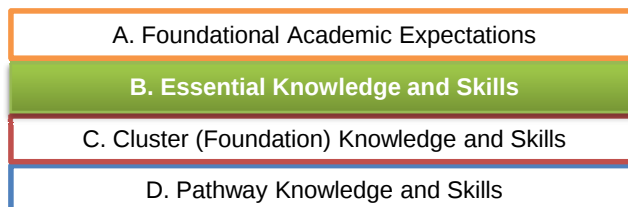
### A. FOUNDATIONAL ACADEMIC EXPECTATIONS

All secondary students should meet their state's academic standards. All Essential Cluster and Pathway Knowledge and Skills are predicated on the assumption that foundational academic skills have been attained. Some knowledge and skill statements will further define critical linkages and applications of academics in the cluster and/or pathway.



### B. ESSENTIAL KNOWLEDGE AND SKILLS

The following Essential Knowledge and Skill statements apply to careers in all clusters and pathways. Persons preparing for careers in this pathway should be able to demonstrate these skills in the context of this cluster and pathway.



#### Essential Topic ESS01

**ACADEMIC FOUNDATIONS:** *Achieve additional academic knowledge and skills required to pursue the full range of career and postsecondary education opportunities within a career cluster.*

#### ESS01.01

**Complete required training, education, and certification to prepare for employment in a particular career field.**



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- ESS01.01.01 Identify training, education and certification requirements for occupational choice.
- ESS01.01.02 Participate in career-related training and/or degree programs.
- ESS01.01.03 Pass certification tests to qualify for licensure and/or certification in chosen occupational area.

**ESS01.02 Demonstrate language arts knowledge and skills required to pursue the full range of post-secondary education and career opportunities.**

- ESS01.02.01 Model behaviors that demonstrate active listening.
- ESS01.02.02 Adapt language for audience, purpose, situation. (i.e. diction/structure, style).
- ESS01.02.03 Organize oral and written information.
- ESS01.02.04 Compose focused copy for a variety of written documents such as agendas, audio-visuals, bibliographies, drafts, forms/documents, notes, oral presentations, reports, and technical terminology.
- ESS01.02.05 Edit copy to create focused written documents such as agendas, audio-visuals, bibliographies, drafts, forms/documents, notes, oral presentations, reports, and technical terminology.
- ESS01.02.06 Comprehend key elements of oral and written information such as cause/effect, comparisons/contrasts, conclusions, context, purpose, charts/tables/graphs, evaluation/critiques, mood, persuasive text, sequence, summaries, and technical subject matter.
- ESS01.02.07 Evaluate oral and written information for accuracy, adequacy/sufficiency, appropriateness, clarity, conclusions/solutions, fact/opinion, propaganda, relevancy, validity, and relationship of ideas.
- ESS01.02.08 Identify assumptions, purpose, outcomes/solutions, and propaganda techniques.
- ESS01.02.09 Predict potential outcomes and/or solutions based on oral and written information regarding trends.
- ESS01.02.10 Present formal and informal speeches including discussion, information requests, interpretation, and persuasive arguments.

**ESS01.03 Demonstrate mathematics knowledge and skills required to pursue the full range of post-secondary education and career opportunities.**

- ESS01.03.01 Identify whole numbers, decimals, and fractions.
- ESS01.03.02 Demonstrate knowledge of basic arithmetic operations such as addition, subtraction, multiplication, and division.
- ESS01.03.03 Demonstrate use of relational expressions such as equal to, not equal, greater than, less than, etc.
- ESS01.03.04 Apply data and measurements to solve a problem.
- ESS01.03.05 Analyze Mathematical problem statements for missing and/or irrelevant data.
- ESS01.03.06 Construct charts/tables/graphs from functions and data.
- ESS01.03.07 Analyze data when interpreting operational documents.



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**ESS01.04      Demonstrate science knowledge and skills required to pursue the full range of post-secondary and career education opportunities.**

- ESS01.04.01      Evaluate scientific constructs including conclusions, conflicting data, controls, data, inferences, limitations, questions, sources of errors, and variables.
- ESS01.04.02      Apply scientific methods in qualitative and quantitative analysis, data gathering, direct and indirect observation, predictions, and problem identification.

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| <b>Essential Topic<br/>ESS02</b> | <b>COMMUNICATIONS:</b> <i>Use oral and written communication skills in creating, expressing and interpreting information and ideas including technical terminology and information.</i> |
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**ESS02.01      Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.**

- ESS02.01.01      Determine the most appropriate reading strategy for identifying the overarching purpose of a text (i.e. skimming, reading for detail, reading for meaning or critical analysis).
- ESS02.01.02      Demonstrate use of content, technical concepts and vocabulary when analyzing information and following directions.
- ESS02.01.03      Select the reading strategy or strategies needed to fully comprehend the content within a written document (i.e., skimming, reading for detail, reading for meaning or critical analysis).
- ESS02.01.04      Interpret information, data, and observations to apply information learned from reading to actual practice.
- ESS02.01.05      Transcribe information, data, and observations to apply information learned from reading to actual practice.
- ESS02.01.06      Communicate information, data, and observations to apply information learned from reading to actual practice.

**ESS02.02      Demonstrate use of the concepts, strategies, and systems for obtaining and conveying ideas and information to enhance communication in the workplace.**

- ESS02.02.01      Employ verbal skills when obtaining and conveying information.
- ESS02.02.02      Record information needed to present a report on a given topic or problem.
- ESS02.02.03      Write internal and external business correspondence that conveys and/or obtains information effectively.
- ESS02.02.04      Communicate with other employees to clarify workplace objectives.
- ESS02.02.05      Communicate effectively with customers and employees to foster positive relationships.

**ESS02.03      Locate, organize and reference written information from various sources to communicate with co-workers and clients/participants.**



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ESS02.03.01      Locate written information used to communicate with co-workers and customers.

ESS02.03.02      Organize information to use in written and oral communications.

ESS02.03.03      Reference the sources of information.

**ESS02.04      Evaluate and use information resources to accomplish specific occupational tasks.**

ESS02.04.01      Use informational texts, Internet web sites, and/or technical materials to review and apply information sources for occupational tasks.

ESS02.04.02      Evaluate the reliability of information from informational texts, Internet Web sites, and/or technical materials and resources.

**ESS02.05      Use correct grammar, punctuation and terminology to write and edit documents.**

ESS02.05.01      Compose multi-paragraph documents clearly, succinctly, and accurately.

ESS02.05.02      Use descriptions of audience and purpose when preparing and editing written documents.

ESS02.05.03      Use correct grammar, spelling, punctuation, and capitalization when preparing written documents.

**ESS02.06      Develop and deliver formal and informal presentations using appropriate media to engage and inform audiences.**

ESS02.06.01      Prepare oral presentations to provide information for specific purposes and audiences.

ESS02.06.02      Identify support materials that will enhance an oral presentation.

ESS02.06.03      Prepare support materials that will enhance an oral presentation.

ESS02.06.04      Deliver an oral presentation that sustains listeners' attention and interest.

ESS02.06.05      Align presentation strategies to the intended audience.

ESS02.06.06      Implement multi-media strategies for presentations.

**ESS02.07      Interpret verbal and nonverbal cues/behaviors to enhance communication with co-workers and clients/participants.**

ESS02.07.01      Interpret verbal behaviors when communicating with clients and co-workers.

ESS02.07.02      Interpret nonverbal behaviors when communicating with clients and co-workers.

**ESS02.08      Apply active listening skills to obtain and clarify information.**

ESS02.08.01      Interpret a given verbal message/information.

ESS02.08.02      Respond with restatement and clarification techniques to clarify information.

**ESS02.09      Develop and interpret tables, charts, and figures to support written and oral communications.**

ESS02.09.01      Create tables, charts, and figures to support written and oral communications.

ESS02.09.02      Interpret tables, charts, and figures used to support written and oral communication.



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| <b>ESS02.10</b>                  | <b>Listen to and speak with diverse individuals to enhance communication skills.</b>                                                                                                                               |
| ESS02.10.01                      | Apply factors and strategies for communicating with a diverse workforce.                                                                                                                                           |
| ESS02.10.02                      | Demonstrate ability to communicate and resolve conflicts within a diverse workforce.                                                                                                                               |
| <b>ESS02.11</b>                  | <b>Exhibit public relations skills to increase internal and external customer/client satisfaction.</b>                                                                                                             |
| ESS02.11.01                      | Communicate effectively when developing positive customer/client relationships.                                                                                                                                    |
| <b>Essential Topic<br/>ESS03</b> | <b>PROBLEM-SOLVING AND CRITICAL THINKING:</b> <i>Solve problems using critical thinking skills (analyze, synthesize, and evaluate) independently and in teams. Solve problems using creativity and innovation.</i> |
| <b>ESS03.01</b>                  | <b>Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate).</b>                                                                   |
| ESS03.01.01                      | Identify common tasks that require employees to use problem-solving skills.                                                                                                                                        |
| ESS03.01.02                      | Analyze elements of a problem to develop creative solutions.                                                                                                                                                       |
| ESS03.01.03                      | Describe the value of using problem-solving and critical thinking skills to improve a situation or process.                                                                                                        |
| ESS03.01.04                      | Create ideas, proposals, and solutions to problems.                                                                                                                                                                |
| ESS03.01.05                      | Evaluate ideas, proposals, and solutions to problems.                                                                                                                                                              |
| ESS03.01.06                      | Use structured problem-solving methods when developing proposals and solutions.                                                                                                                                    |
| ESS03.01.07                      | Generate new and creative ideas to solve problems by brainstorming possible solutions.                                                                                                                             |
| ESS03.01.08                      | Critically analyze information to determine value to the problem-solving task.                                                                                                                                     |
| ESS03.01.09                      | Guide individuals through the process of recognizing concerns and making informed decisions.                                                                                                                       |
| ESS03.01.10                      | Identify alternatives using a variety of problem-solving and critical thinking skills.                                                                                                                             |
| ESS03.01.11                      | Evaluate alternatives using a variety of problem-solving and critical thinking skills.                                                                                                                             |
| <b>ESS03.02</b>                  | <b>Employ critical thinking and interpersonal skills to resolve conflicts with staff and/or customers.</b>                                                                                                         |
| ESS03.02.01                      | Analyze situations and behaviors that affect conflict management.                                                                                                                                                  |
| ESS03.02.02                      | Determine best options/outcomes for conflict resolution using critical thinking skills.                                                                                                                            |
| ESS03.02.03                      | Identify with others' feelings, needs, and concerns.                                                                                                                                                               |
| ESS03.02.04                      | Implement stress management techniques.                                                                                                                                                                            |
| ESS03.02.05                      | Resolve conflicts with/for customers using conflict resolution skills.                                                                                                                                             |



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ESS03.02.06 Implement conflict resolution skills to address staff issues/problems.  
**ESS03.03 Identify, write and monitor workplace performance goals to guide progress in assigned areas of responsibility and accountability.**

ESS03.03.01 Write realistic performance goals, objectives and action plans.  
ESS03.03.02 Monitor performance goals and adjust as necessary.  
ESS03.03.03 Recognize goal achievement using appropriate rewards in the workplace.

ESS03.03.04 Communicate goal achievement with managers and co-workers.  
**ESS03.04 Conduct technical research to gather information necessary for decision-making.**

ESS03.04.01 Align the information gathered to the needs of the audience.  
ESS03.04.02 Gather technical information and data using a variety of resources.  
ESS03.04.03 Analyze information and data for value to the research objectives.  
ESS03.04.04 Evaluate information and data to determine value to research objectives.

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| <b>Essential Topic<br/>ESS04</b> | <b>INFORMATION TECHNOLOGY APPLICATIONS:</b> <i>Use information technology tools specific to the career cluster to access, manage, integrate, and create information.</i> |
| <b>ESS04.01</b>                  | <b>Use Personal Information Management (PIM) applications to increase workplace efficiency.</b>                                                                          |
| ESS04.01.01                      | Manage personal schedules and contact information.                                                                                                                       |
| ESS04.01.02                      | Create memos and notes.                                                                                                                                                  |
| <b>ESS04.02</b>                  | <b>Employ technological tools to expedite workflow.</b>                                                                                                                  |
| ESS04.02.01                      | Use information technology tools to manage and perform work responsibilities.                                                                                            |
| <b>ESS04.03</b>                  | <b>Operate electronic mail applications to communicate within a workplace.</b>                                                                                           |
| ESS04.03.01                      | Use email to share files and documents.                                                                                                                                  |
| ESS04.03.02                      | Identify the functions and purpose of email systems.                                                                                                                     |
| ESS04.03.03                      | Use email to communicate within and across organizations.                                                                                                                |
| <b>ESS04.04</b>                  | <b>Operate Internet applications to perform workplace tasks.</b>                                                                                                         |
| ESS04.04.01                      | Access and navigate Internet (e.g., use a web browser).                                                                                                                  |
| ESS04.04.02                      | Search for information and resources.                                                                                                                                    |
| ESS04.04.03                      | Evaluate Internet resources for reliability and validity.                                                                                                                |
| <b>ESS04.05</b>                  | <b>Operate writing and publishing applications to prepare business communications.</b>                                                                                   |
| ESS04.05.01                      | Prepare simple documents and other business communications.                                                                                                              |
| ESS04.05.02                      | Prepare reports and other business communications by integrating graphics and other non-text elements.                                                                   |
| ESS04.05.03                      | Prepare complex multi-media publications.                                                                                                                                |
| <b>ESS04.06</b>                  | <b>Operate presentation applications to prepare presentations.</b>                                                                                                       |



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| ESS04.06.01     | Prepare presentations for training, sales and information sharing.                                    |
| ESS04.06.02     | Deliver presentations with supporting materials.                                                      |
| <b>ESS04.07</b> | <b>Employ spreadsheet applications to organize and manipulate data.</b>                               |
| ESS04.07.01     | Create a spreadsheet.                                                                                 |
| ESS04.07.02     | Perform calculations and analyses on data using a spreadsheet.                                        |
| <b>ESS04.08</b> | <b>Employ database applications to manage data.</b>                                                   |
| ESS04.08.01     | Manipulate data elements.                                                                             |
| ESS04.08.02     | Manage interrelated data elements.                                                                    |
| ESS04.08.03     | Analyze interrelated data elements.                                                                   |
| ESS04.08.04     | Generate reports showing interrelated data elements.                                                  |
| <b>ESS04.09</b> | <b>Employ collaborative/groupware applications to facilitate group work.</b>                          |
| ESS04.09.01     | Facilitate group work through management of shared schedule and contact information.                  |
| ESS04.09.02     | Facilitate group work through management of shared files and online information.                      |
| ESS04.09.03     | Facilitate group work through instant messaging or virtual meetings.                                  |
| <b>ESS04.10</b> | <b>Employ computer operations applications to manage work tasks.</b>                                  |
| ESS04.10.01     | Manage computer operations.                                                                           |
| ESS04.10.02     | Manage file storage.                                                                                  |
| ESS04.10.03     | Compress or alter files.                                                                              |
| <b>ESS04.11</b> | <b>Use computer-based equipment (containing embedded computers or processors) to control devices.</b> |
| ESS04.11.01     | Operate computer driven equipment and machines.                                                       |
| ESS04.11.02     | Use installation and operation manuals.                                                               |
| ESS04.11.03     | Troubleshoot computer driven equipment and machines.                                                  |
| ESS04.11.04     | Access support as needed to maintain operation of computer driven equipment and machines.             |

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| <b>Essential Topic<br/>ESS05</b> | <b>SYSTEMS:</b> <i>Understand roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment. Identify how key organizational systems affect organizational performance and the quality of products and services. Understand global context of industries and careers.</i> |
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| <b>ESS05.01</b> | <b>Describe the nature and types of business organizations to build an understanding of the scope of organizations.</b> |
| ESS05.01.01     | List the types and functions of businesses.                                                                             |
| ESS05.01.02     | Describe the types and functions of businesses.                                                                         |
| ESS05.01.03     | Explain the functions and interactions of common departments within a business.                                         |
| <b>ESS05.02</b> | <b>Implement quality control systems and practices to ensure quality products and services.</b>                         |



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ESS05.02.01      Describe quality control standards and practices common to the workplace.

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| <b>Essential Topic<br/>ESS06</b> | <b>SAFETY, HEALTH AND ENVIRONMENTAL:</b> <i>Understand the importance of health, safety, and environmental management systems in organizations and their importance to organizational performance and regulatory compliance. Follow organizational policies and procedures and contribute to continuous improvement in performance and compliance.</i> |
| <b>ESS06.01</b>                  | <b>Implement personal and jobsite safety rules and regulations to maintain safe and healthful working conditions and environments.</b>                                                                                                                                                                                                                 |
| ESS06.01.01                      | Assess workplace conditions with regard to safety and health.                                                                                                                                                                                                                                                                                          |
| ESS06.01.02                      | Align safety issues with appropriate safety standards to ensure a safe workplace/jobsite.                                                                                                                                                                                                                                                              |
| ESS06.01.03                      | Identify safety hazards common to workplaces.                                                                                                                                                                                                                                                                                                          |
| ESS06.01.04                      | Identify safety precautions to maintain a safe worksite.                                                                                                                                                                                                                                                                                               |
| ESS06.01.05                      | Select appropriate personal protective equipment as needed for a safe workplace/jobsite.                                                                                                                                                                                                                                                               |
| ESS06.01.06                      | Inspect personal protective equipment commonly used for selected career pathway.                                                                                                                                                                                                                                                                       |
| ESS06.01.07                      | Use personal protective equipment according to manufacturer rules and regulations.                                                                                                                                                                                                                                                                     |
| ESS06.01.08                      | Employ a safety hierarchy and communication system within the workplace/jobsite.                                                                                                                                                                                                                                                                       |
| ESS06.01.09                      | Implement safety precautions to maintain a safe worksite.                                                                                                                                                                                                                                                                                              |
| <b>ESS06.02</b>                  | <b>Complete work tasks in accordance with employee rights and responsibilities and employers obligations to maintain workplace safety and health.</b>                                                                                                                                                                                                  |
| ESS06.02.01                      | Identify rules and laws designed to promote safety and health in the workplace.                                                                                                                                                                                                                                                                        |
| ESS06.02.02                      | State the rationale of rules and laws designed to promote safety and health.                                                                                                                                                                                                                                                                           |
| <b>ESS06.03</b>                  | <b>Employ emergency procedures as necessary to provide aid in workplace accidents.</b>                                                                                                                                                                                                                                                                 |
| ESS06.03.01                      | Use knowledge of First Aid procedures as necessary.                                                                                                                                                                                                                                                                                                    |
| ESS06.03.02                      | Use knowledge of CPR procedures as necessary.                                                                                                                                                                                                                                                                                                          |
| ESS06.03.03                      | Use safety equipment as necessary.                                                                                                                                                                                                                                                                                                                     |
| <b>ESS06.04</b>                  | <b>Employ knowledge of response techniques to create a disaster and/or emergency response plan.</b>                                                                                                                                                                                                                                                    |
| ESS06.04.01                      | Complete an assessment of an emergency and/or disaster situation.                                                                                                                                                                                                                                                                                      |
| ESS06.04.02                      | Create an emergency and/or disaster plan.                                                                                                                                                                                                                                                                                                              |



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| <b>Essential Topic<br/>ESS07</b> | <b>LEADERSHIP AND TEAMWORK: <i>Use leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.</i></b>                                                                                                               |
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| <b>ESS07.01</b>                  | <b>Employ leadership skills to accomplish organizational goals and objectives.</b>                                                                                                                                                                                      |
| ESS07.01.01                      | Analyze the various roles of leaders within organizations (e.g. contribute ideas; share in building an organization; act as role models to employees by adhering to company policies, procedures, and standards; promote the organization's vision; and mentor others). |
| ESS07.01.02                      | Exhibit traits such as empowerment, risk, communication, focusing on results, decision-making, problem solution, and investment in individuals when leading a group in solving a problem.                                                                               |
| ESS07.01.03                      | Exhibit traits such as compassion, service, listening, coaching, developing others, team development, and understanding and appreciating others when acting as a manager of others in the workplace.                                                                    |
| ESS07.01.04                      | Exhibit traits such as enthusiasm, creativity, conviction, mission, courage, concept, focus, principle-centered living, and change when interacting with others in general.                                                                                             |
| ESS07.01.05                      | Consider issues related to self, team, community, diversity, environment, and global awareness when leading others.                                                                                                                                                     |
| ESS07.01.06                      | Exhibit traits such as innovation, intuition, adaptation, life-long learning and coachability to develop leadership potential over time.                                                                                                                                |
| ESS07.01.07                      | Analyze leadership in relation to trust, positive attitude, integrity, and willingness to accept key responsibilities in a work situation.                                                                                                                              |
| ESS07.01.08                      | Describe observations of outstanding leaders using effective management styles.                                                                                                                                                                                         |
| ESS07.01.09                      | Participate in civic and community leadership and teamwork opportunities to enhance skills.                                                                                                                                                                             |
| <b>ESS07.02</b>                  | <b>Employ organizational and staff development skills to foster positive working relationships and accomplish organizational goals.</b>                                                                                                                                 |
| ESS07.02.01                      | Implement organizational skills when facilitating others' work efforts.                                                                                                                                                                                                 |
| ESS07.02.02                      | Explain how to manage a staff that satisfies work demands while adhering to budget constraints.                                                                                                                                                                         |
| ESS07.02.03                      | Describe how staff growth and development to increase productivity and employee satisfaction.                                                                                                                                                                           |
| ESS07.02.04                      | Organize team involvement within a group environment.                                                                                                                                                                                                                   |
| ESS07.02.05                      | Work with others to develop and gain commitment to team goals.                                                                                                                                                                                                          |
| ESS07.02.06                      | Distribute responsibility and work load fairly.                                                                                                                                                                                                                         |
| ESS07.02.07                      | Model leadership and teamwork qualities to aid in employee morale.                                                                                                                                                                                                      |
| ESS07.02.08                      | Identify best practices for successful team functioning.                                                                                                                                                                                                                |
| ESS07.02.09                      | Explain best practices for successful team functioning.                                                                                                                                                                                                                 |



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| <b>ESS07.03</b> | <b>Employ teamwork skills to achieve collective goals and use team members' talents effectively.</b>                                                                                  |
| ESS07.03.01     | Work with others to achieve objectives in a timely manner.                                                                                                                            |
| ESS07.03.02     | Promote the full involvement and use of team members' individual talents and skills.                                                                                                  |
| ESS07.03.03     | Employ conflict-management skills to facilitate solutions.                                                                                                                            |
| ESS07.03.04     | Demonstrate teamwork skills through working cooperatively with co-workers, supervisory staff, and others, both in and out of the organization, to achieve particular tasks.           |
| ESS07.03.05     | Demonstrate teamwork processes that provide team building, consensus, continuous improvement, respect for the opinions of others, cooperation, adaptability, and conflict resolution. |
| ESS07.03.06     | Develop plans to improve team performance.                                                                                                                                            |
| ESS07.03.07     | Demonstrate commitment to and a positive attitude toward team goals.                                                                                                                  |
| ESS07.03.08     | Take responsibility for shared group and individual work tasks.                                                                                                                       |
| ESS07.03.09     | Assist team members in completing their work.                                                                                                                                         |
| ESS07.03.10     | Adapt effectively to changes in projects and work activities.                                                                                                                         |
| ESS07.03.11     | Negotiate effectively to arrive at decisions.                                                                                                                                         |
| <b>ESS07.04</b> | <b>Establish and maintain effective working relationships with all levels of personnel and other departments in order to accomplish objectives and tasks.</b>                         |
| ESS07.04.01     | Build effective working relationships using interpersonal skills.                                                                                                                     |
| ESS07.04.02     | Use positive interpersonal skills to work cooperatively with co-workers representing different cultures, genders and backgrounds.                                                     |
| ESS07.04.03     | Manage personal skills to accomplish assignments.                                                                                                                                     |
| ESS07.04.04     | Treat people with respect.                                                                                                                                                            |
| ESS07.04.05     | Provide constructive praise and criticism.                                                                                                                                            |
| ESS07.04.06     | Demonstrate sensitivity to and value for diversity.                                                                                                                                   |
| ESS07.04.07     | Manage stress and control emotions.                                                                                                                                                   |
| <b>ESS07.05</b> | <b>Conduct and participate in meetings to accomplish work tasks.</b>                                                                                                                  |
| ESS07.05.01     | Develop meeting goals, objectives and agenda.                                                                                                                                         |
| ESS07.05.02     | Assign responsibilities for preparing materials and leading discussions.                                                                                                              |
| ESS07.05.03     | Prepare materials for leading discussion.                                                                                                                                             |
| ESS07.05.04     | Assemble and distribute meeting materials.                                                                                                                                            |
| ESS07.05.05     | Conduct meeting to achieve objectives within scheduled time.                                                                                                                          |
| ESS07.05.06     | Demonstrate effective communication skills in meetings.                                                                                                                               |
| ESS07.05.07     | Produce meeting minutes including decisions and next steps.                                                                                                                           |
| ESS07.05.08     | Use parliamentary procedure, as needed, to conduct meetings.                                                                                                                          |
| <b>ESS07.06</b> | <b>Employ mentoring skills to inspire and teach others.</b>                                                                                                                           |
| ESS07.06.01     | Use motivational techniques to enhance performance in others.                                                                                                                         |
| ESS07.06.02     | Provide guidance to enhance performance in others.                                                                                                                                    |

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| <b>Essential Topic</b> | <b>ETHICS AND LEGAL RESPONSIBILITIES: <i>Know and understand the importance of professional ethics and legal responsibilities.</i></b> |
| <b>ESS08</b>           |                                                                                                                                        |



**Health Science Career Cluster**  
**Biotechnology Research and Development Pathway**  
**Knowledge and Skill Statements**

|                 |                                                                                                                                                                |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ESS08.01</b> | <b>Apply ethical reasoning to a variety of workplace situations in order to make ethical decisions.</b>                                                        |
| ESS08.01.01     | Evaluate alternative responses to workplace situations based on legal responsibilities and employer policies.                                                  |
| ESS08.01.02     | Evaluate alternative responses to workplace situations based on personal or professional ethical responsibilities.                                             |
| ESS08.01.03     | Identify personal and long-term workplace consequences of unethical or illegal behaviors.                                                                      |
| ESS08.01.04     | Explain personal and long-term workplace consequences of unethical or illegal behaviors.                                                                       |
| ESS08.01.05     | Determine the most appropriate response to workplace situations based on legal and ethical considerations.                                                     |
| ESS08.01.06     | Explain the most appropriate response to workplace situations based on legal and ethical considerations.                                                       |
| <b>ESS08.02</b> | <b>Interpret and explain written organizational policies and procedures to help employees perform their jobs according to employer rules and expectations.</b> |
| ESS08.02.01     | Locate information on organizational policies in handbooks and manuals.                                                                                        |
| ESS08.02.02     | Discuss how specific organizational policies and procedures influence a specific work situation.                                                               |

|                                  |                                                                                                                                                                                                                               |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Essential Topic<br/>ESS09</b> | <b>EMPLOYABILITY AND CAREER DEVELOPMENT:</b> <i>Know and understand the importance of employability skills. Explore, plan, and effectively manage careers. Know and understand the importance of entrepreneurship skills.</i> |
| <b>ESS09.01</b>                  | <b>Identify and demonstrate positive work behaviors and personal qualities needed to be employable.</b>                                                                                                                       |
| ESS09.01.01                      | Demonstrate self-discipline, self-worth, positive attitude, and integrity in a work situation.                                                                                                                                |
| ESS09.01.02                      | Demonstrate flexibility and willingness to learn new knowledge and skills.                                                                                                                                                    |
| ESS09.01.03                      | Exhibit commitment to the organization.                                                                                                                                                                                       |
| ESS09.01.04                      | Identify how work varies with regard to site, from indoor confined spaces to outdoor areas, including aerial space and a variety of climatic and physical conditions.                                                         |
| ESS09.01.05                      | Apply communication strategies when adapting to a culturally diverse environment.                                                                                                                                             |
| ESS09.01.06                      | Manage resources in relation to the position (i.e. budget, supplies, computer, etc).                                                                                                                                          |
| ESS09.01.07                      | Identify positive work-qualities typically desired in each of the career cluster's pathways.                                                                                                                                  |
| ESS09.01.08                      | Manage work roles and responsibilities to balance them with other life roles and responsibilities.                                                                                                                            |



**Health Science Career Cluster**  
**Biotechnology Research and Development Pathway**  
**Knowledge and Skill Statements**

|                 |                                                                                                                                                 |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ESS09.02</b> | <b>Develop a personal career plan to meet career goals and objectives.</b>                                                                      |
| ESS09.02.01     | Develop career goals and objectives as part of a plan for future career direction.                                                              |
| ESS09.02.02     | Develop strategies to reach career objectives.                                                                                                  |
| <b>ESS09.03</b> | <b>Demonstrate skills related to seeking and applying for employment to find and obtain a desired job.</b>                                      |
| ESS09.03.01     | Use multiple resources to locate job opportunities.                                                                                             |
| ESS09.03.02     | Prepare a résumé.                                                                                                                               |
| ESS09.03.03     | Prepare a letter of application.                                                                                                                |
| ESS09.03.04     | Complete an employment application.                                                                                                             |
| ESS09.03.05     | Interview for employment.                                                                                                                       |
| ESS09.03.06     | List the standards and qualifications that must be met in order to enter a given industry.                                                      |
| ESS09.03.07     | Employ critical thinking and decision-making skills to exhibit qualifications to a potential employer.                                          |
| <b>ESS09.04</b> | <b>Maintain a career portfolio to document knowledge, skills and experience in a career field.</b>                                              |
| ESS09.04.01     | Select educational and work history highlights to include in a career portfolio.                                                                |
| ESS09.04.02     | Produce a record of work experiences, licenses, certifications and products.                                                                    |
| ESS09.04.03     | Organize electronic or physical portfolio for use in demonstrating knowledge, skills and experiences.                                           |
| <b>ESS09.05</b> | <b>Demonstrate skills in evaluating and comparing employment opportunities in order to accept employment positions that match career goals.</b> |
| ESS09.05.01     | Compare employment opportunities to individual needs and career plan objectives.                                                                |
| ESS09.05.02     | Evaluate employment opportunities based upon individual needs and career plan objectives.                                                       |
| ESS09.05.03     | Demonstrate appropriate methods for accepting or rejecting employment offers.                                                                   |
| <b>ESS09.06</b> | <b>Identify and exhibit traits for retaining employment to maintain employment once secured.</b>                                                |
| ESS09.06.01     | Model behaviors that demonstrate reliability and dependability.                                                                                 |
| ESS09.06.02     | Maintain appropriate dress and behavior for the job to contribute to a safe and effective workplace/jobsite.                                    |
| ESS09.06.03     | Complete required employment forms and documentation such as I-9 form, work visa, W-4 and licensures to meet employment requirements.           |
| ESS09.06.04     | Summarize key activities necessary to retain a job in the industry.                                                                             |
| ESS09.06.05     | Identify positive work behaviors and personal qualities necessary to retain employment.                                                         |



**Health Science Career Cluster**  
**Biotechnology Research and Development Pathway**  
**Knowledge and Skill Statements**

|                 |                                                                                                                                                                                                               |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ESS09.07</b> | <b>Identify and explore career opportunities in one or more career pathways to build an understanding of the opportunities available</b>                                                                      |
| ESS09.07.01     | Locate and identify career opportunities that appeal to personal career goals.                                                                                                                                |
| ESS09.07.02     | Match personal interest and aptitudes to selected careers.                                                                                                                                                    |
| <b>ESS09.08</b> | <b>Recognize and act upon requirements for career advancement to plan for continuing education and training.</b>                                                                                              |
| ESS09.08.01     | Identify opportunities for career advancement.                                                                                                                                                                |
| ESS09.08.02     | Pursue education and training opportunities to acquire skills necessary for career advancement.                                                                                                               |
| ESS09.08.03     | Examine the organization and structure of various segments of the industry to prepare for career advancement.                                                                                                 |
| ESS09.08.04     | Research local and regional labor (workforce) market and job growth information to project potential for advancement.                                                                                         |
| ESS09.08.05     | Manage employment relations to make career advancements.                                                                                                                                                      |
| <b>ESS09.09</b> | <b>Continue professional development to keep current on relevant trends and information within the industry.</b>                                                                                              |
| ESS09.09.01     | Use self assessment, organizational priorities, journals, Internet sites, professional associations, peers and other resources to develop goals that address training, education and self-improvement issues. |
| ESS09.09.02     | Read trade magazines and journals, manufacturers' catalogues, industry publications and Internet sites to keep current on industry trends.                                                                    |
| ESS09.09.03     | Participate in relevant conferences, workshops, mentoring activities and in-service training to stay current with recent changes in the field.                                                                |
| <b>ESS09.10</b> | <b>Examine licensing, certification and credentialing requirements at the national, state and local levels to maintain compliance with industry requirements.</b>                                             |
| ESS09.10.01     | Examine continuing education requirements related to licensing, certification, and credentialing requirements at the local, state and national levels for chosen occupation.                                  |
| ESS09.10.02     | Examine the procedures and paperwork involved in maintaining and updating licensure, certification and credentials for chosen occupation.                                                                     |
| ESS09.10.03     | Align ongoing licensing, certification and credentialing requirements to career plans and goals.                                                                                                              |
| <b>ESS09.11</b> | <b>Examine employment opportunities in entrepreneurship to consider entrepreneurship as an option for career planning.</b>                                                                                    |
| ESS09.11.01     | Describe the opportunities for entrepreneurship in a given industry.                                                                                                                                          |

**Essential Topic**  
**ESS10**

**TECHNICAL SKILLS:** *Use of technical knowledge and skills required to pursue careers in all career cluster, including knowledge of design, operation, and maintenance of technological systems critical to the career cluster.*

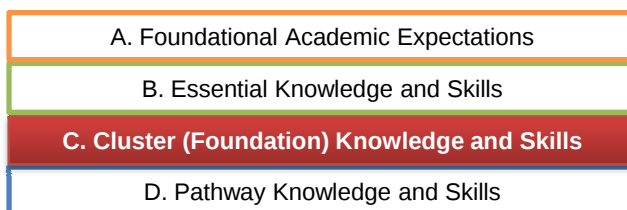


**Health Science Career Cluster**  
**Biotechnology Research and Development Pathway**  
**Knowledge and Skill Statements**

|                 |                                                                                                               |
|-----------------|---------------------------------------------------------------------------------------------------------------|
| <b>ESS10.01</b> | <b>Employ information management techniques and strategies in the workplace to assist in decision-making.</b> |
| ESS10.01.01     | Use information literacy skills when accessing, evaluating and disseminating information.                     |
| ESS10.01.02     | Describe the nature and scope of information management.                                                      |
| ESS10.01.03     | Maintain records to facilitate ongoing business operations.                                                   |
| <b>ESS10.02</b> | <b>Employ planning and time management skills and tools to enhance results and complete work tasks.</b>       |
| ESS10.02.01     | Develop goals and objectives.                                                                                 |
| ESS10.02.02     | Prioritize tasks to be completed.                                                                             |
| ESS10.02.03     | Develop timelines using time management knowledge and skills.                                                 |
| ESS10.02.04     | Use project-management skills to improve workflow and minimize costs.                                         |

## C. CLUSTER (FOUNDATION) KNOWLEDGE AND SKILLS

The following Cluster (Foundation) Knowledge and Skill statements apply to all careers in the Health Sciences Cluster. Persons preparing for careers in the Health Sciences Cluster should be able to demonstrate these skills in addition to those found on the Essential Knowledge and Skills Chart.



|                                      |                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Cluster Topic</b><br><b>HLC01</b> | <b>ACADEMIC FOUNDATIONS:</b> <i>Achieve additional academic knowledge and skills required to pursue the full range of career and postsecondary education opportunities within a career cluster.</i>                                                                                                                                                                                              |
| <b>HLC01.01</b>                      | <b>Health care workers will know the academic subject matter required for proficiency within their area. They will use this knowledge as needed in their role. In addition to state high school graduation requirements, the following are included:</b>                                                                                                                                         |
| HLC01.01.01                          | Use a knowledge of human structure and function to conduct health care role.                                                                                                                                                                                                                                                                                                                     |
| <i>Sample Indicators</i>             | Describe the basic structures and functions of cells, tissues, organs, and systems as they relate to homeostasis.<br>Compare relationships among cells, tissues, organs, and systems.<br>Explain body planes, directional terms, quadrants, and cavities.<br>Analyze the interdependence of the body systems as they relate to wellness, disease, disorders, therapies, and care rehabilitation. |
| HLC01.01.02                          | Use a knowledge of diseases and disorders to conduct health care role.                                                                                                                                                                                                                                                                                                                           |



# Health Science Career Cluster

## Biotechnology Research and Development Pathway

### Knowledge and Skill Statements

#### Sample Indicators

Compare selected diseases/disorders including respective classification(s), causes, diagnoses, therapies, and care/rehabilitation to include biotechnological applications.

Analyze methods to control the spread of pathogenic microorganisms.

Contrast various types of immunities.

Analyze body system changes in light of diseases, disorders and wellness.

Compare the aging process among the body systems.

#### Cluster Topic HLC02

**COMMUNICATIONS:** *Use oral and written communication skills in creating, expressing and interpreting information and ideas including technical terminology and information.*

*No additional statements in the topic beyond those found in the Essential Knowledge and Skills Chart.*

#### Cluster Topic HLC03

**PROBLEM-SOLVING AND CRITICAL THINKING:** *Solve problems using critical thinking skills (analyze, synthesize, and evaluate) independently and in teams. Solve problems using creativity and innovation.*

*No additional statements in the topic beyond those found in the Essential Knowledge and Skills Chart.*

#### Cluster Topic HLC04

**INFORMATION TECHNOLOGY APPLICATIONS:** *Use information technology tools specific to the career cluster to access, manage, integrate, and create information.*

*No additional statements in the topic beyond those found in the Essential Knowledge and Skills Chart.*

#### Cluster Topic HLC05

**SYSTEMS:** *Understand roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment. Identify how key organizational systems affect organizational performance and the quality of products and services. Understand global context of industries and careers.*

#### HLC05.01

**Health care workers will understand how their role fits into their department, their organization and the overall health care environment. They will identify how key systems affect services they perform and quality of care.**

##### HLC05.01.01

##### Sample Indicators

Explain systems theory as it applies to the health care environment.

Describe systems theory and its components.

##### HLC05.01.02

##### Sample Indicators

Construct a general systems model using inputs, throughputs, and a feedback loop.

Explain the health care delivery system.

Construct a healthcare delivery system model.

Predict where and how factors such as cost, managed care, technology, an aging population, access to care, alternative therapies, and lifestyle/behavior changes may affect various health care delivery system models.

Project outcomes as interconnected components of a modified health care system.

Calculate the cost effectiveness of two separate health care delivery systems using the same client procedure.



## Health Science Career Cluster Biotechnology Research and Development Pathway Knowledge and Skill Statements

**HLC05.01.03** Health care workers will understand the existing and potential hazards to clients, co-workers, and self. They will prevent injury or illness through safe work practices and follow health and safety policies and procedures.

*Sample Indicators*

- Diagram the interdependence of health care professions within a given health care delivery system and pertaining to the delivery of quality health care.
- Design a system analysis process that evaluates the following outcomes; client satisfaction, productivity, cost effectiveness, and efficiency.
- Evaluate the impact of enhanced technology on the health care delivery system.

**HLC05.01.04** Explain the concept of system change as it applies to the health care environment.

*Sample Indicators*

- Analyze the cause and effect on health care system change based on the influence of technology, epidemiology, bio-ethics, socio-economics, and various forms of complimentary (non-traditional) medicine.

### Cluster Topic HLC06

**SAFETY, HEALTH AND ENVIRONMENTAL: *Understand the importance of health, safety, and environmental management systems in organizations and their importance to organizational performance and regulatory compliance. Follow organizational policies and procedures and contribute to continuous improvement in performance and compliance.***

**HLC06.01** Health care workers will understand the existing and potential hazards to clients, co-workers, and self. They will prevent injury or illness through safe work practices and follow health and safety policies and procedures.

**HLC06.01.01** Explain infection control practices and procedures.

*Sample Indicators*

- Practice infection control procedures.
- Practice appropriate cleaning, disinfecting, and sterilizing processes.
- Contrast medical and surgical asepsis.

**HLC06.01.02** Employ personal safety practices.

*Sample Indicators*

- Manage a personal exposure incident in compliance with OSHA regulations.
- Apply principles of body mechanics and ergonomics.
- Use personal protective equipment as appropriate to the environment.

**HLC06.01.03** Use techniques to insure environmental safety.

*Sample Indicators*

- Modify the environment to create safe working conditions.
- Demonstrate methods of fire prevention in the health care setting.
- Prevent accidents by using proper safety techniques.
- Practice good housekeeping by maintaining a safe work environment.

**HLC06.01.04** Identify common safety hazards.

*Sample Indicators*

- Use Materials Safety Data Sheets (MSDS).
- Adhere to hazardous labeling requirements.
- Comply with safety signs, symbols, and labels.
- Take appropriate action when observing a hazardous material problem.
- Apply safety principles within given environment.
- Handle hazardous chemicals commonly used in the health care environment in an appropriate manner.

**HLC06.01.05** Use emergency procedures and protocols.

*Sample Indicators*

- Interpret the evacuation plan for the health care setting.
- Construct an emergency plan for a health care setting in response to a natural disaster or other emergency.



**Health Science Career Cluster**  
**Biotechnology Research and Development Pathway**  
**Knowledge and Skill Statements**

|                                         |                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HLC06.01.06<br><i>Sample Indicators</i> | Follow the facility procedure when a fire is discovered.                                                                                                                                                                                                                                                                                                  |
|                                         | Describe healthy behaviors.<br>Apply behaviors that promote health and wellness.<br>Advocate available preventive health screening and examinations.<br>Use practices that promote the prevention of disease and injury.<br>Use appropriate safety practices as related to high-risk behaviors.<br>Evaluate the validity of alternative health practices. |

|                                |                                                                                                                                                           |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Cluster Topic<br/>HLC07</b> | <b>LEADERSHIP AND TEAMWORK: <i>Use leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.</i></b> |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|

|                 |                                                                                                                                                                                                          |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>HLC07.01</b> | <b>Health care workers will understand the roles and responsibilities of individual members as part of the health care team, including their ability to promote the delivery of quality health care.</b> |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                         |                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HLC07.01.01<br><i>Sample Indicators</i> | Describe health care teams.<br>Apply the team concept in providing quality patient/client care.<br>Recognize characteristics of effective teams.<br>Analyze roles of various team participants.<br>Respond to given critical situations appropriately as a team member/leader.<br>Accept compromise as necessary to ensure a best outcome. |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HLC07.01.02<br><i>Sample Indicators</i> | Describe team member participation.<br>Communicate verbally and nonverbally with team colleagues to assure a best result for the client.<br>Collaborate with others to formulate team objectives.<br>Act responsibly as a team member, completing assigned tasks in a timely and effective manner.<br>Actively listen to other team members.<br>Exercise leadership skills as appropriate.<br>Respect and value the expertise and contributions of all team members.<br>Work collaboratively with persons from diverse backgrounds to accomplish a common goal.<br>Apply corrective action to an acknowledged conflict situation.<br>Exhibit a strong sense of team identity and commitment to purpose. |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| <b>Cluster Topic<br/>HLC08</b> | <b>ETHICS AND LEGAL RESPONSIBILITIES: <i>Know and understand the importance of professional ethics and legal responsibilities.</i></b> |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|

|                 |                                                                                                                                                                                                                       |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>HLC08.01</b> | <b>Health care workers will understand the legal responsibilities, limitations, and implications of their actions within the health care delivery setting in order to deliver services within legal requirements.</b> |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                         |                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HLC08.01.01<br><i>Sample Indicators</i> | Describe legal implications affecting health care workers.<br>Analyze legal responsibilities, limitations, and implications of actions.<br><br>Use problem-solving techniques when confronted with legal dilemmas or issues.<br>Compare and contrast behaviors and practices that could result in malpractice, liability, or negligence.<br>Comply with policies and requirements for documentation and record keeping. |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



## Health Science Career Cluster Biotechnology Research and Development Pathway Knowledge and Skill Statements

Comply with established risk management criteria and procedures.  
Determine when an incident is reportable.  
Comply with non-discriminatory laws.  
Comply with institutional policy and procedure.

HLC08.01.02 Describe legal practices employed by health care workers.

*Sample Indicators* Perform duties according to regulations, policies, laws, and legislated rights of clients.  
Maintain clients' rights according to the Patients' Bill of Rights.

Maintain confidentiality according to Health Information Portability Access Act (HIPAA).

Practice within licensure, certification, registration, and legislated scope of practice.  
Apply the doctrine of informed consent.  
Evaluate technological threats to confidentiality.  
Follow mandated standards for workplace safety, i.e., OSHA, CDC, CLIA.  
Apply mandated standards for harassment, labor, and employment laws.

**HLC08.02 Health care workers will understand accepted ethical practices with respect to cultural, social, and ethnic differences within the health care environment. They will perform quality health care delivery.**

HLC08.02.01 Describe legal and ethical boundaries in health care delivery.

*Sample Indicators* Differentiate between morality and ethics and the relationship of each to health care outcomes.  
Differentiate between ethical and legal issues impacting health care.  
Contract personal, professional, and organizational ethics.  
Analyze legal and ethical aspects of confidentiality.  
Discuss bio-ethical issues related to health care.  
Analyze and evaluate the implications of medical ethics.

HLC08.02.02 Describe ethical practice as it applies to health care delivery.

*Sample Indicators* Demonstrate professionalism when interacting with fellow students, patients/clients, co-workers, and the organization.  
Respect interdisciplinary roles of team members.  
Report activities and behaviors by self and others that adversely affect the health, safety, or welfare of students, patients/clients, or co-workers.  
Demonstrate fairness and equal treatment of all persons.  
Practice responsibly within the ethical framework of the Patients' Bill of Rights.  
Value clients' independence and determination.

HLC08.02.03 Explain cultural, social, and ethnic diversity as it applies to health care delivery.

*Sample Indicators* Discuss the impact of religions and cultures on those giving and receiving health care with an understanding of past and present events.  
Demonstrate respect of individual cultural, social, and ethnic diversity within the health care environment.

**Cluster Topic  
EDC09**

**EMPLOYABILITY AND CAREER DEVELOPMENT: *Know and understand the importance of employability skills. Explore, plan, and effectively manage careers. Know and understand the importance of entrepreneurship skills.***



## Health Science Career Cluster Biotechnology Research and Development Pathway Knowledge and Skill Statements

No additional statements in the topic beyond those found in the Essential Knowledge and Skills Chart.

| Cluster Topic<br>EDC10 | <b>TECHNICAL SKILLS:</b> Use the technical knowledge and skills required to pursue the targeted careers for all pathways in the career cluster, including knowledge of design, operation, and maintenance of technological systems critical to the career cluster.                                                     |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HLC10.01               | <b>Health care workers will apply technical skills required for all career specialties. They will demonstrate skills and knowledge as appropriate to conduct health care related tasks.</b>                                                                                                                            |
| HLC10.01.01            | Employ occupational safety techniques.                                                                                                                                                                                                                                                                                 |
| Sample Indicators      | Apply Standard Precautions as described in the rules and regulations set forth by the Occupational Safety and Health Administration (OSHA).<br>Demonstrate safety procedures to protect clients, co-workers, and self.<br>Obtain Cardiopulmonary Resuscitation (CPR) certification.<br>Obtain First Aid Certification. |

### D. PATHWAY KNOWLEDGE AND SKILLS

The following knowledge and skill statements apply to all careers in the Biotechnology Research and Development Pathway. The statements are organized within six topics.

|                                              |
|----------------------------------------------|
| A. Foundational Academic Expectations        |
| B. Essential Knowledge and Skills            |
| C. Cluster (Foundation) Knowledge and Skills |
| <b>D. Pathway Knowledge and Skills</b>       |

| Pathway Topic<br>HLPE01 | <b>CONTRIBUTIONS OF BIOTECHNOLOGY TO HEALTH AND THE HUMAN CONDITION</b>                                                                                                                                                                                     |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HLPE01.01               | <b>Summarize the goals of biotechnology research and development as being the development of biotechnological products that improve the quality of life within legal and ethical protocols.</b>                                                             |
| HLPE01.01.01            | Identify biotechnology's contributions to quality of life.                                                                                                                                                                                                  |
| Sample Indicators       | Propose a biological or industrial enzyme that could be used for treating disease and contribute to the quality of life.<br>Generate a list of environmental diseases or chronic conditions that have been or could be treated with biotechnology products. |
| HLPE01.01.02            | Assess legal and ethical considerations associated with using biotechnology.                                                                                                                                                                                |
| Sample Indicators       | Assess a current biotechnology-related ethical issue in the "news," and how the issue may affect the quality of life.                                                                                                                                       |
| Pathway Topic<br>HLPE02 | <b>ACADEMIC FOUNDATIONS</b>                                                                                                                                                                                                                                 |



**Health Science Career Cluster**  
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|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>HLPE02.01</b>         | <b>Apply the fundamentals of biochemistry, cell biology, genetics, mathematical concepts, microbiology, molecular biology, organic chemistry and statistics in order to conduct effective biotechnology research and development of products.</b>                                                                                      |
| HLPE02.01.01             | Apply mathematical concepts to the field of biotechnology.                                                                                                                                                                                                                                                                             |
| <i>Sample Indicators</i> | Illustrate the concepts of percentages and ratios using a biotechnology application.<br>Contrast weight-to-weight and weight-to-volume calculations for solutions.<br>Explain scientific notation.                                                                                                                                     |
| HLPE02.01.02             | Use statistical data when conducting biotechnology research and development.                                                                                                                                                                                                                                                           |
| <i>Sample Indicators</i> | Compare the standard deviation and the mean of data results from testing effectiveness of two biotechnology products.<br><br>Graphically illustrate a set of biotech data such that a layman would understand it.                                                                                                                      |
| HLPE02.01.03             | Apply genetic principles to biotechnology.                                                                                                                                                                                                                                                                                             |
| <i>Sample Indicators</i> | Describe the basic structure of a chromosome.<br>Construct a karyotype with human chromosomes.<br>Differentiate the genetic inheritance of a dominant homozygous trait (e.g. dwarfism) from a heterozygous disease (e.g., sickle cell anemia).                                                                                         |
| HLPE02.01.04             | Apply principles of organic chemistry to biotechnology.                                                                                                                                                                                                                                                                                |
| <i>Sample Indicators</i> | Construct a molecule of a compound with 3 or more carbon atoms.<br>Create an equation of two organic substrates leading to a product.<br>Describe atomic number, atomic mass and orbitals.<br>Contrast covalent, ionic and hydrogen bonding.                                                                                           |
| HLPE02.01.05             | Apply principles of biochemistry to biotechnology.                                                                                                                                                                                                                                                                                     |
| <i>Sample Indicators</i> | Diagram six chemical side groups that could be in a biotechnology product.<br>Categorize all amino acids into essential and non-essential.<br><br>Describe the relationship between biochemistry and biotechnology product development.<br>Compare the underlying reasons why some molecules are hydrophilic and some are hydrophobic. |
| HLPE02.01.06             | Apply principles of cell biology to biotechnology.                                                                                                                                                                                                                                                                                     |
| <i>Sample Indicators</i> | Describe the basic structures and functions of cells and how this knowledge is used in biotechnology.<br><br>Select cellular barriers to be overcome for a biotechnology product to work inside a cell.                                                                                                                                |
| HLPE02.01.07             | Apply principles of molecular biology to biotechnology.                                                                                                                                                                                                                                                                                |
| <i>Sample Indicators</i> | Diagram the structure of the nucleic acid DNA.<br>Demonstrate DNA replication graphically and its importance to biotechnology product development.<br>Describe the central dogma of molecular biology and how understanding this process impacts biotechnology research and development.                                               |
| HLPE02.01.08             | Apply principles of microbiology to biotechnology.                                                                                                                                                                                                                                                                                     |
| <i>Sample Indicators</i> | Analyze how microorganisms are used in mass producing recombinant proteins.<br><br>Compare and contrast bacterial, fungal, and animal cells and how these similarities and differences affect biotechnology product development and production decisions.                                                                              |



**Health Science Career Cluster**  
**Biotechnology Research and Development Pathway**  
**Knowledge and Skill Statements**

Compare and contrast the use of plasmids in bacterial transformation and the process of plasmid DNA isolation.

| Pathway Topic<br>HLPE03 |                          | UNDERSTAND BIOTECHNOLOGY KNOWLEDGE AREAS AND TECHNIQUES                                                                                                                                                                                                                                                                                                           |
|-------------------------|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HLPE03.01               |                          | <b>Demonstrate basic knowledge of recombinant DNA, genetic engineering, bioprocessing, monoclonal antibody production, nanotechnology, bioinformatics, genomics, proteomics and transcriptomics to conduct biotechnology research and development.</b>                                                                                                            |
| HLPE03.01.01            |                          | Identify techniques used in biotechnology.<br>Describe the following techniques; recombinant DNA, genetic engineering, monoclonal antibody production, separation and purification of biotechnology products and bioprocessing.                                                                                                                                   |
|                         | <i>Sample Indicators</i> |                                                                                                                                                                                                                                                                                                                                                                   |
| HLPE03.01.02            |                          | Identify trends in the field of biotechnology.<br>Predict how nanotechnology, bioinformatics, proteomics, genomics and transcriptomics will create new career opportunities.                                                                                                                                                                                      |
|                         | <i>Sample Indicators</i> |                                                                                                                                                                                                                                                                                                                                                                   |
| Pathway Topic<br>HLPE04 |                          | LABORATORY PROTOCOLS AND PROCEDURES                                                                                                                                                                                                                                                                                                                               |
| HLPE04.01               |                          | <b>Demonstrate the principles of solution preparation, sterile techniques, contamination control, and measurement and calibration of instruments. Maintain a safe laboratory environment using biosafety protocols.</b>                                                                                                                                           |
| HLPE04.01.01            |                          | Use laboratory procedures to prepare solutions, sterilize, control contamination, use measurement instruments and calibrate instruments.                                                                                                                                                                                                                          |
|                         | <i>Sample Indicators</i> | Describe how molarity relates to solution preparation.<br>Calculate the molarity of a given solution and measure the pH of this solution.<br>Prepare a serial dilution of a microbial culture starting with 10 <sup>-3</sup> going to 10 <sup>-8</sup> and plate on to nutrient agar petri dishes. Determine the original concentration of the microbial culture. |
| HLPE04.01.01.03         |                          |                                                                                                                                                                                                                                                                                                                                                                   |
| HLPE04.01.02            |                          | Apply biosafety protocols in the laboratory environment.                                                                                                                                                                                                                                                                                                          |
|                         | <i>Sample Indicators</i> | Describe the criticality of the requirements of sterile techniques.<br>Respond to a hypothetical laboratory accident appropriately as a member of a laboratory team.                                                                                                                                                                                              |
| Pathway Topic<br>HLPE05 |                          | PRODUCT DEVELOPMENT AND REGULATION                                                                                                                                                                                                                                                                                                                                |
| HLPE05.01               |                          | <b>Identify process for product design and production and how their work contributes to the result in order to demonstrate an understanding of the biotechnology product development process.</b>                                                                                                                                                                 |
| HLPE05.01.01            |                          | Explain biotechnology product development processes.                                                                                                                                                                                                                                                                                                              |
|                         | <i>Sample Indicators</i> | Diagram the process involved in making one biotech product in an industrial setting.                                                                                                                                                                                                                                                                              |



**Health Science Career Cluster**  
**Biotechnology Research and Development Pathway**  
**Knowledge and Skill Statements**

|                          |                                                                                                                                                                                  |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HLPE05.01.02             | Analyze the role of pre-clinical and clinical trials in biotechnology product development.<br>Explain regulations effecting the processes for biotechnology product development. |
| <i>Sample Indicators</i> | Examine the role of a Quality Assurance person in this process.<br>Define Current Good Manufacturing Practices (cGMP) and why it is important in biotech production.             |

| Pathway Topic<br>HLPE06  | APPLY PRINCIPLES OF BIOETHICAL CONDUCT                                                                                                                                        |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HLPE06.01                | <b>Summarize and explain the larger ethical, moral and legal issues related to biotech research, product development and use in society.</b>                                  |
| HLPE06.01.01             | Explain biotechnological implications on society.<br>Differentiate between morality and ethics and the relationship of each to biotechnology health care product development. |
| <i>Sample Indicators</i> | Discuss bioethical issues related to biogenetic products.<br>Contrast personal, professional and organizational ethics.                                                       |
| HLPE06.01.02             | Apply institutional protocols to biotech research and product development.                                                                                                    |
| <i>Sample Indicators</i> | Comply with policies and requirements for documentation and record keeping.<br>Comply with institutional ethical policies and procedures.                                     |