

State-Approved Technical Skill Assessments

5/3/2017

Pathway: Science and Mathematics - Agriculture, Food, & Natural Resources (AFNR) Biotechnology Systems

Cluster: Science, Technology, Engineering, and Mathematics

CLUSTER/ PATHWAY/ PROGRAM	CERTIFICATION / ASSESSMENT TITLE	TYPE	ISSUING ORGANIZATION	WEBSITE Please report broken web links	ELIGIBILITY REQUIREMENTS / PREREQUISITES	ADMINISTRA- TION ELIGIBILITY (Written, Oral, Practical, etc.)	PASSING SCORE	COST	COMMENTS
<p>● For use at SECONDARY For use at SECONDARY For use at SECONDARY For use at SECONDARY</p>									
Agriculture, Food, and Natural Resources (CLUSTER)	Introduction to AFNR (Agriculture, Food, and Natural Resources) - PILOT PHASE	Academic Assessment	CASE	http://case4learning.org/index.php/assessment/4-case/curriculum/94-case-end-of-course-examinations	Broad-based assessment that verifies the knowledge and skills in agriculture, food, and natural resources including animal and plant biotechnology.	Online; Estimated time for assessment: 45 minutes		\$18/exam	Not available at this time, estimated completion date- 2015
Agriculture, Food, and Natural Resources (CLUSTER)	Principles of Agricultural Science Animal	Academic Assessment	CASE	http://case4learning.org/index.php/assessment/4-case/curriculum/94-case-end-of-course-examinations	Broad-based assessment that verifies the knowledge and skills in animal sciences including biotechnology.	Online; Estimated time for assessment: 45 minutes		\$18/exam	Available fall, 2013
Agriculture, Food, and Natural Resources (CLUSTER)	Principles of Agricultural Science Plant	Academic Assessment	CASE	http://case4learning.org/index.php/assessment/4-case/curriculum/94-case-end-of-course-examinations	Broad-based assessment that verifies the knowledge and skills in plant sciences including biotechnology.	Online; Estimated time for assessment: 45 minutes		\$18/exam	Available fall, 2013
Biotechnology Systems	Laboratory Assistant	Academic Assessment	CareerTech	http://www.okcareertech.org/educators/assessments-and-testing/testing/study-guides/StudyGuideList_20162017.pdf	Assess the knowledge, skills, and abilities needed to perform as a laboratory assistant in an agriculture setting.	Online	70%	\$12 per exam	40 item multiple choice exam; estimated assessment time-up to 1 hour
	Careertech Testing Information for Consortia Leaders and/or High School Testing Coordinators	Careertech	TESTING AGREEMENT	Each institution/ consortium should have a Testing Coordinator who contacts Careertech to obtain assessment exams, proctoring information, data management needs, and other important functions. Click here for the Careertech Testing Agreement form: http://www.okcareertech.org/about/state-agency/divisions/testing					

Biotechnology Systems	Animal and Plant Biotechnology	Academic Assessment	CASE	http://case4learning.org/index.php/assessment/4-case/curriculum/94-case-end-of-course-examinations	Assessment that verifies the knowledge and skills in biotechnology.	Online; Estimated time for assessment: 45 minutes		No cost	Assessment included with annual license.
Biotechnology Systems	Biotechnology	Academic Assessment	NOCTI	http://www.nocti.org	Job ready assessment that verifies the knowledge and skills in biotechnology	Online; Estimated time for assessment: Up to 3 hours	70%	\$19/post-test; \$31 pretest & post-test	New assessment to be implemented in fall, 2013; 200 multiple choice items on exam.
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PERFORMANCE INDICATOR	PERFORMANCE MEASURE	COMMON CORE COMPETENCIES Consensus among work group		COMMENTS
		Secondary	Post - secondary	
TOPIC 1: ACADEMIC FOUNDATIONS: Achieve additional academic knowledge and skills required to pursue the full range of career and education opportunities within a career cluster and/or career pathway.				
INDICATOR 01.01 Know the academic subject matter required for proficiency within their area. They will use this knowledge as needed in their role.	MEASURE 01.01.01 Describe the basic structures and functions of cells, tissues, organs, and systems as they relate to homeostasis.	Y	Y	
	MEASURE 01.01.02 Compare physiological interactions between cells, tissues, organs, and systems.	Y	Y	<i>e.g., Explain how they communicate with each other.</i>
INDICATOR 01.02 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.	MEASURE 01.02.01 Apply mathematical concepts to the field of biotechnology.	Y	Y	<i>e.g., Illustrate the concepts of percentages and ratios using a biotechnology application.</i>
				<i>e.g., Contrast weight-to-weight and weight-to-volume calculations for solutions.</i>
	MEASURE 01.02.02 Use statistical data when conducting biotechnology research and development.	Y	Y	<i>e.g., Explain scientific notation.</i>
				<i>e.g., Compare the standard deviation and the mean of data results from testing effectiveness of two biotechnology products.</i>
				<i>e.g., Graphically illustrate a set of biotech data such that a layman would understand it.</i>

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	MEASURE 01.02.03 Apply genetic principles to biotechnology.	Y	Y	e.g., Describe the basic structure of a chromosome.
				e.g., Construct a karyotype with human chromosomes.
				e.g., Differentiate the genetic inheritance of a dominant homozygous trait (e.g. dwarfism) from a heterozygous disease (e.g., sickle cell anemia).
	MEASURE 01.02.04 Apply principles of organic chemistry to biotechnology.	Y	Y	e.g., Construct a molecule of a compound with 3 or more carbon atoms.
				e.g., Create an equation of two organic substrates leading to a product.
				e.g., Describe atomic number, atomic mass and orbitals.
				e.g., Contrast covalent, ionic and hydrogen bonding.
	MEASURE 01.02.05 Apply principles of biochemistry to biotechnology.	Y	Y	e.g., Diagram six chemical side groups that could be in a biotechnology product.
				e.g., Categorize all amino acids into essential and non-essential.
e.g., Describe the relationship between biochemistry and biotechnology product development.				
e.g., Compare the underlying reasons why some molecules are hydrophilic and some are hydrophobic.				

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	MEASURE 01.02.06 Apply principles of cell biology to biotechnology.	Y	Y	e.g., Describe the basic structures and functions of cells and how this knowledge is used in biotechnology.
				e.g., Select cellular barriers to be overcome for a biotechnology product to work inside a cell.
	MEASURE 01.02.07 Apply principles of molecular biology to biotechnology.	Y	Y	e.g., Diagram the structure of the nucleic acid DNA.
				e.g., Demonstrate DNA replication graphically and its importance to biotechnology product development.
				e.g., Describe the central dogma of molecular biology and how understanding this process impacts biotechnology research and development.
	MEASURE 01.02.08 Apply principles of microbiology to biotechnology.	Y	Y	e.g., Analyze how microorganisms are used in mass producing recombinant proteins.
				e.g., Compare and contrast bacterial, fungal, and animal cells and how these similarities and differences affect biotechnology product development and production decisions.
				e.g., Compare and contrast the use of plasmids in bacterial transformation and the process of plasmid DNA isolation.

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TOPIC 2: COMMUNICATIONS - Communicate clearly and effectively with reason including technical terminology and information.				
INDICATOR 02.01 Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.	MEASURE 02.01.01-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).	Y	Y	<i>e.g., Explain technical concepts to non-technical audience</i>
	MEASURE 02.01.02 Demonstrate use of content, technical concepts and vocabulary when analyzing information and following directions.	Y	Y	
	MEASURE 02.01.03 Interpret , transcribe, and communicate information, data, and observations to apply information learned from reading to actual practice.	Y	Y	
INDICATOR 02.02 Demonstrate use of the concepts, strategies, and systems for obtaining and conveying ideas and information to enhance communication in the workplace.	MEASURE 02.02.01 Employ verbal skills when obtaining and conveying information.	Y	Y	
	MEASURE 02.02.02 Record information needed to present a report on a given topic or problem.	Y	Y	

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	MEASURE 02.02.03 Write internal and external business correspondence that conveys and/or obtains information effectively.	Y	O	<i>e.g., E-mail correspondence</i>
	MEASURE 02.02.04 Communicate with other employees to clarify workplace objectives and positive relationships.	Y	O	
INDICATOR 02.03 Locate, organize and reference written information from various sources to communicate with co-workers and clients/participants.	MEASURE 02.03.01 Locate and organize written information used to communicate with co-workers and customers.	Y	Y	
	MEASURE 02.03.02 Reference the sources of information.	Y	Y	
INDICATOR 02.04 Evaluate and use information resources to accomplish specific occupational tasks.	MEASURE 02.04.01 Use informational texts, Internet web sites, and/or technical materials to review and apply information sources for occupational tasks.	Y	Y	<i>e.g., Reference manuals for kits</i>
	MEASURE 02.04.02 Evaluate the reliability of information from informational texts, Internet Web sites, and/or technical materials and resources.	Y	Y	

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INDICATOR 02.05 Use correct grammar, punctuation and terminology to write and edit documents.	MEASURE 02.05.01 Compose multi-paragraph documents clearly, succinctly, and accurately.	Y	Y	<i>e.g., Lab reports, Power Point presentations</i>
	MEASURE 02.05.02 Use correct grammar, spelling, punctuation, and capitalization when preparing text documents.	Y	Y	
INDICATOR 02.06 Develop and deliver formal and informal presentations using appropriate media to engage and inform audiences.	MEASURE 02.06.01 Prepare oral presentations to provide information for specific purposes and audiences.	Y	Y	
	MEASURE 02.06.02 Identify and prepare multi-media support materials that will enhance an oral presentation.	Y	Y	<i>e.g., Power Point & other technology presentation materials (i.e., Excel, Spreadsheets)</i>
	MEASURE 02.06.03 Deliver an oral presentation that-captures listeners' attention and interest.	Y	Y	
INDICATOR 02.07 Interpret verbal and nonverbal cues/behaviors to enhance communication with co-workers and clients/participants.	MEASURE 02.07.01 Interpret verbal and nonverbal behaviors when communicating with clients and/or co-workers.	Y	Y	
INDICATOR 02.08 Apply active listening skills to obtain and clarify information.	MEASURE 02.08.01 Interpret a given verbal message/information.	Y	Y	
	MEASURE 02.08.02 Respond with restatement and clarification techniques to clarify information.	Y	Y	

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INDICATOR 02.09 Develop and interpret tables, charts, and figures to support written and oral communications.	MEASURE 02.09.01 Create tables, charts, and figures to support written and oral communications.	Y	Y	
	MEASURE 02.09.02 Interpret tables, charts, and figures used to support written and oral communication.	Y	Y	
INDICATOR 02.10 Listen to and speak with diverse individuals to enhance communication skills.	MEASURE 02.10.01 Apply factors and strategies for communicating within the workforce.	Y	Y	
	MEASURE 02.10.02 Demonstrate ability to communicate and resolve conflicts.	Y	Y	
TOPIC 3: PROBLEM-SOLVING AND CRITICAL THINKING - Utilize critical thinking skills to make sense of problems and persevere in solving them. Employ valid, reliable research strategies. Demonstrate creativity and innovation.				
INDICATOR 03.01 Employ critical thinking skills.	MEASURE 03.01.01 Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate).	Y	Y	e.g., Analyze situations and behaviors that affect conflict management.
	MEASURE 03.01.02 Identify common tasks that require employees to use problem-solving skills.	Y	Y	e.g., Use structured problem-solving methods when developing proposals and solutions. e.g., Guide individuals through the process of recognizing concerns and making informed decisions.

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	MEASURE 03.01.03 Analyze elements of a problem to develop creative solutions.	Y	Y	<i>e.g., Generate new and creative ideas to solve problems by brainstorming possible solutions.</i>
	MEASURE 03.01.04 Describe the value of using problem-solving and critical thinking skills to improve a situation or process.	Y	Y	<i>e.g., Critically analyze information to determine value to the problem-solving task.</i>
	MEASURE 03.01.05 Create ideas, proposals, and solutions to problems.	Y	Y	<i>e.g., Identify alternatives using a variety of problem-solving and critical thinking skills.</i>
	MEASURE 03.01.06 Evaluate ideas, proposals, and solutions to problems.	Y	Y	<i>e.g., Evaluate alternatives using a variety of problem-solving and critical thinking skills.</i>
	MEASURE 03.01.07 Conduct technical research to gather information necessary for decision-making.	Y	Y	
	MEASURE 03.01.08 Employ critical thinking skills in discipline-related work.	Y	Y	
	MEASURE 03.01.09 Gather technical information and data using a variety of resources.	Y	Y	
	MEASURE 03.01.10 Analyze information and data for value to the research objectives.	Y	Y	

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	MEASURE 03.01.11 Evaluate information and data to determine value to research objectives.	Y	Y	
INDICATOR 03.02 Understand peer review process.	MEASURE 03.02.01 Provide constructive peer review.	Y	O	
	MEASURE 03.02.02 Accept and implement constructive suggestions from peers.	Y	O	
TOPIC 4: TECHNOLOGY APPLICATIONS - Use technology to enhance productivity.				
INDICATOR 04.01 Operate writing and publishing applications to prepare communications.	MEASURE 04.01.01 Prepare simple documents and other communications.	Y	Y	
	MEASURE 04.01.02 Prepare reports and other communications by integrating graphics and other non-text elements.	Y	Y	
INDICATOR 04.02 Prepare and deliver scientific presentations for information sharing.	MEASURE 04.02.01 Prepare scientific presentations.	Y	Y	
	MEASURE 04.02.02 Deliver scientific presentations with supporting materials.	Y	Y	

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INDICATOR 04.03 Employ spreadsheet applications to organize and manipulate data.	MEASURE 04.03.01 Create a spreadsheet.	Y	Y	
	MEASURE 04.03.02 Perform calculations and analyses on data using a spreadsheet.	Y	Y	
INDICATOR 04.04 Use computer-based equipment (containing embedded computers or processors) to control devices.	MEASURE 04.04.01 Operate computer driven equipment and machines.	Y	Y	<i>e.g., PCR techniques, CAD/CAM</i>
	MEASURE 04.04.02 Use operation manuals.	Y	Y	
	MEASURE 04.04.03 Troubleshoot computer driven equipment and machines.	O	O	
	MEASURE 04.04.04 Access support as needed to maintain operation of computer driven equipment and machines.	Y	O	

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TOPIC 5: ORGANIZATIONAL AND GLOBAL SYSTEMS – Understand the environmental, social, and economic impacts of decisions within an organization. Understand global context of industries and careers.

INDICATOR 05.01 Describe the nature and types of organizations to build an understanding of the scope of organizations.	MEASURE 05.01.01 Explain the functions and interactions of common departments within an organization.	O	O	
INDICATOR 05.02 Implement quality control systems and practices to ensure quality products and services.	MEASURE 05.02.01 Describe quality control standards and practices common to the workplace.	Y	O	

TOPIC 6: SAFETY, HEALTH, AND ENVIRONMENT – Understand the importance of safety, health, and environmental management systems and their importance to organizational performance and regulatory compliance.

INDICATOR 06.01 Employ occupational safety techniques.	MEASURE 06.01.01 Demonstrate safety procedures to protect clients, coworkers, and self.	Y	Y	<i>e.g., Standard precautions/ OSHA</i>
INDICATOR 06.02 Apply infection control practices and procedures.	MEASURE 06.02.01 Practice infection control procedures.	Y	O	
	MEASURE 06.02.02 Apply an understanding of appropriate cleaning, disinfecting, and sterilizing techniques.	Y	Y	
INDICATOR 06.03 Apply safety practices within the given environment: personal, hazardous materials, emergency, & environmental.	MEASURE 06.03.01 Use Materials Safety Data Sheets (MSDS).	Y	Y	
	MEASURE 06.03.02 Adhere to hazardous labeling requirements.	Y	Y	

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	MEASURE 06.03.03 Take appropriate action when observing a hazardous problem.	Y	Y	
	MEASURE 06.03.04 Apply safety principles within a given environment.	Y	Y	<i>e.g., Identify and comply with safety signs, symbols, and labels.</i>
INDICATOR 06.04 Use emergency procedures and protocols.	MEASURE 06.04.01 Follow the facility procedure when an emergency is discovered.	Y	Y	<i>e.g., Standard precautions/ OSHA</i>
	MEASURE 06.04.02 Know the evacuation plan for the biomedical lab setting.	Y	Y	
INDICATOR 06.05 Employ personal safety techniques.	MEASURE 06.05.01 Apply OSHA rules and regulations as it applies to a workplace incident.	Y	Y	
	MEASURE 06.05.02 Apply principles of body mechanics and ergonomics.	O	O	<i>e.g., Lifting.</i>

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	MEASURE 06.05.03 Use personal protective equipment as appropriate to the environment.	Y	Y	
INDICATOR 06.06 Use techniques to ensure environmental safety.	MEASURE 06.06.01 Create and maintain safe working conditions in your environment.	Y	Y	
	MEASURE 06.06.02 Demonstrate methods of fire prevention in the lab setting.	Y	Y	
	MEASURE 06.06.03 Prevent accidents by using proper safety techniques.	Y	Y	
TOPIC 7: LEADERSHIP AND TEAMWORK - Use leadership in collaborating with others to accomplish productive organizational goals and objectives with an awareness of cultural/global competence.				
INDICATOR 07.01 Understand the roles and responsibilities of individual members as part of a scientific team, including their ability to promote the delivery of quality research and development.	MEASURE 07.01.01 Build effective working relationships using interpersonal skills.	Y	Y	
	MEASURE 07.01.02 Use positive interpersonal skills to work cooperatively with co-workers representing diverse cultures, genders and backgrounds.	Y	Y	
	MEASURE 07.01.03 Work collaboratively with persons from diverse backgrounds to accomplish a common goal.	Y	Y	

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	MEASURE 07.01.04 Support an environment that draws upon the strength of the diversity of the workforce to meet and exceed expectations.	Y	Y	<i>e.g., Manage personal skills to accomplish assignments.</i> <i>e.g., Manage personal skills to accomplish assignments.</i> <i>e.g., Treat people with respect.</i> <i>e.g., Provide constructive praise and criticism.</i> <i>e.g., Demonstrate sensitivity to and value for diversity.</i> <i>e.g., Manage stress and control emotions.</i>
INDICATOR 07.02 Establish specific goals to manage project assignments in a timely manner.	MEASURE 07.02.01 Establish specific goals to manage assignments in a timely manner.	Y	Y	<i>e.g., Identify and list key project activities.</i>
	MEASURE 07.02.02 Work in teams that effectively manage assignments.	Y	Y	<i>e.g., Determine and list assignments by activity and personnel; complete assignments.</i>
INDICATOR 07.03 Manage relationships with internal and external parties to successfully complete projects.	MEASURE 07.03.01 Describe strategies used to promote collaboration, trust and clear communication with internal and external parties in the lab setting.	Y	Y	
	MEASURE 07.03.02 Plan and organize project meetings.	Y	O	
INDICATOR 07.04 Employ mentoring skills to inspire and teach others.	MEASURE 07.04.01 Use motivational techniques to enhance performance in others.	Y	Y	

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	MEASURE 07.04.02 Provide guidance to enhance performance in others.	Y	O	
TOPIC 8: ETHICS AND LEGAL RESPONSIBILITIES –Know, understand, and model the importance of ethics, integrity, and legal responsibilities.				
INDICATOR 08.01 Summarize and explain the larger ethical, moral, and legal issues related to biotech research, product development, and use in society.	MEASURE 08.01.01 Explain biotechnological implications on society.	Y	Y	<i>e.g., Differentiate between morality and ethics and the relationship of each to biotechnology health care product development.</i>
				<i>e.g., Discuss bioethical issues related to biogenetic products.</i>
	MEASURE 08.01.02 Apply institutional protocols to biotech research and product development.	Y	Y	<i>e.g., Contrast personal, professional and organizational ethics.</i>
				<i>e.g., Comply with policies and requirements for documentation and record keeping.</i>
				<i>e.g., Comply with institutional ethical policies and procedures.</i>
TOPIC 9: CAREER DEVELOPMENT, EMPLOYABILITY, AND CITIZENSHIP –Attend to personal health and financial well-being. Know and understand the importance of employability skills. Plan education and career paths aligned to personal goals and employability goals. Act as a responsible and contributing citizen and employee.				
INDICATOR 09.01 Identify and demonstrate positive work behaviors and personal qualities needed to be employable.	MEASURE 09.01.01 Demonstrate self-discipline, positive attitude, and integrity in a work situation.	Y	Y	
	MEASURE 09.01.02 Demonstrate flexibility and willingness to learn new knowledge and skills.	Y	Y	

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	MEASURE 09.01.03 Exhibit commitment to the organization.	Y	Y	<i>e.g. on time, follow-through, participation</i>
	MEASURE 09.01.04 Manage resources in relation to the position (e.g., budget, supplies, computer, etc).	Y	Y	
	MEASURE 09.01.05 Identify positive work-qualities typically desired in each of the career cluster's pathways.	Y	Y	
	MEASURE 09.01.06 Manage work roles and responsibilities to balance them with other life roles and responsibilities.	Y	Y	
INDICATOR 09.02 Develop a personal career plan to meet career goals and objectives.	MEASURE 09.02.01 Develop career goals and objectives as part of a plan for future career direction.	Y	Y	
	MEASURE 09.02.02 Develop strategies to reach career objectives.	Y	Y	
INDICATOR 09.03 Demonstrate skills related to seeking and applying for employment to find and obtain a desired job.	MEASURE 09.03.01 Use multiple resources to locate job opportunities.	O	O	
	MEASURE 09.03.02 Prepare a résumé.	O	O	
	MEASURE 09.03.03 Prepare a letter of application.	O	O	
	MEASURE 09.03.04 Complete an employment application.	O	O	

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	MEASURE 09.03.05 Interview for employment.	O	O	Comment from Secondary: Student organization activity --proficiency award interview
	MEASURE 09.03.06 List the standards and qualifications that must be met in order to enter a given industry.	O	O	
	MEASURE 09.03.07 Employ critical thinking and decision-making skills to exhibit qualifications to a potential employer.	O	O	
INDICATOR 09.04 Maintain a career portfolio to document knowledge, skills and experience in a career field.	MEASURE 09.04.01 Select educational and work history highlights to include in a career portfolio.	O	O	
	MEASURE 09.04.02 Produce a record of work experiences, licenses, certifications and products.	O	O	
	MEASURE 09.04.03 Organize electronic or physical portfolio for use in demonstrating knowledge, skills and experiences.	O	O	

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		Consensus among work group		
		Secondary	Post - secondary	
INDICATOR 09.05 Demonstrate skills in evaluating and comparing employment opportunities in order to accept employment positions that match career goals.	MEASURE 09.05.01 Compare employment opportunities to individual needs and career plan objectives.	Y	O	
	MEASURE 09.05.02 Evaluate employment opportunities based upon individual needs and career plan objectives.	Y	Y	
INDICATOR 09.06 Identify and exhibit traits for retaining employment to maintain employment once secured.	MEASURE 09.06.01 Model behaviors that demonstrate reliability and dependability.	Y	Y	
	MEASURE 09.06.02 Maintain appropriate dress and behavior for the job to contribute to a safe and effective workplace/jobsite.	Y	Y	
	MEASURE 09.06.03 Complete required employment forms and documentation such as I-9 form, work visa, W-4 and licensures to meet employment requirements.	O	O	
	MEASURE 09.06.04 Summarize key activities necessary to retain a job in the industry.	Y	Y	
	MEASURE 09.06.05 Identify positive work behaviors and personal qualities necessary to retain employment.	Y	Y	

Pathway: Science and Mathematics - Agriculture, Food, & Natural Resources (AFNR) Biotechnology Systems

Cluster: Science, Technology, Engineering, & Mathematics

KEY: Y=Essential N=Not Essential O=Optional

PERFORMANCE INDICATOR	PERFORMANCE MEASURE	COMMON CORE COMPETENCIES Consensus among work group		COMMENTS
		Secondary	Post - secondary	
INDICATOR 09.07 Identify and explore career opportunities in one or more career pathways to build an understanding of the opportunities available in the cluster.	MEASURE 09.07.01 Locate and identify career opportunities that appeal to personal career goals.	Y	O	
	MEASURE 09.07.02 Match personal interest and aptitudes to selected careers.	Y	O	
INDICATOR 09.08 Recognize and act upon requirements for career advancement to plan for continuing education and training.	MEASURE 09.08.01 Identify education and training opportunities to acquire skills necessary for career advancement.	Y	O	
	MEASURE 09.08.02 Examine the organization and structure of various segments of the industry to prepare for career advancement.	O	O	
	MEASURE 09.08.03 Understand local and regional labor (workforce) market and job trends to project potential for advancement.	Y	Y	
	MEASURE 09.08.04 Understand employability skills to make career advancements.	O	O	<i>e.g. teamwork, problem solving, time management</i>

Pathway: Science and Mathematics - Agriculture, Food, & Natural Resources (AFNR) Biotechnology Systems

Cluster: Science, Technology, Engineering, & Mathematics

KEY: Y=Essential N=Not Essential O=Optional

PERFORMANCE INDICATOR	PERFORMANCE MEASURE	COMMON CORE COMPETENCIES		COMMENTS
		Consensus among work group		
		Secondary	Post - secondary	
INDICATOR 09.09 Continue professional development to keep current on relevant trends and information within the industry.	MEASURE 09.09.01 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.	Y	Y	
	MEASURE 09.09.02 Read trade magazines and journals, manufacturers' catalogues, industry publications and Internet sites to keep current on industry trends.	Y	Y	
	MEASURE 09.09.03 Participate in relevant conferences, workshops, mentoring activities and in-service training to stay current with recent changes in the field.	Y	Y	<i>e.g. job shadows, tours</i>
INDICATOR 09.10 Examine licensing, certification and credentialing requirements at the national, state and local levels to maintain compliance with industry requirements.	MEASURE 09.10.01 Examine continuing education requirements related to licensing, certification, and credentialing requirements at the local, state and national levels for chosen occupation.	Y	Y	

Pathway: Science and Mathematics - Agriculture, Food, & Natural Resources (AFNR) Biotechnology Systems

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KEY: Y=Essential N=Not Essential O=Optional

PERFORMANCE INDICATOR	PERFORMANCE MEASURE	COMMON CORE COMPETENCIES Consensus among work group		COMMENTS
		Secondary	Post - secondary	
	MEASURE 09.10.02 Examine the procedures and paperwork involved in maintaining and updating licensure, certification and credentials for chosen occupation.	O	Y	
INDICATOR 09.11 Examine employment opportunities in entrepreneurship to consider entrepreneurship as an option for career planning.	MEASURE 09.11.01 Describe the opportunities for entrepreneurship in a given industry.	Y	O	
TOPIC 10: TECHNICAL LITERACY – Apply technical knowledge and skills required to pursue careers in a specific career cluster and/or career pathway.				
INDICATOR 10.01 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.	MEASURE 10.01.01 Identify biotechnology's contributions to quality of life within legal and ethical protocols.	Y	Y	<i>e.g., Propose a biological or industrial enzyme that could be used for treating disease and contribute to the quality of life.</i>
				<i>e.g., Generate a list of environmental diseases or chronic conditions that have been or could be treated with biotechnology products.</i>
	MEASURE 10.01.02 Assess legal and ethical considerations associated with using biotechnology.	Y	Y	<i>e.g., Assess a current biotechnology-related ethical issue in the "news," and how the issue may affect the quality of life.</i>

Pathway: Science and Mathematics - Agriculture, Food, & Natural Resources (AFNR) Biotechnology Systems

Cluster: Science, Technology, Engineering, & Mathematics

KEY: Y=Essential N=Not Essential O=Optional

PERFORMANCE INDICATOR	PERFORMANCE MEASURE	COMMON CORE COMPETENCIES Consensus among work group		COMMENTS
		Secondary	Post - secondary	
INDICATOR 10.02 Demonstrate basic knowledge of recombinant DNA, genetic engineering, bioprocessing, monoclonal antibody production, nanotechnology, bioinformatics, genomics, proteomics and transcriptomics to conduct biotechnology research and development.	MEASURE 10.02.01 Identify techniques used in biotechnology.	Y	Y	e.g., Describe the following techniques; recombinant DNA, genetic engineering, monoclonal antibody production, separation and purification of biotechnology products and bioprocessing.
	MEASURE 10.02.02 Identify trends in the field of biotechnology.	Y	Y	e.g., Predict how nanotechnology, bioinformatics, proteomics, genomics and transcriptomics will create new career opportunities.
INDICATOR 10.03 Demonstrate the principles of solution preparation, sterile techniques, contamination control, and measurement and calibration of instruments. Maintain a safe laboratory environment using biosafety protocols.	MEASURE 10.03.01 Use laboratory procedures to prepare solutions, sterilize, control contamination, use measurement instruments and calibrate instruments.	Y	Y	e.g., Describe how molarity relates to solution preparation.
				e.g., Calculate the molarity of a given solution and measure the pH of this solution.
				e.g., Prepare a serial dilution of a microbial culture starting with 10 ⁻³ going to 10 ⁻⁸ and plate on to nutrient agar petri dishes. Determine the original concentration of the microbial culture.
	MEASURE 10.03.02 Apply biosafety protocols in the laboratory environment.	Y	Y	e.g., Describe the criticality of the requirements of sterile techniques.
				e.g., Respond to a hypothetical laboratory accident appropriately as a member of a laboratory team.

Pathway: Science and Mathematics - Agriculture, Food, & Natural Resources (AFNR) Biotechnology Systems

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KEY: Y=Essential N=Not Essential O=Optional

PERFORMANCE INDICATOR	PERFORMANCE MEASURE	COMMON CORE COMPETENCIES Consensus among work group		COMMENTS
		Secondary	Post - secondary	
INDICATOR 10.04 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.	MEASURE 10.04.01 Identify biotechnology product development processes.	Y	Y	e.g., Identify the process involved in making one biotech product in an industrial setting.
				e.g., Know the role of pre-clinical and clinical trials in biotechnology product development.
	MEASURE 10.04.02 Comply with and adhere to regulations affecting the processes for biotechnology product development.	Y	Y	e.g., Examine the role of a Quality Assurance person in this process.
				e.g., Define Current Good Manufacturing Practices (CGMP) and why it is important in biotech production.

Core Competencies

7/1/2014

Pathway: Mathematics and Science - Agriculture, Food, & Natural Resources (AFNR) Biotechnology Systems
Cluster: Science, Technology, Engineering, and Mathematics

KEY: Y=Essential N=Not Essential O=Optional

PERFORMANCE INDICATOR	PERFORMANCE MEASURE	COMMON CORE		COMMENTS
		Secondary	Post - secondary	
TOPIC 11: PATHWAY CONTENT STANDARD: The student will demonstrate competence in the application of scientific principles and techniques to biotechnology in agriculture.				
INDICATOR 11.01 Recognize the historical, social, cultural and potential applications of biotechnology.	MEASURE 11.01.01 Distinguish major innovators, historical developments and potential applications of biotechnology in agriculture.	Y	Y	Measure 11.01.01 A - Level 1: Define biotechnology and explore the historical impact it has had on agriculture.
		Y	Y	Level 2: Create a timeline and use it to explain the developmental progression of biotechnology.
		Y	Y	Level 3: Research and report on the major innovators and milestones in the development of biotechnology.
		Y	Y	Measure 11.01.01 B - Level 1: Investigate current applications of biotechnology in agriculture.
		Y	Y	Level 2: Research and report on current work being done in agricultural biotechnology (e.g. employment opportunities within different industry sectors)
		Y	Y	Level 3: Analyze the scope and impact of agricultural biotechnology in today's global society.
		Y	Y	Measure 11.01.01 C - Level 1: Examine potential future applications of biotechnology in agriculture and compare them with alternative approaches to improving agriculture.
		O	Y	Level 2: Research and report on emerging problems and issues associated with agricultural biotechnology.

		O	Y	<i>Level 3: Assess the future impact agricultural biotechnology could have on world populations.</i>
MEASURE 11.01.02 Determine regulatory issues and identify agencies associated with biotechnology.		Y	O	Measure 11.01.02 A - Level 1: Describe the role of agencies that regulate biotechnology. (e.g. FDA, USDA, EPA)
		O	Y	<i>Level 2: Interpret the major regulatory issues related to biotechnology.</i>
		O	O	<i>Level 3: Research, evaluate and articulate a major regulatory issue pertaining to biotechnology.</i> Comment from Business/Industry: Four-year degree program
MEASURE 11.01.03 Analyze the ethical, legal, social and cultural issues relating to biotechnology.		Y	Y	Measure 11.01.03 A - Level 1: Explore ethical, legal and social biotechnology issues.
		Y	Y	<i>Level 2: Evaluate the benefits and risks associated with biotechnology.</i> Comment from Business/Industry: Employer's responsibility
		O	O	<i>Level 3: Research, evaluate and articulate the implications of an ethical, legal, social or cultural biotechnology issue.</i>
		O	Y	Measure 11.01.03 B - Level 1: Explore the emergence, evolution and implications of bioethics.
		O	O	<i>Level 2: Examine an ethical dilemma associated with biotechnology by identifying its components.</i>
		O	O	<i>Level 3: Research and debate an ethical issue associated with biotechnology.</i>
		O	Y	Measure 11.01.03 C - Level 1: Explain the meaning of intellectual properties as related to biotechnology.
		N	O	<i>Level 2: Examine intellectual properties associated with biotechnology by defining their components.</i>
		N	Y	<i>Level 3: Analyze an intellectual property issue associated with bioethics.</i>

INDICATOR 11.02 Demonstrate laboratory skills as applied to biotechnology.	MEASURE 11.02.01 Maintain and interpret biotechnology laboratory records.	Y	Y	Measure 11.02.01 A - Level 1: Maintain a biotechnology laboratory notebook.
		y	Y	Level 2: Analyze strengths of the research based on data and procedures, and propose future investigation.
		O	Y	Level 3: Utilize external reviews and compare them to research conducted (i.e. Scientific journal).
	MEASURE 11.02.02 Operate biotechnology laboratory equipment according to standard procedures.	Y	Y	Measure 11.02.02 A - Level 1: Operate basic laboratory equipment and measurement devices.
		Y	Y	Level 2: Operate advanced laboratory equipment and measurement devices. Comment from Business/Industry: Follow S.O.P. (Standard Operating Procedures).
		O	O	Level 3: Calibrate laboratory equipment and conduct instrument qualification tests.
	MEASURE 11.02.03 Demonstrate proper laboratory procedures using biological materials.	Y	Y	Measure 11.02.03 A - Level 1: Demonstrate basic aseptic techniques in the biotechnology laboratory.
		Y	Y	Level 2: Demonstrate advanced aseptic techniques in the biotechnology laboratory.
		Y	Y	Level 3: Perform bioassays and experiments under aseptic conditions.
		Y	Y	Measure 11.02.03 B - Level 1: Perform procedures with biological materials according to directions.
		Y	Y	Level 2: Select an appropriate standard operating procedure for working with biological materials.
		O	O	Level 3: Develop a standard operating procedure for a biological process.
	MEASURE 11.02.04 Safely manage biological materials, chemicals and wastes used in the laboratory.	Y	Y	Measure 11.02.04 A - Level 1: Prepare simple chemical solutions using standard operating procedures.
		Y	Y	Level 2: Prepare buffers, reagents, solutions and media.
		Y	Y	Level 3: Verify the physical properties of buffers, reagents, solutions and media.

Y	Y	Measure 11.02.04 B - Level 1 : Identify and describe hazards associated with biological and chemical materials.	
O	O	Level 2: Inventory biological and chemical materials, and maintain accurate records of supplies and expiration dates.	
N	O	Level 3: Order, stock and maintain supplies of biological and chemical materials.	
Y	Y	Measure 11.02.04 C - Level 1 : Maintain a safe environment by properly identifying and disposing of laboratory waste.	
N	O	Level 2: Diagram the flow of waste after it leaves the laboratory.	
N	O	Level 3: Devise a management plan to reduce laboratory waste.	
MEASURE 11.02.05 Perform microbiology, molecular biology, enzymology and immunology procedures.	Y	Y	Measure 11.02.05 A - Level 1 : Differentiate the types of organisms and demonstrate how to handle them safely.
	Y	Y	Level 2: Isolate, maintain, quantify and store cell cultures.
	Y	Y	Level 3: Characterize the basic physical, chemical and biological properties of organism (model) microbes.
	Y	Y	Measure 11.02.05 B - Level 1 : Explain the structures of DNA and RNA and how genotype associated with phenotype.
	Y	Y	Level 2: Explain the molecular basis for heredity and the tools and techniques used in DNA and RNA manipulations.
	Y	Y	Level 3: Analyze factors that influence gene expression.
	Y	Y	Measure 11.02.05 C - Level 1 : Extract or purify DNA .
	Y	Y	Level 2: Perform electrophoretic techniques and interpret electrophoresis fragmentation patterns.

		O	Y	<i>Level 3: Perform DNA manipulations, such as cloning/subcloning, blotting, sequencing and amplification.</i>
		Y	Y	Measure 11.02.05 D - Level 1: Perform simple enzyme activity assays to detect proteins.
		Y	Y	Level 2: Perform protein separation techniques and interpret the results.
		O	Y	Level 3: Characterize the biochemical properties of proteins.
		Y	Y	Measure 11.02.05 E - Level 1: Describe how antibodies are formed and how they can be used in biotechnology applications.
		Y	Y	Level 2: Conduct an Enzyme-Linked Immunosorbent Assay (ELISA).
		O	O	Level 3: Use antibodies to detect and quantify antigens.
		Y	Y	Measure 11.02.05 F - Level 1: Explain reasons for detecting microbes and identify sources of microbes.
		Y	Y	Level 2: Research and describe the use of biotechnology to detect microbes.
		O	O	Level 3: Design and perform an assay to detect a target microorganism in food, water or the environment.
INDICATOR 11.03 Demonstrate the application of biotechnology to Agriculture, Food and Natural Resources (AFNR).	MEASURE 11.03.01 Evaluate the application of genetic engineering to improve products of AFNR systems.	Y	Y	Measure 11.03.01 A - Level 1: Explain biological, social, agronomic and economic reasons for genetic modification of eukaryotes.
		Y	Y	Level 2: Diagram the processes and describe the techniques used to produce transgenic eukaryotes.
		O	O	Level 3: Design and conduct an experiment to evaluate an existing transgenic eukaryote.

Y	Y	<p>Measure 11.03.01 B - Level 1 : Describe enzymes, the changes in the physical and chemical parameters that affect enzymatic reactions.</p> <p>Comment from Business/Industry: e.g. basic experiment of chemicals</p>
Y	Y	<p>Level 2: Describe the industrial processes by which enzymes are produced through biotechnology -</p>
O	O	<p>Level 3: Use biotechnology tools or microbial strain selection to improve or discover enzymes for use in food processing.</p>
Y	Y	<p>Measure 11.03.01 C - Level 1 : Compare and contrast the use of natural organisms and genetically engineered organisms in the treatment of wastes.</p>
O	O	<p>Level 2: Diagram the process by which organisms are genetically engineered for waste treatment.</p>
O	O	<p>Level 3: Monitor and evaluate the treatment of a waste product using a genetically engineered organism.</p>
O	O	<p>Measure 11.03.01 D - Level 1 : Describe the benefits and risks associated with the use of biotechnology to increase productivity and improve quality of aquatic systems.</p>
O	O	<p>Level 2: Investigate and report on genetic engineering procedures of aquatic systems.</p>

MEASURE 11.03.02 Perform biotechnology processes used in AFNR systems.	O	O	Measure 11.03.02 A - Level 1: Explain the functions of hormones in animals and plants.
	Y	Y	Level 2: Describe the processes used to produce animal and plant hormones from transgenic organisms. Comment from Business/Industry: Revision in wording
	Y	Y	Measure 11.03.02 B - Level 1: Identify foods produced or modified through fermentation.
	O	O	Level 2: Compare and contrast bioengineering and conventional pathways used in food processing.
	O	O	Level 3: Process food using biotechnology (e.g. yogurt, cheese curds, beer)
	Y	Y	Measure 11.03.02 C - Level 1: Explain the process of fermentation.
	Y	Y	Level 2: Describe the process used in producing alcohol from biomass.
	O	O	Level 3: Produce alcohol and co-products from biomass.
	Y	Y	Measure 11.03.02 D - Level 1: Explain the process of transesterification. Comment from Business/Industry: Biodiesel production
	O	O	Level 2: Diagram the process used in producing biodiesel from biomass.
	O	O	Level 3: Produce biodiesel and co-products from biomass.
	O	O	Measure 11.03.02 E - Level 1: Explain the process of producing methane from biomass.
O	O	Level 2: Illustrate the process used in producing methane from biomass.	

MEASURE 11.03.03 Use biotechnology to monitor and evaluate procedures performed in AFNR systems.	Y	Y	Measure 11.03.03 A - Level 1: Describe the selective plant breeding process.
	Y	Y	Level 2: Identify biotechnology tools used to monitor and direct plant breeding.
	O	O	Level 3: Design and conduct an experiment using biotechnology tools to evaluate selectively bred plants.
	Y	Y	Measure 11.03.03 B - Level 1: Describe biotechnology processes applicable to animal health.
	Y	Y	Level 2: Assess the benefits, risks, regulations, and opportunities associated with using biotechnology to promote animal health.
	O	O	Level 3: Design animal-care protocols that use biotechnology tools to ethically monitor and promote animal systems.
	Y	Y	Measure 11.03.03 C - Level 1: Give examples of instances in which bioremediation can be applied to clean up environmental contaminants.
	Y	Y	Level 2: Describe the use of biotechnology in bioremediation.
	O	O	Level 3: Monitor and evaluate the effectiveness of bioremediation efforts by participating in a bioremediation project.
	Y	Y	Measure 11.03.03 D - Level 1: Explain the use of microorganisms in biological waste management.
	O	Y	Level 2: Describe the processes involved in biotreatment of biological wastes.
	O	O	Level 3: Monitor and evaluate the treatment of biological wastes with microorganisms.
	Y	Y	Measure 11.03.03 E - Level 1: Explain the role of microorganisms in industrial chemical waste treatment.

O	Y	Level 2: Interpret the processes involved in biotreatment of industrial chemical wastes.
O	O	Level 3: Monitor and evaluate the treatment of industrial chemical wastes with microorganisms.
Y	Y	Measure 11.03.03 F - Level 1: Explain the global importance of biodiversity.
O	O	Level 2: Select biotechnology tools used to measure biodiversity.
O	O	Level 3: Use biotechnology tools to measure biodiversity in a population.
Y	Y	Measure 11.03.03 G - Level 1: Explain the consequences of agricultural practices on wild populations.
O	Y	Level 2: Explain how biotechnology tools can be used to monitor the effects of agricultural practices on wild populations.
O	O	Level 3: Analyze the implications of biotechnology on wild species.
Y	Y	Measure 11.03.03 H - Level 1: Explain biomass and sources of biomass.
Y	Y	Level 2: Assess the characteristics of biomass that make it useful for biofuels production.
O	Y	Level 3: Evaluate the technologies used to create biofuels from biomass. Comment from Business/Industry: e.g. ethanol
Y	Y	Measure 11.03.03 I - Level 1: Define industrial biotechnology, and describe the benefits and risks associated with its use in the manufacturing of fabrics, plastics and other products.
O	O	Level 2: Describe the processes used in the production of molecules for use in industrial applications. Comment from Business/Industry: Probably at four-year degree level

Technical Skill Assessment Blueprint

7/1/2014

Pathway: Science and Mathematics - Agriculture, Food, and Natural Resources (AFNR) Biotechnology Systems
Cluster: Science, Technology, Engineering, and Mathematics

An "assessment blueprint" is a document that indicates the knowledge and skills that will be covered in an assessment instrument and the percentage of the assessment that will be devoted to each area of knowledge and skills. The Minnesota assessment blueprints will be used to review the appropriateness of existing assessments by determining how closely those assessments match up to what the Science and Mathematics - Agriculture, Food, & Natural Resources Biotechnology Systems career pathway working groups have determined should be assessed. The assessment blueprints can also be used to guide the development of new assessments where suitable third-party assessments do not exist.

		SECONDARY	POST-SECONDARY	BUSINESS & INDUSTRY
		% of Assessment ↓	% of Assessment ↓	% of Assessment ↓
TOPIC 1	ACADEMIC FOUNDATIONS: Achieve additional academic knowledge and skills required to pursue the full range of career and education opportunities within a career cluster and/or career pathway.	15%	26%	20%
TOPIC 2	COMMUNICATIONS - Communicate clearly and effectively with reason including technical terminology and information.	10%	12%	5%
TOPIC 3	PROBLEM-SOLVING AND CRITICAL THINKING - Utilize critical thinking skills to make sense of problems and persevere in solving them. Employ valid, reliable research strategies. Demonstrate creativity and innovation.	10%	11%	15%
TOPIC 4	TECHNOLOGY APPLICATIONS - Use technology to enhance productivity.	5%	6%	10%
TOPIC 5	ORGANIZATIONAL AND GLOBAL SYSTEMS – Understand the environmental, social, and economic impacts of decisions within an organization. Understand global context of industries and careers.	5%	4%	4%
TOPIC 6	SAFETY, HEALTH, AND ENVIRONMENT – Understand the importance of safety, health, and environmental management systems and their importance to organizational performance and regulatory compliance.	10%	8%	10%
TOPIC 7	LEADERSHIP AND TEAMWORK - Use leadership in collaborating with others to accomplish productive organizational goals and objectives with an awareness of cultural/global competence.	10%	3%	10%
TOPIC 8	ETHICS AND LEGAL RESPONSIBILITIES –Know, understand, and model the importance of ethics, integrity, and legal responsibilities.	5%	8%	3%
TOPIC 9	CAREER DEVELOPMENT, EMPLOYABILITY, AND CITIZENSHIP –Attend to personal health and financial well-being. Know and understand the importance of employability skills. Plan education and career paths aligned to personal goals and employability goals. Act as a responsible and contributing citizen and employee.	10%	3%	3%
TOPIC 10	TECHNICAL LITERACY – Apply technical knowledge and skills required to pursue careers in a specific career cluster and/or career pathway.	20%	19%	20%
		100%	100%	100%

Science, Technology, Engineering, and Mathematics: Science and Mathematics – Agriculture, Food, & Natural Resources (AFNR) Biotechnology Systems Career Pathway Plan of Study for ► Learners ► Parents ► Counselors ► Teachers/Faculty--Effective Graduates 2015 & Beyond

*This Career Pathway Plan of Study (based on the Biotechnology Systems in the Science and Mathematics Career Cluster) can serve as a guide, along with other career planning materials, as learners continue on a career path. Courses listed within this plan are only recommended coursework and should be individualized to meet each learner's educational and career goals. *This Plan of Study, used for learners at an educational institution, should be customized with course titles and appropriate high school graduation requirements as well as college entrance requirements.*

EDUCATION LEVELS	GRADE	English/ Language Arts	Math	Science	Social Studies/ Sciences	Other Required Courses Other Electives Recommended Electives Learner Activities	*Career and Technical Courses and/or Degree Major Courses for Biotechnology Systems Career Pathway	SAMPLE Occupations Relating to This Pathway	
<i>Interest Inventory Administered and Plan of Study Initiated for all Learners</i>									
SECONDARY	9	English/ Language Arts I	Geometry	Earth or Life or Physical Science	Government & Citizenship/ Geography	All plans of study should meet local and state high school graduation requirements and college entrance requirements including art, health, physical education, and world language. FFA, HOSA, SkillsUSA, or other CTE student organization activities are also important for personal growth and leadership development.	<ul style="list-style-type: none"> • Introduction to Agriculture, Food, and Natural Resources • Computer Applications 	<p>Occupations Requiring Less than Baccalaureate Degree:</p> <ul style="list-style-type: none"> ► Lab Assistant--Genetics ► Lab Technician ► Maintenance & Instrument Technician ► Process Technician ► Quality Assurance Technician ► Quality Control Technician <p>Occupations Requiring Baccalaureate Degree:</p> <ul style="list-style-type: none"> ► Biochemist ► Bioinformatics Associate ► Bioinformatics Scientist ► Bioinformatics Specialist ► Bioinformatics Chemist ► Biostatistician ► Cell Biologist ► Clinical Trials Research Associate ► Clinical Trials Research Coordinator ► Geneticist ► Microbiologist ► Pharmaceutical Scientist ► Regulatory Affairs Scientist ► Research Assistant ► Research Associate ► Research Scientist ► Toxicologist 	
	10	English/ Language Arts II	Algebra II	Biology	U.S. History		<ul style="list-style-type: none"> • Plant Sciences • Animal Sciences 		
	11	English/ Language Arts III	Probability and Statistics or Pre- calculus	Chemistry or Physics or CTE Science Equivalent	World History		<ul style="list-style-type: none"> • Principles of Biotechnical Engineering • Environmental Sciences 		
	<i>College Placement Assessments-Academic/Career Advisement Provided</i>								
	12	English/ Language Arts IV	Precalculus or Calculus	Anatomy and Physiology, Microbiology, or Molecular Biology	Economics (Ag. Ed./ Bus. Ed./ Social Studies)		<ul style="list-style-type: none"> • Animal and Plant Biotechnology • Mentorship/ Internship—Animal and/or Plant Biotechnology 		
<i>Articulation/Dual Credit Transcribed-Postsecondary courses may be taken/moved to the secondary level for articulation/dual credit purposes.</i>									
POSTSECONDARY	Year 1	Required Transfer Curriculum Goals Determined by Local College Program in College Year 1 and Year 2 - Goal 1: Communication; Goal 2: Critical Thinking/Problem-Solving; Goal 3: Natural Science; Goal 4: Mathematical/Logical Reasoning; Goal 5: History and the Social and Behavior Sciences; Goal 6: The Humanities and the Arts; Goal 7: Human Diversity; Goal 8: Global Perspective; Goal 9: Ethical and Civic Responsibility; Goal 10: People and the Environment			All plans of study need to meet learners' career goals with regard to required degrees, licenses, certifications or journey worker status. HOSA,PAS, SkillsUSA, or other local student organization activities may also be important to include.	<ul style="list-style-type: none"> • Core Biomedical Devices Classes (Ex. Introduction to Bioscience, Principles of Biology, Principals of Chemistry I & II, Microbiology, Regulatory Affairs/Quality Control) 			
	Year 2	<ul style="list-style-type: none"> • Advanced Biomedical Devices (Ex. Organic Chemistry, Analytical Chemistry and Instrumentation, Molecular Biology, Biochemistry) 							
	Yr. 3	<ul style="list-style-type: none"> • Continue Courses in the Area of Specialization 							
	Yr. 4	<ul style="list-style-type: none"> • Complete Biotechnology Major (4-year degree program) 							