Curriculum Standard for Science and Math: Biotechnology

Career Cluster: Science, Technology, Engineering, and Math **

Cluster Description: Planning, managing, and providing scientific research and professional and technical services (e.g., physical science, social science, engineering) including laboratory and testing services, and research and development services.

Pathway: Science and Mathematics	**Effective Term:** Spring 2019 (2019*01)

Program Majors Under Pathway

Program Major / Classification of Instruction Programs (CIP) Code		Credential Level(s) Offered	Program Major Code
Agricultural Biotechnology	CIP Code: 26.0308	AAS/Diploma/Certificate	A20110
Biotechnology	CIP Code: 26.1201	AAS/Diploma/Certificate	A20100
Marine Biotechnology	CIP Code: 26.1304	AAS/Diploma/Certificate	A20170

Pathway Description:

The Biotechnology curriculum, which has emerged from molecular biology and chemical engineering, is designed to meet the increasing demands for skilled laboratory technicians in various fields of biological and chemical technology.

Course work emphasizes biology, chemistry, mathematics, and technical communications. The curriculum objectives are designed to prepare graduates to serve in three distinct capacities: research assistant to a biologist or chemist, laboratory technician/instrumentation technician, and quality control/quality assurance technician.

Graduates should be qualified for employment in various areas of industry and government, including research and development, manufacturing, sales, and customer service.

Program Major Description: Choose one of the following ***4th paragraphs*** *to use in conjunction with the first three paragraphs of the pathway description above for documentation used to identify each* ***Program Major:***

Agricultural Biotechnology: A program that focuses on the application of molecular biology, biochemistry, and biophysics to the study of biomolecular structures, functions, and processes specific to plants and plant substances. Potential course work includes instruction in the biochemistry of plant cells, nuclear-cytoplasmic interactions, molecular cytostructures, photosynthesis, plant molecular genetics, and the molecular biology of plant diseases.

Biotechnology: A program that focuses on the application of the biological sciences, biochemistry, and genetics to the preparation of new and enhanced agricultural, environmental, clinical, and industrial products, including the commercial exploitation of microbes, plants, and animals. Potential course work includes instruction in general biology, general and organic chemistry, physics, biochemistry, molecular biology, immunology, microbiology, genetics, and cellular biology.

Marine Biotechnology: A program that focuses on the scientific study of the ecology and behavior of microbes, plants, and animals inhabiting aquatic environments. Potential course work includes instruction in geology and hydrology; aquatic ecosystems; microbiology; mycology; botany; ichthyology; mammalogy; population biology and biodiversity; studies of specific species, phyla, and habitats; and applications to fields such as natural resources conservation, fisheries science, and biotechnology.

I. General Education Academic Core

[*Curriculum Requirements for associate degree, diploma, and certificate programs in accordance with 1D SBCCC 400.10]*: *Degree programs must contain a minimum of 15 semester hours including at least one course from each of the following areas: humanities/fine arts, social/behavioral sciences, and natural sciences/mathematics. Degree programs must contain a minimum of 6 semester hours of communications. Diploma programs must contain a minimum of 6 semester hours of general education; 3 semester hours must be in communications. General education is optional in certificate programs.*

**Within the degree program, the institution shall include opportunities for the achievement of competence in reading, writing, oral communication, fundamental mathematical skills, and basic use of computers.*

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Science and Math: Biotechnology

Recommended General Education Academic Core				AAS	Diploma	Certificate
Minimum General Education Hours Required:				**15 SHC**	**6 SHC**	**0 SHC**
Courses listed below are recommended general education courses for this curriculum standard. Colleges may choose to include additional or alternative general education courses to meet local curriculum needs.						
Communication:				**6 SHC**	**3-6 SHC**	**Optional**
*	COM	101	Workplace Communication	3 SHC		
	COM	110	Introduction to Communication	3 SHC		
	COM	120	Intro Interpersonal Com	3 SHC		
	COM	231	Public Speaking	3 SHC		
*	ENG	101	Applied Communications I	3 SHC		
*	ENG	102	Applied Communications II	3 SHC		
	ENG	110	Freshman Composition	3 SHC		
	ENG	111	Expository Writing	3 SHC		
	ENG	112	Argument-Based Research	3 SHC		
	ENG	114	Prof Research & Reporting	3 SHC		
	ENG	115	Oral Communication	3 SHC		
	ENG	116	Technical Report Writing	3 SHC		
Humanities/Fine Arts:				**3 SHC**	**0-3 SHC**	**Optional**
*	HUM	101	Values in the Workplace	2 SHC		
	HUM	110	Technology and Society	3 SHC		
	HUM	115	Critical Thinking	3 SHC		
	HUM	230	Leadership Development	3 SHC		
	PHI	230	Introduction to Logic	3 SHC		
	PHI	240	Introduction to Ethics	3 SHC		
Social /Behavioral Sciences:				**3 SHC**	**0-3 SHC**	**Optional**
	ECO	151	Survey of Economics	3 SHC		
	ECO	251	Prin of Microeconomics	3 SHC		
	GEO	110	Introduction to Geography	3 SHC		
	GEO	111	World Regional Geography	3 SHC		
*	PSY	101	Applied Psychology	3 SHC		
*	PSY	102	Human Relations	2 SHC		
	PSY	118	Interpersonal Psychology	3 SHC		
	PSY	135	Group Processes	3 SHC		
	PSY	150	General Psychology	3 SHC		
*	SOC	105	Social Relationships	3 SHC		
	SOC	210	Introduction to Sociology	3 SHC		
	SOC	215	Group Processes	3 SHC		
Natural Sciences/Mathematics:				**3 SHC**	**0-3 SHC**	**Optional**
	BIO	140	Environmental Biology	3 SHC		
	BIO	160	Introductory Life Science	3 SHC		
	BIO	175	General Microbiology	3 SHC		
	BIO	275	Microbiology	4 SHC		
	CHM	131	Introduction to Chemistry	3 SHC		
	CHM	131A	Intro to Chemistry Lab	1 SHC		
	CHM	151	General Chemistry I	4 SHC		
	MAT	110	Math Measurement & Literacy	3 SHC		
	MAT	121	Algebra/Trigonometry I	3 SHC		
	MAT	143	Quantitative Literacy	3 SHC		
	MAT	152	Statistical Methods I	4 SHC		
	PHY	110	Conceptual Physics	3 SHC		
	PHY	121	Applied Physics I	4 SHC		

**Recommended certificate and diploma level curriculum courses. These courses may <u>not</u> be included in associate degree programs.*

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II. Major Hours. AAS, diploma, and certificate programs must include courses which offer specific job knowledge and skills. Work-based learning may be included in associate in applied science degrees up to a maximum of 8 semester hours of credit; in diploma programs up to a maximum of 4 semester hours of credit; and in certificate programs up to a maximum of 2 semester hours of credit. Below is a description of each section under Major Hours.

A. Technical Core. The technical core is comprised of specific courses which are required for all Program Majors under this Curriculum Standard. A diploma program offered under an approved AAS program standard or a certificate which is the highest credential level awarded under an approved AAS program standard must include a minimum of 12 semester hours credit derived from the curriculum core courses or core subject area of the AAS program.

B. Program Major(s). The Program Major must include a minimum of 12 semester hours credit from required subjects and/or courses. The Program Major is in addition to the technical core.

C. Other Major Hours. Other major hours must be selected from prefixes listed on the curriculum standard. A maximum of 9 semester hours of credit may be selected from each prefix listed, with the exception of prefixes listed in the core.

Science and Math: Biotechnology		**AAS**	**Diploma**	**Certificate**
Minimum Major Hours Required:		**49 SHC**	**30 SHC**	**12 SHC**
A. Technical Core:				
BIO 111 General Biology I	4 SHC	**24-28 SHC**	**12-16 SHC**	
BIO 112 General Biology II	4 SHC			
CHM 132 Organic and Biochemistry	4 SHC *or*			
CHM 152 General Chemistry II	4 SHC			
B. Program Major(s).				
Agricultural Biotechnology				
*BIO 280 Biotechnology	3 SHC			
*BTC 150 Bioethics	3 SHC			
*BTC 285 Cell Culture	3 SHC			
*Agriculture. Select 6 SHC:				
AGR 160 Plant Science	3 SHC			
AGR 261 Agronomy	3 SHC			
ANS 110 Animal Science	3 SHC			
ANS 150 Animal Health Management	3 SHC			
HOR 134 Greenhouse Operations	3 SHC			
HOR 168 Plant Propagation	3 SHC			
AGR 170 Soil Science	3 SHC			
*Courses required for the Agricultural Biotechnology diploma are designated with **				
Program Major(s) Biotechnology				
+ Biotechnology Lab. Choose one.				
BTC 181 Basic Lab Techniques	4 SHC			
BTC 288 Biotech Lab Experience	2 SHC			
+ Microbiology. Choose one.				
BIO 175 General Microbiology	3 SHC			
BIO 275 Microbiology	4 SHC			
BTC 275 Industrial Microbiology	4 SHC			
+ Chemistry. Choose one:				
CHM 131 Introduction to Chemistry	3 SHC *and*			
CHM 131A Introduction to Chemistry Lab	1 SHC			
CHM 151 General Chemistry I	4 SHC			

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+ Genetics. Choose one:

BIO	250	Genetics	4 SHC
BTC	250	Principles of Genetics	3 SHC

Courses required for the Biotechnology diploma are designated with +

Marine Biotechnology

Select a minimum of 12 SHC from the following courses for the Marine Biotechnology AAS program:

AQU	215	Algae Culture	3 SHC
AQU	230	Fish Genetics & Breeding	3 SHC
AQU	255	Invert Culture	3 SHC
BTC	260	Marine Biotechnology	4 SHC
BTC	181	Basic Lab Techniques	4 SHC

A Marine Biotechnology diploma requires a minimum of 12 SHC extracted from the required technical/program major core of the AAS degree.

C. Other Major Hours.

T*o be selected from the following prefixes:*

ACC, AGR, ALT, ANS, AQU, BIO, BTC, BUS, CHM, CIS, CIV, COM, CSC, CTC, EHS, ENV, FOR, GEL, GIS, HEA, HOR, ISC, LBT, LID, MAT, MSC, NAN, PHS, PHY, SCI, SST, VEN, WAT, WBL, and WEB

Up to two semester hour credits may be selected from ACA.

Up to three semester hour credits may be selected from the following prefixes: ARA, ASL, CHI, FRE, GER,ITA, JPN, LAT, POR, RUS and SPA.

III. Other Required Hours

A college may include courses to meet graduation or local employer requirements in a certificate (0-1 SHC), diploma (0-4 SHC), or an associate in applied science (0-7 SHC) program. These curriculum courses shall be selected from the Combined Course Library and must be approved by the System Office prior to implementation. Restricted, unique, or free elective courses may not be included as other required hours.

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IV. Employability Competencies

Fundamental competencies that address soft skills vital to employability, personal, and professional success are listed below. Colleges are encouraged to integrate these competencies into the curriculum by embedding appropriate student learning outcomes into one or more courses or through alternative methods.

A. Interpersonal Skills and Teamwork – The ability to work effectively with others, especially to analyze situations, establish priorities, and apply resources for solving problems or accomplishing tasks.

B. Communication – The ability to effectively exchange ideas and information with others through oral, written, or visual means.

C. Integrity and Professionalism – Workplace behaviors that relate to ethical standards, honesty, fairness, respect, responsibility, self-control, criticism and demeanor.

D. Problem-solving – The ability to identify problems and potential causes while developing and implementing practical action plans for solutions.

E. Initiative and Dependability – Workplace behaviors that relate to seeking out new responsibilities, establishing and meeting goals, completing tasks, following directions, complying with rules, and consistent reliability.

F. Information processing – The ability to acquire, evaluate, organize, manage, and interpret information.

G. Adaptability and Lifelong Learning – The ability to learn and apply new knowledge and skills and adapt to changing technologies, methods, processes, work environments, organizational structures and management practices.

H. Entrepreneurship – The knowledge and skills necessary to create opportunities and develop as an employee or self-employed business owner.

An **Employability Skills Resource Toolkit has been developed by NC-NET for the competencies listed above. Additional information is located at: http://www.nc-net.info/employability.php*

**The *North Carolina Career Clusters Guide was developed by the North Carolina Department of Public Instruction and the North Carolina Community College system to link the academic and Career and Technical Education programs at the secondary and postsecondary levels to increase student achievement. Additional information about Career Clusters is located at: http://www.nc-net.info/NC_career_clusters_guide.php or http://www.careertech.org.*

Summary of Required Semester Hour Credits (SHC) for each credential:

	AAS	Diploma	Certificate
Minimum General Education Hours	15	6	0
Minimum Major Hours	49	30	12
Other Required Hours	0-7	0-4	0-1
Total Semester Hours Credit (SHC)	**64-76**	**36-48**	**12-18**

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