Scope and Sequence

Cluster:	Science, Technology, Engineering & Mathematics
Course Name:	Advanced Biotechnology (One Credit) This document has been created to fit the needs of the Health Science teacher.
Course Description:	(1) Students enrolled in this course will apply advanced academic knowledge and skills to the emerging fields of biotechnology such as agricultural, medical, regulatory, and forensics. Students will have the opportunity to use sophisticated laboratory equipment, perform statistical analysis, and practice quality-control techniques. (2) Students will conduct laboratory and field investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving. Students in Advanced Biotechnology study a variety of topics that include structures and functions of cells, nucleic acids, proteins, and genetics. (3) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable. (4) Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation can be experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked. (5) Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods and ethical and social decisions that involve the application of scientific information. (6) A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in terms of space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.
Course Requirements:	This course is recommended for students in Grades 11-12. Recommended prerequisites: Biology and Chemistry. To receive credit in science, students must meet the 40% laboratory and fieldwork requirement identified in §74.3(b)(2)(C) of this title (relating to Description of a Required Secondary Curriculum).
Equipment & Supplies	Required: gloves, masks, hand scrub/germicidal soap, microscopes, reagent strips, slides, cover strips, test tubes, stains for blood and bacteria, distilled water, computers, monitors, tv/dvdplayer, internet access Recommended: centrifuge, clinitest, acetest, autoclave, autoclave tape, assorted instruments, wraps (paper-sterile, cloth-nylon), multimedia projector

Units of Study	Knowledge and Skills	Student Expectations	Resources
I. Introduction to Bioscience			
A. Biotechnology defined B. History of Biotechnology C. Biotechnology Disciplines D. Careers in Biotechnology	(4) The student explores the emerging field of biotechnology. The student is expected to:	(A) define biotechnology as related to new and emerging occupations; (B) explore engineering and bioinformatics; (C) create a timeline of historical biotechnology research and development; and (D) research career opportunities in fields such as molecular, forensic, medical, regulatory, and agricultural biotechnology.	http://www.dnai.org http://www.ornl.gov/sci/techresources/Human_Genome/education/careers.shtml http://www.accessexcellence.org Biotech, Chapter 1, p. 3-29 Intro to Biotech, Chapter 1, p. 2-20
II. Regulating Biotechnology			
A. USDA-plant, plant pests, and animal vaccines B. EPA-microbial/plant pesticides, other toxic substances C. FDA-food, animal feeds, pharmaceuticals D. Bioremediation	(8) The student examines federal, state, local, and industry regulations as related to biotechnology. The student is expected to:	(A) discuss the relationship between the local, state, and federal agencies responsible for regulation of the biotechnology industry; and (B) analyze policies and procedures used in the biotechnology industry such as animal research laboratories.	http://www.usda.gov http://www.epa.gov http://www.fda.gov Intro to Biotech, Chapter 9, p. 186-201; Chapter 12, p. 271-285
III. Laboratory			
A. Safety B. Skills	(1) The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:	(A) demonstrate safe practices during laboratory and field investigations, including chemical, electrical, and fire safety, and safe handling of live and preserved organisms; (B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials; (C) demonstrate appropriate safety procedures, guidelines, and chemical hygiene plan; (D) maintain required safety training, including location and understanding of interpretation of material safety data sheets; (E) comply with federal and state safety regulations as specified by Occupational Safety and Health Administration and other regulatory agencies as appropriate; (F) identify and obey safety symbols and signs; (G) maintain clean and well organized work areas; (H) dispose of equipment, glassware, and biologics according to laboratory policies; (I) recognize common laboratory hazards; (J) observe procedures for the safe use of instruments, gas cylinders, and chemicals; and (K) maintain safety and personal protection equipment.	matcmadison.edu/ **biotech**/resources/methods/ **labManual**/ http://www.cdc.gov/od/ohs/safety/S2.pdf http://www.osha.gov/SLTC/laboratories/index.html http://www.absa.org/restool.html http://www.bio-link.org/lab.htm Biotech, Chapter 3, p.67-89

Units of Study	Knowledge and Skills	Student Expectations	Resources
IV. Standard Laboratory Procedures			
	(1) The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:	(A) demonstrate safe practices during laboratory and field investigations, including chemical, electrical, and fire safety, and safe handling of live and preserved organisms;	Biotechnology, Chapter 7, p. 188-207
		(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials;	
		(C) demonstrate appropriate safety procedures, guidelines, and chemical hygiene plan;	
		(D) maintain required safety training, including location and understanding of interpretation of material safety data sheets;	
		(E) comply with federal and state safety regulations as specified by Occupational Safety and Health Administration and other regulatory agencies as appropriate;	
		(F) identify and obey safety symbols and signs;	
		(G) maintain clean and well organized work areas;	
		(H) dispose of equipment, glassware, and biologics according to laboratory policies;	
		(I) recognize common laboratory hazards;	
		(J) observe procedures for the safe use of instruments, gas cylinders, and chemicals; and	
		(K) maintain safety and personal protection equipment.	
	(9) The student performs standard biotechnology laboratory procedures. The student is expected to:	(A) operate laboratory equipment such as a microscope, thermocycler, hood, pH meter, stirrers, balance, mixers, autoclave, power supply, shakers, dry heat oven, incubators, and Bunsen burners;	
		(B) practice measuring volumes and weights to industry standards;	
		(C) analyze data, perform calculations, and statistical analysis as it relates to biotechnology laboratory experiments;	
		(D) demonstrate and show proficiency in titration and pipetting techniques;	
		(E) identify microorganisms using staining methods such as the Gram stain, methylene-blue stain, and acid-fast staining;	
		(F) document laboratory results; and	
		(G) investigate how laboratory techniques vary in different industry sectors.	

Units of Study	Knowledge and Skills	Student Expectations	Resources
	(10) The student prepares solutions and reagents for the biotechnology laboratory. The student is expected to:	(A) practice aseptic technique;	
		(B) prepare, dispense, and monitor physical properties of stock reagents, buffers, media, and solutions;	
		(C) calculate and prepare a dilution series; and	
		(D) determine acceptability and optimum conditions of reagents for experimentation.	
V. Quality Control and Quality Assurance			
	(12) The student conducts quality control analysis while performing biotechnology laboratory procedures. The student is expected to:	(A) perform validation testing on laboratory reagents and equipment; and	http://www.careervoyages.gov/biotechnology-quality.cfm
		(B) analyze data and perform calculations and statistical analysis on results of quality control samples such as trending of data.	
VI. Cells			
A. Cellular Structure and Function	(1) The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:	(A) demonstrate safe practices during laboratory and field investigations, including chemical, electrical, and fire safety, and safe handling of live and preserved organisms;	Intro to Biotech, Chapter 2, p. 24-25 Biotech, Chapter 2, p. 42-47 http://www.cellsalive.com/ http://www.carolina.com/ http://www.accessexcellence.org/
		(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials;	
		(C) demonstrate appropriate safety procedures, guidelines, and chemical hygiene plan;	
		(D) maintain required safety training, including location and understanding of interpretation of material safety data sheets;	
		(E) comply with federal and state safety regulations as specified by Occupational Safety and Health Administration and other regulatory agencies as appropriate;	
		(F) identify and obey safety symbols and signs;	
		(G) maintain clean and well organized work areas;	
		(H) dispose of equipment, glassware, and biologics according to laboratory policies;	
		(I) recognize common laboratory hazards;	
		(J) observe procedures for the safe use of instruments, gas cylinders, and chemicals; and	
		(K) maintain safety and personal protection equipment.	
	(5) The student analyzes bacterial, plant, and animal cell structures. The student is expected to:	(A) distinguish among bacterial, plant, and animal cells;	
		(B) describe the major structures in a bacterial cell and their functions such as pili, capsule, and flagella;	

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		(C) describe the major structures in a plant cell and their functions such as cell wall and chloroplasts;	
		(D) describe the major structures in an animal cell and their functions such as nucleus, nucleolus, cell membrane, mitochondria, ribosomes, Golgi apparatus, chromatin, cytoplasm, and endoplasmic reticulum; and	
		(E) identify cells using the microscope.	
	(9) The student performs standard biotechnology laboratory procedures. The student is expected to:	(A) operate laboratory equipment such as a microscope, thermocycler, hood, pH meter, stirrers, balance, mixers, autoclave, power supply, shakers, dry heat oven, incubators, and Bunsen burners.	
VII. Genes and Genetics			
A. DNA and RNA B. DNA Replication C. Protein Synthesis D. Gene Expression E. Electrophoresis	(1) The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:	(A) demonstrate safe practices during laboratory and field investigations, including chemical, electrical, and fire safety, and safe handling of live and preserved organisms;	Intro to Biotech, Chapter 2, p. 25-48 Biotech, Chapter 2, p. 48-56; Chapter 4, p. 116-120 http://learn.genetics.utah.edu/content/begin/tour/ http://www.dnalc.org/resources/ http://www.dnai.org/index.htm
		(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials;	
		(C) demonstrate appropriate safety procedures, guidelines, and chemical hygiene plan;	
		(D) maintain required safety training, including location and understanding of interpretation of material safety data sheets;	
		(E) comply with federal and state safety regulations as specified by Occupational Safety and Health Administration and other regulatory agencies as appropriate;	
		(F) identify and obey safety symbols and signs;	
		(G) maintain clean and well organized work areas;	
		(H) dispose of equipment, glassware, and biologics according to laboratory policies;	
		(I) recognize common laboratory hazards;	
		(J) observe procedures for the safe use of instruments, gas cylinders, and chemicals; and	
		(K) maintain safety and personal protection equipment.	

Units of Study	Knowledge and Skills	Student Expectations	Resources
	(2) The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:	(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(3) of this section;	
		(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;	
		(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;	
		(D) distinguish between scientific hypotheses and scientific theories;	
		(E) plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting, handling, and maintaining appropriate equipment and technology;	
		(F) collect data individually or collaboratively, make measurements with precision and accuracy, record values using appropriate units, and calculate statistically relevant quantities to describe data, including mean, median, and range;	
		(G) demonstrate the use of course apparatus, equipment, techniques, and procedures;	
		(H) organize, analyze, evaluate, build models, make inferences, and predict trends from data;	
		(I) perform calculations using dimensional analysis, significant digits, and scientific notation; and	
		(J) communicate valid conclusions using essential vocabulary and multiple modes of expression such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.	
	(3) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:	(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;	
		(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;	
		(C) draw inferences based on data related to promotional materials for products and services;	

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		(D) evaluate the impact of research and technology on scientific thought, society, and the environment;	
		(E) describe the connection between biotechnology and future careers; and	
		(F) research and describe the history of biotechnology and contributions of scientists.	
	(6) The student understands the role of genetics in the biotechnology industry. The student is expected to:	(A) explain terms related to molecular biology such as nucleic acids, nitrogen bases, amino acids, transcription, translation, polymerase, and protein synthesis:	
		(B) describe the structure of a nucleotide;	
		(C) identify the nitrogen bases of deoxyribonucleic acid and ribonucleic acid;	
		(D) explain how nucleotides join together to form a double-helical deoxyribonucleic acid molecule;	
		(E) describe the deoxyribonucleic acid and ribonucleic acid replication process;	
		(F) illustrate the process of protein synthesis; and	
		(G) define genome and gene expression.	
	(9) The student performs standard biotechnology laboratory procedures. The student is expected to:	(A) operate laboratory equipment such as a microscope, thermocycler, hood, pH meter, stirrers, balance, mixers, autoclave, power supply, shakers, dry heat oven, incubators, and Bunsen burners;	
		(B) practice measuring volumes and weights to industry standards;	
		(C) analyze data and perform calculations and statistical analysis as it relates to biotechnology laboratory experiments;	
		(D) demonstrate and show proficiency in titration and pipetting techniques;	
		(F) document laboratory results; and	
		(G) investigate how laboratory techniques vary in different industry sectors.	
	(10) The student prepares solutions and reagents for the biotechnology laboratory. The student is expected to:	(A) practice aseptic technique;	
		(B) prepare, dispense, and monitor physical properties of stock reagents, buffers, media, and solutions;	
		(C) calculate and prepare a dilution series; and	
		(D) determine acceptability and optimum conditions of reagents for experimentation.	
	(11) The student performs advanced biotechnology laboratory procedures. The student is expected to:	(E) precipitate and solubilize proteins;	
		(F) isolate and interpret proteins using electrophoresis; and	

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		(G) perform nucleic acid sequencing procedures.	
VIII. Microbial Biotechnology			
A. Structure of Bacteria B. Identification of Bacteria C. Bacterial Transformation D. Human Genome Project	(1) The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:	(A) demonstrate safe practices during laboratory and field investigations, including chemical, electrical, and fire safety, and safe handling of live and preserved organisms;	Intro to Biotech, Chapter 2, p. 25-26; Chapter 5, p. 105-133 Biotech, Chapter 1, p. 13-4; Chapter 4, p. 105-111 http://www.cellsalive.com/ http://www.carolina.com/ http://www.accessexcellence.org/ http://www.genome.gov/Education/
		(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials;	
		(C) demonstrate appropriate safety procedures, guidelines, and chemical hygiene plan;	
		(D) maintain required safety training, including location and understanding of interpretation of material safety data sheets;	
		(E) comply with federal and state safety regulations as specified by Occupational Safety and Health Administration and other regulatory agencies as appropriate;	
		(F) identify and obey safety symbols and signs;	
		(G) maintain clean and well organized work areas;	
		(H) dispose of equipment, glassware, and biologics according to laboratory policies;	
		(I) recognize common laboratory hazards;	
		(J) observe procedures for the safe use of instruments, gas cylinders, and chemicals; and	
		(K) maintain safety and personal protection equipment.	
	(2) The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:	(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(3) of this section;	
		(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;	
		(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;	
		(D) distinguish between scientific hypotheses and scientific theories;	
		(E) plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting, handling, and maintaining appropriate equipment and technology;	

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		(F) collect data individually or collaboratively, make measurements with precision and accuracy, record values using appropriate units, and calculate statistically relevant quantities to describe data, including mean, median, and range;	
		(G) demonstrate the use of course apparatus, equipment, techniques, and procedures;	
		(H) organize, analyze, evaluate, build models, make inferences, and predict trends from data;	
		(I) perform calculations using dimensional analysis, significant digits, and scientific notation; and	
		(J) communicate valid conclusions using essential vocabulary and multiple modes of expression such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.	
	(3) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:	(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;	
		(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;	
		(C) draw inferences based on data related to promotional materials for products and services;	
		(D) evaluate the impact of research and technology on scientific thought, society, and the environment;	
		(E) describe the connection between biotechnology and future careers; and	
		(F) research and describe the history of biotechnology and contributions of scientists.	
	(9) The student performs standard biotechnology laboratory procedures. The student is expected to:	(E) identify microorganisms using staining methods such as the Gram stain, methylene-blue stain, and acid-fast staining; and	
		(F) document laboratory results.	
	(11) The student performs advanced biotechnology laboratory procedures. The student is expected to:	(A) explain the importance of media components to the outcome of cultures;	
		(B) isolate, maintain, and store pure cultures;	
		(C) prepare seed inoculum; and	
		(D) perform plating techniques such as the Kirby-Bauer method.	

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IX. Genetic Manipulation			
A. Recombinant DNA B. Bacterial Cloning 1. Plasmid DNA C. Vectors D. Polymerase chain reaction E. Tissue cultures	(1) The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:	(A) demonstrate safe practices during laboratory and field investigations, including chemical, electrical, and fire safety, and safe handling of live and preserved organisms;	Intro to Biotech, Chapter 3, p. 52-78 Biotech, Chapter 4, p. 112-120 http://www.carolina.com/ http://www.dnai.org/b/index.html http://www.dnalc.org/resources/
		(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials;	
		(C) demonstrate appropriate safety procedures, guidelines, and chemical hygiene plan;	
		(D) maintain required safety training, including location and understanding of interpretation of material safety data sheets;	
		(E) comply with federal and state safety regulations as specified by Occupational Safety and Health Administration and other regulatory agencies as appropriate;	
		(F) identify and obey safety symbols and signs;	
		(G) maintain clean and well organized work areas;	
		(H) dispose of equipment, glassware, and biologics according to laboratory policies;	
		(I) recognize common laboratory hazards;	
		(J) observe procedures for the safe use of instruments, gas cylinders, and chemicals; and	
		(K) maintain safety and personal protection equipment.	
	(2) The student uses scientific methods and equipment during laboratory and field investigations. The student is expected to:	(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(3) of this section;	
		(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;	
		(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;	
		(D) distinguish between scientific hypotheses and scientific theories;	
		(E) plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting, handling, and maintaining appropriate equipment and technology;	

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		(F) collect data individually or collaboratively, make measurements with precision and accuracy, record values using appropriate units, and calculate statistically relevant quantities to describe data, including mean, median, and range;	
		(G) demonstrate the use of course apparatus, equipment, techniques, and procedures;	
		(H) organize, analyze, evaluate, build models, make inferences, and predict trends from data;	
		(I) perform calculations using dimensional analysis, significant digits, and scientific notation; and	
		(J) communicate valid conclusions using essential vocabulary and multiple modes of expression such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.	
	(3) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:	(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;	
		(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;	
		(C) draw inferences based on data related to promotional materials for products and services;	
		(D) evaluate the impact of research and technology on scientific thought, society, and the environment;	
		(E) describe the connection between biotechnology and future careers; and	
		(F) research and describe the history of biotechnology and contributions of scientists.	
	(7) The student analyzes the importance of recombinant deoxyribonucleic acid technology and genetic engineering. The student will be able to:	(A) define recombinant deoxyribonucleic acid technology as it relates to the biotechnology industry;	
		(B) explain how recombinant deoxyribonucleic acid technology is used to clone genes;	
		(C) explain the role of tissue cultures to genetic modification procedures;	
		(D) propagate plant cultures;	
		(E) maintain proper growing conditions for plant tissue cultures;	
		(F) explain the role of restriction enzymes and plasmid deoxyribonucleic acid;	
		(G) describe the vectors commonly used including bacteriophage vectors;	
		(H) discuss the polymerase chain reaction and its application in recombinant deoxyribonucleic acid technology; and	

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		(I) perform restriction digests.	
	(9) The student performs standard biotechnology laboratory procedures. The student is expected to:	(A) operate laboratory equipment such as a microscope, thermocycler, hood, pH meter, stirrers, balance, mixers, autoclave, power supply, shakers, dry heat oven, incubators, and Bunsen burners;	
		(B) practice measuring volumes and weights to industry standards;	
		(C) analyze data and perform calculations and statistical analysis as it relates to biotechnology laboratory experiments;	
		(D) demonstrate and show proficiency in titration and pipetting techniques;	
		(F) document laboratory results; and	
		(G) investigate how laboratory techniques vary in different industry sectors.	
	(10) The student prepares solutions and reagents for the biotechnology laboratory. The student is expected to:	(A) practice aseptic technique;	
		(B) prepare, dispense, and monitor physical properties of stock reagents, buffers, media, and solutions;	
		(C) calculate and prepare a dilution series; and	
		(D) determine acceptability and optimum conditions of reagents for experimentation.	
	(11) The student performs advanced biotechnology laboratory procedures. The student is expected to:	(A) explain the importance of media components to the outcome of cultures;	
		(B) isolate, maintain, and store pure cultures;	
		(C) prepare seed inoculum;	
		(D) perform plating techniques such as the Kirby-Bauer method;	
		(E) precipitate and solubilize proteins;	
		(F) isolate and interpret proteins using electrophoresis; and	
		(G) perform nucleic acid sequencing procedures.	
X. Bioethics			
A. Define Bioethics B. Ethical Decision Making C. Moral Standards	(6) The student understands the role of genetics in the biotechnology industry. The student is expected to:	(H) evaluate the significance of ethics and regulations as it relates to gene expression; and	Intro to Biotech, Chapter 13, p.288-303 Biotech, Chapter 1, 27-29
		(I) summarize the role of genetics in the biotechnology industry.	http://www.bioethics.net http://www.bioethics.iastate.edu http://www.accessexcellence.org/RC/AB/IE/
XI. The Business of Bioscience			
A. Bioinformatics B. Applications of Biotechnology	(13) The student summarizes biotechnology laboratory procedures and their applications in the biotechnology industry. The student is expected to:	(A) identify the major sectors of the biotechnology industry;	Intro to Biotech, Chapter 14, p. 374-375; Chapter 6, p. 137-148; Chapter 7, p. 153 - 167; Chapter 8, p. 170 - 181; Chapter 10, p. 206-231; Chapter 11, p. 234-263

Units of Study	Knowledge and Skills	Student Expectations	Resources
C. From Discovery to Marketing		(B) categorize the biotechnology laboratory procedures included in each sectors; and	Biotech, Chapter 3, p. 78-82;Chapter 9, p. 241-259; Chapter 10, p. 266-289; Chapter 11, p. 299-313; Chapter 12, p. 325-337
		(C) compare the different applications used in biotechnology laboratory procedures of each sector.	http://www.accessexcellence.org/

Resources: Books

Intro to Biotech	Introduction to Biotechnology, Pearson Benjamin Cummings, 2004.	978-0321491459
Biotech	Biotechnology Science for the New Millennium, Paradigm, 2007	978-0763822781

Resources: Web Sites

Access Excellence	http://www.accessexcellence.org/
American Biological Safety Association	http://www.absa.org/
American Journal of Bioethics	http://www.bioethics.net
Bioethics at Iowa State University	http://www.bioethics.iastate.edu
Biotechnology Virtual Laboratory	http://www.bio-link.org/lab.htm
Carolina Biological	http://www.carolina.com/
Cells Alive	http://www.cellsalive.com/
DNA Interactive	http://www.dnai.org/index.htm
Dolan DNA Learning Center	http://www.dnalc.org/resources/
Human Genome Project Information	http://www.ornl.gov/sci/techresources/Human_Genome/education/careers.shtml
Laboratory Safety - CDC	http://www.cdc.gov/od/ohs/safety/S2.pdf
Laboratory Safety - OSHA	http://www.osha.gov/SLTC/laboratories/index.html
National Human Genome Research Institute	http://www.genome.gov/Education/
United Stated Environmental Protection Agency	http://www.epa.gov
United Stated Food and Drug Administration	http://www.fda.gov
United States Department of Agriculture	http://www.usda.gov