Implementation date
Fall 2009

GeorgiaStandards.Org
GATEWAY TO EDUCATION & PROFESSIONAL RESOURCES
One Stop Shop For Teachers

PROGRAM CONCENTRATION: Healthcare Science
CAREER PATHWAY: Biotechnology Research and Development
COURSE TITLE: Introduction to Biotechnology

Course Description: This course is the second course in the career pathway that introduces students to the fundamentals of biotechnology. Included in this course is a basic overview of current trends and careers in biotechnology. Additionally, emphasis on basic laboratory skills along with the business, regulatory, and ethical aspects of biotechnology is included. The knowledge and skills gained in this course will provide students with a broad understanding of biotechnology and its impact on society and with a set of foundation skills for entry into the career pathway.

ACADEMIC FOUNDATIONS

HS-IBT-1. Students will demonstrate knowledge and understanding of the academic subject matter required for proficiency within their area. Students will demonstrate knowledge in fundamentals of math and statistics concepts, genetics, organic chemistry, biochemistry, cell biology, microbiology and molecular biology.

a. Define terms common to the field of biotechnology.
b. Apply basic math including metric conversions, time conversions, percentages, and basic statistical concepts.
c. Describe atomic number, atomic mass, and orbitals.
d. Contrast covalent, ionic, and hydrogen bonding.
e. Analyze cellular design and function in plant, animal, and bacterial cells.
f. Analyze nucleic acid structure and function.
g. Analyze protein structure and function.
h. Explore the use of enzymes in biotechnology.
i. Explain the use of antigens and antibodies in biotechnology.
j. Demonstrate how microbiological tools are used in biotechnology.

Academic Standards:
SB1 Students will analyze the nature of the relationships between structures and functions in living cells.

SCSh5 Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

SCSh6 Students will communicate scientific investigations and information clearly.

ELA9RL5 The student understands and acquires new vocabulary and uses it correctly in reading and writing.

ELA9W1 The student produces writing that establishes an appropriate organizational structure, sets a context and engages the reader, maintains a coherent focus throughout, and signals closure.

MM1P1 Students will solve problems (using appropriate technology).

MM1P3 Students will communicate mathematically their ideas.

MM1P4 Students will make connections among mathematical ideas and to other disciplines.

MM1P5 Students will represent mathematics in multiple ways.

MM1D2 Students will use the basic laws of probability.

SAFETY APPLICATIONS IN THE CLASSROOM/LABORATORY

HS-IBT-2. Students will demonstrate understanding of required safety practices and procedures in the classroom and laboratory environment.

a. Define health and safety regulations, including Occupational Health and Safety Administration (OSHA), Environmental Protection Agency (EPA), and Right to Know and demonstrate procedures for documenting and reporting hazards and compliance.
b. Demonstrate health and safety practices, including use of Material Safety Data Sheets (MSDS), appropriate personal protective equipment (PPE) for the situation, emergency equipment, storage of chemicals, reagents and compounds, and maintenance of equipment.
c. Demonstrate disaster preparedness procedures for each emergency situation – fire prevention and the emergency evacuation plan, inclement weather, school and workplace violence, bomb threat, and biotechnology related emergencies.
d. Demonstrate and incorporate proper use of ergonomics and correct body mechanics in the classroom, laboratory, and workplace.
e. Demonstrate knowledge of standard precautions including proper handling and disposal of biohazardous materials.
f. Complete a formal first aid training program successfully.
g. Demonstrate CPR/AED skills.
h. Demonstrate proper storage procedures for various laboratory supplies, reagents, and chemicals.

Academic Standards:
SCSh2 Students will use standard safety practices for all classroom laboratory and workplace investigations.

MM1P4 Students will make connections among mathematical ideas and to other disciplines.

CONTRIBUTIONS OF BIOTECHNOLOGY TO HEALTH AND THE HUMAN CONDITION

HS-IBT-3. Students will understand the basis for biotechnology products and how such products affect the quality of life.

a. Explain the sequence of events that led to the development of biotechnology.
b. Identify examples of technologies used in the biotechnology industry.
c. Classify applications of biotechnology.
d. Review current trends in the biotechnology industry.

Academic Standards:
ELA9RC2 The student participates in discussions related to curricular learning in all subject areas.

ELA9LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.

ELA9RL5 The student understands and acquires new vocabulary and uses it correctly in reading and writing.

CAREER PLANNING AND DEVELOPMENT

HS-IBT-4. Students will analyze careers in human health and diagnostics, biomanufacturing, environmental applications, and agriculture that utilize biotechnology.

a. Examine careers in human health and diagnostics that utilize biotechnology.
b. Examine careers in biomanufacturing that utilize biotechnology.
c. Examine careers in agriculture that utilize biotechnology.
d. Examine careers in environmental applications that utilize biotechnology.

Academic Standards:
ELA9RC2 The student participates in discussions related to curricular learning in all subject areas.

ELA9LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.

ELA9RL5 The student understands and acquires new vocabulary and uses it correctly in reading and writing.

HS-IBT- 5. Students will demonstrate understanding of the career development planning process and recognize the need for continuous self-assessment and

goals modification in order to encourage personal and professional growth in the process of life-long learning.

a. Complete a self-assessment, develop a career plan, and evaluate a career choice within the biotechnology pathway.
b. Differentiate between a job and a career, professional networking and professional development, and a job application and a resume.
c. Develop a career portfolio including a detailed career plan.

Academic Standards:
ELA9W1 The student produces writing that establishes an appropriate organizational structure, sets a context and engages the reader, maintains a coherent focus throughout, and signals closure.

ELA10C1 The student demonstrates understanding and control of the rules of the English language, realizing that usage involves the appropriate application of conventions and grammar in both written and spoken formats.

ELA10LSV1(d) Actively solicits another person's comments or opinion. (e) Offers own opinion forcefully without domineering.

TEAMWORK, COMMUNICATION, AND DOCUMENTATION

HS-IBT-6. Students will describe the attributes of effective teamwork and leadership and will communicate effectively orally and in writing, applying academic knowledge in scientific communications.

a. Describe Career and Technical Student Organizations and their importance in leadership development and identify benefits of belonging to Health Occupations Students of America (HOSA).
b. Respond appropriately to a variety of situations as a designated member of a team.
c. Demonstrate an understanding of the nature of employer-employee relationships.
d. Organize and develop ideas into accurate verbal reports and record appropriate data, including appropriate use of telecommunications.
e. Demonstrate appropriate record keeping and documentation of lab notebooks.
f. Demonstrate the ability to follow Standard Operating Procedures (SOP).

Academic Standards:
SCSh5 Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

SCSh6 Students will communicate scientific investigations and information clearly.

MM1P4 Students will make connections among mathematical ideas and to other disciplines.

MM1P3 Students will communicate mathematically their ideas.

MM1P4 Students will make connections among mathematical ideas and to other disciplines.

MM1D2 Students will use expected value to predict outcomes.

MM1D3 Students will relate samples to a population.

ELA9W1 The student produces writing that establishes an appropriate organizational structure, sets a context and engages the reader, maintains a coherent focus throughout, and signals closure.

ELA10C1 The student demonstrates understanding and control of the rules of the English language, realizing that usage involves the appropriate application of conventions and grammar in both written and spoken formats.

ELA10LSV1(d) Actively solicits another person's comments or opinion. (e) Offers own opinion forcefully without domineering.

BASIC LABORATORY SKILLS

HS-IBT-7. Students will demonstrate the ability to conduct basic laboratory procedures and protocols.

a. Select the appropriate volume measurement device (pipettes, micropipettes, glassware, etc.) based on the level of precision required.
b. Demonstrate skill and correct use of common lab equipment such as microcentrifuge, pH meter, balance, etc.
c. Prepare various solutions and media and perform serial dilutions as necessary in a laboratory setting.
d. Demonstrate an understanding of the importance of aseptic technique while using a laminar flow hood, personal protective equipment, biohazard containment hood, and autoclave in a laboratory setting.
e. Explain and demonstrate the correct use of a microscope and prepare slides.
f. Understand the scientific method and how it applies to basic research.
g. Demonstrate correct procedures for labeling primary and secondary reagents.

Academic Standards:
SCSh3 Students will identify and investigate problems scientifically.

SCSh4 Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh5 Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

SC7 Students will characterize the properties that describe solutions and the nature of acids and bases.

MM1A1 Students will explore and interpret the characteristics of functions, using graphs, tables, and simple algebraic techniques.

MM1P1 Students will solve problems (using appropriate technology).

Basic Biotechnology Laboratory Skills

HS-IBT-8. Students will demonstrate the ability to conduct basic biotechnology laboratory procedures and protocols.

a. Explain and demonstrate the correct use of an ultraviolet /visible (uv/vis) spectrophotometer.
b. Apply the principles of electrophoresis and demonstrate the skills necessary to separate and identify DNA fragments based on size.
c. Demonstrate an understanding of the principles, types, and uses of chromatography.
d. Isolate DNA and establish its quantity, quality, and purity.
e. Demonstrate basic Polymerase Chain Reaction (PCR) procedures.
f. Conduct a qualitative Enzyme-Linked Immunosorbent Assay (ELISA).
g. Demonstrate bacterial transformation.
h. Demonstrate an understanding of how physical and chemical parameters impact enzymatic reactions.

Academic Standards:
SCSh3 Students will identify and investigate problems scientifically.

SCSh4 Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh5 Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

SPS6 Students will investigate the properties of solutions.

SC7 Students will characterize the properties that describe solutions and the nature of acids and bases.

SPS10 Students will investigate the properties of electricity and magnetism.

MM1A1 Students will explore and interpret the characteristics of functions, using graphs, tables, and simple algebraic techniques.

MM1P1 Students will solve problems (using appropriate technology).

MM1P3 Students will communicate mathematically their ideas.

MM1P4 Students will make connections among mathematical ideas and to other disciplines.

MM1D2 Students will use expected value to predict outcomes.

MM1D3 Students will relate samples to a population.

ELA9RL5 The student understands and acquires new vocabulary and uses it correctly in reading and writing.

ELA9W1 The student produces writing that establishes an appropriate organizational structure, sets a context and engages the reader, maintains a coherent focus throughout, and signals closure.

LEGAL, ETHICAL, AND SOCIAL ISSUES

HS-IHS-9. Students will analyze economic, social, and ethical issues related to the use of biotechnology.

a. Differentiate between moral, ethical, and legal biotechnology issues.
b. Research ethical issues presented by evolving science, including genetically modified foods, cloning, bioterrorism, gene therapy, and stem cells.
c. Determine personal and prevailing attitudes about the use of biotechnology in society regionally, nationally, and internationally.
d. Contrast personal, professional, and organizational ethics.

Academic Standard:
ELA9RL5 The student understands and acquires new vocabulary and uses it correctly in reading and writing.

Reading Across the Curriculum

Reading Standard Comment
After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal learning. Students encounter a variety of informational as well as fictional texts, and they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn

through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in *context*.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

CTAE-RC-1 Students will enhance reading in all curriculum areas by:

Reading in All Curriculum Areas

-Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
-Read both informational and fictional texts in a variety of genres and modes of discourse.
-Read technical texts related to various subject areas.

Discussing Books

-Discuss messages and themes from books in all subject areas.
-Respond to a variety of texts in multiple modes of discourse.
-Relate messages and themes from one subject area to messages and themes in another area.
-Evaluate the merit of texts in every subject discipline.
-Examine author's purpose in writing.
-Recognize the features of disciplinary texts.

Building Vocabulary Knowledge

-Demonstrate an understanding of contextual vocabulary in various subjects.
-Use content vocabulary in writing and speaking.
-Explore understanding of new words found in subject area texts.

Establishing Context

-Explore life experiences related to subject area content.
-Discuss in both writing and speaking how certain words are subject area related.
-Determine strategies for finding content and contextual meaning for unknown words.

<u>CTAE Foundation Skills</u>

Implementation date
Fall 2009

GeorgiaStandards.Org
GATEWAY TO EDUCATION & PROFESSIONAL RESOURCES
One Stop Shop For Teachers

The Foundation Skills for Career, Technical and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state's academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education's 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.