Mississippi Department of Education
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Office of Career Education and Workforce Development
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TO: District Superintendents and Secondary Vocational Directors/Contact Persons

FROM: Jean Massey, Associate State Superintendent
Office of Career Technical Education

DATE: July 14, 2011

RE: **Revised Secondary Curriculum Framework**

The State Board of Education, on July 14, 2011, gave final approval to the Office of Career and Technical Education to revise the Mississippi Secondary Curriculum Frameworks for the following secondary programs:

1. Business Management
2. Entrepreneurship
3. Horticulture
4. STEM

A copy of the secondary curriculum can be downloaded from the following site:

https://cia.rcu.msstate.edu/curriculum/download.asp

If additional information is needed, please contact Mrs. Jean Massey, Associate State Superintendent of Career and Technical Education at 601-359-3465.

JM:cb

MEMORANDUM#11.062

FRAMEWORKS FOR

CAREER-TECHNICAL PROGRAMS

REVISED IN

2011

SECONDARY

EXECUTIVE SUMMARY

2011

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Mississippi State, MS 39762

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Foreword

Secondary career-technical education programs in Mississippi are faced with many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, Mississippi Code of 1972, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, ch. 487, §14; Laws, 1991, ch. 423, §1; Laws, 1992, ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act III, 1998; and No Child Left Behind Act of 2001).

Each secondary career-technical course consists of a series of instructional units which focus on a common theme. All units have been written using a common format which includes the following components:

- Unit Number and Title
- Suggested Time on Task - An estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75-80 percent of the time in the course.
- Competencies and Suggested Objectives
  - A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies.
  - The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.
- Suggested Teaching Strategies - This section of each unit indicates strategies that can be used to enable students to master each competency. Emphasis has been placed on strategies which reflect active learning methodologies. Teachers should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.
- Suggested Assessment Strategies - This section indicates strategies that can be used to measure student mastery. Examples of suggested strategies could include rubrics, class participation, reflection, and journaling. Again, teachers should feel free to modify or enhance these suggested assessment strategies based on local needs and resources.
- Integrated Academic Topics, Workplace Skills, Technology Standards, and Occupational Standards - This section identifies related academic topics as required in the Subject Area Assessment Program (SATP) in Algebra I, Biology I, English II, and U. S. History from 1877, which are integrated into the content of the unit. It also identifies the 21st Century

Skills, which were developed by the Partnership for 21st Century Skills, a group of business and education organizations concerned about the gap between the knowledge and skills learned in school and those needed in communities and the workplace. A portion of the 21st Century Skills addresses learning skills needed in the 21st century, including information and communication skills, thinking and problem-solving skills, and interpersonal and self-directional skills. The need for these types of skills have been recognized for some time. The 21st Century Skills are adapted in part from the 1991 report from the U.S. Secretary of Labor's Commission on Achieving Necessary Skills (SCANS). Another important aspect of learning and working in the 21st century involves technology skills. The International Society for Technology in Education, developers of the National Education Technology Standards (NETS), were strategic partners in the Partnership for 21st Century Skills.

- References - A list of suggested references is provided for each unit. The list includes some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested and the list may be modified or enhanced based on needs and abilities of students and on available resources.

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Business Management

Business Management Executive Summary

Program Description

Business Management is a 2-year program for students in the Business: Management, Marketing, and Technology Pathway. The program is designed to prepare students for careers or continuing education in management or entrepreneurship and was written to incorporate the Business Administration Core Standards published by the Marketing Education Resource Center.

Course Outlines

This course focuses on business management and the development of an extensive business plan that encompass all areas of business, including communication, procedures, operations and security, information, and applications, needed in order to operate a successful business. Students will continue to develop educational, career, and professional plans in the area of business management. Participation in DECA (student organization) is ongoing. Students will develop skills toward meeting requirements for the Microsoft Project Skill Standards for Microsoft Office Specialist Certification.

Business and Marketing Fundamentals (2 Carnegie Units)
Course Code: 992300

Unit		Title	Hours
1		Introduction to Business	10
2		Communication and Interpersonal Skills	20
3		Professional Development	15
4		Economics	70
5		Business, Management, and Entrepreneurship	55
6		Business Law	30
7		Personal Finance	30
		Total	**230**

Management (2 Carnegie Units)
Course Code: 992303

Unit		Title	Hours
8		Introduction to Business Management	30
9		Principles of Business Management	30
10		Business Communication for Managers	30
11		Business Procedures	25
12		Business Operations and Security	25
13		Information Management	30
14		Management Applications	35
		Total	**205**

Option 2 – Four One-Carnegie-Unit Courses
Course Description: Business and Marketing Fundamentals, Part A

This course begins with an introduction to business and marketing fundaments, communication and interpersonal skills, and professional development for continued education, training, and careers in business management. Major topics of study in this course are business and economics. Participation in DECA (student organization) is ongoing. Students will develop skills

toward meeting requirements for the Microsoft Project Skill Standards for Microsoft Office Specialist Certification.

Course Description: Business and Marketing Fundamentals, Part B

This course begins with an introduction to business and marketing fundaments. Major topics in this course include economics, business, management, entrepreneurship, business law, and personal finance. Participation in DECA (student organization) is ongoing. Students will develop skills toward meeting requirements for the Microsoft Project Skill Standards for Microsoft Office Specialist Certification.

Course Description: Management Fundamentals

This course focuses on business management and the development of an extensive business plan that encompasses all areas of business, including communication and procedures, needed in order to operate a successful business. Students will continue to develop educational, career, and professional plans in the area of business management. Participation in DECA (student organization) is ongoing. Students will develop skills toward meeting requirements for the Microsoft Project Skill Standards for Microsoft Office Specialist Certification.

Course Description: Management Essentials

This course focuses on business management and the development of an extensive business plan that encompasses all areas of business, including operations and security, information, and applications needed in order to operate a successful business. Students will continue to develop educational, career, and professional plans in the area of business management. Participation in DECA (student organization) is ongoing. Students will develop skills toward meeting requirements for the Microsoft Project Skill Standards for Microsoft Office Specialist Certification.

Business and Marketing Fundamentals, Part A (1 Carnegie Unit)
Course Code: 992301

Unit	Title	Hours
1	Introduction to Business	10
2	Communication and Interpersonal Skills	20
3	Professional Development	15
4	Economics	70
	Total	**115**

Business and Marketing Fundamentals, Part B (1 Carnegie Unit)
Course Code: 992302

Unit	Title	Hours
5	Business, Management, and Entrepreneurship	55
6	Business Law	30
7	Personal Finance	30

	Total	**115**

Management Fundamentals (1 Carnegie Unit)
Course Code: 992304

Unit	Title	Hours
8	Introduction to Business Management	30
9	Principles of Business Management	30
10	Communication for Managers	30
11	Business Procedures	25
	Total	**115**

Management Essentials (1 Carnegie Unit)
Course Code: 992306

Unit	Title	Hours
12	Business Operations and Security	25
13	Information Management	30
14	Management Applications	35
	Total	**90**

Business Management Competencies and Objectives

Unit 1: Introduction to Business Management

1. Review educational, occupational, and leadership opportunities in Business Management. (DOK 1)
   a. Review student rules and regulations for the local school.
   b. Investigate career opportunities and emerging technologies in the Business pathway.
   c. Update the students' career and educational plans.
   d. Identify and describe leadership opportunities available from student youth organizations in the school and community.
   e. Examine the role of business leaders and their responsibilities in a democratic society.
2. Plan and develop an electronic portfolio. (DOK 3)
   a. Discuss the use and development of the electronic portfolio.
   b. Create and maintain an electronic portfolio.
3. Review safety in the classroom and lab. (DOK 1)
   a. Discuss the proper classroom and personal safety procedures to include fire extinguishers, electrical precaution, clothing, jewelry, eye protection, and so forth.
   b. Care for and use computer hardware correctly.
   c. Recognize the potential hazards of computer equipment.
4. Describe legal implications related to the use of technology. (DOK 1)
   a. Research the Copyright Law of 1976.
   b. Discuss software copyright issues.
   c. Examine software licensing.
   d. Outline Internet ethics and policies.
5. Publish and interact with peers, experts, and other audiences using telecommunications. (DOK 3)
   a. Research safety issues related to telecommunications and the Internet.
   b. Develop personal safety guidelines that will be used when using telecommunications and the Internet.
   c. Use browsers, search engines, and e-mail.
   d. Post information to discussion boards, blogs, wikis, and so forth.
   e. Join and participate in appropriate, supervised list servers.
   f. Use an appropriate, supervised chat room to communicate with peers, experts, and other approved audiences.
   g. Evaluate Web page design techniques.

Unit 2: Principles of Business Management

1. Describe management principles. (DOK 2)
   a. Describe the management process to include the managerial functions of planning, organizing, staffing, energizing, and controlling.
2. Evaluate employment information from multiple sources such as interviews, applications, references, and tests to make hiring decisions. (DOK 4)
   a. Explain the relationship of Title VII of the Civil Rights Act of 1964 to employment.
   b. Research the history of the Civil Rights Act of 1964.
   c. Describe situations in which employees or applicants may be asked to take tests.
   d. Evaluate employment applications, and screen applicants to be interviewed.
   e. Develop appropriate employment interview questions.
   f. Conduct employment interviews.
   g. Hire employees.
3. Plan employee orientation and training using online resources. (DOK 4)
   a. Develop appropriate employee orientation and training session.
4. Appraise employee performance. (DOK 3)
   a. Describe the steps in the management control process to include (1) setting standards, (2) measuring performance, (3) comparing performance with standards, and (4) taking corrective action.
   b. Produce an employment procedures manual.
   c. Conduct employee performance appraisals.
   d. Describe problem performance, and identify symptoms of a troubled employee.
   e. Describe counseling and performance management procedures for problem employees.
   f. Describe procedures for firing an employee, including due process.

Unit 3: Business Communication for Managers

1. Demonstrate business telephone procedures. (DOK 2)
   a. Research the history of the telephone and its impact on business communication.
   b. Demonstrate appropriate techniques for answering calls, placing calls on hold, and transferring calls.
   c. Accurately record telephone messages.
   d. Apply techniques for screening calls.
   e. Research specialized equipment available for physically impaired telephone users.
   f. Demonstrate techniques for handling difficult callers.
   g. Research wireless telephone services available for business use.
2. Create business documents. (DOK 3)

a. Identify the parts of business letter.
b. Correctly format business letters in the block, modified block, and simplified block styles and business envelopes.
c. Plan, organize, and create various business letters to include the following: Letter of request, persuasive letter, job offer letter, letter to unsuccessful job applicants, letter of refusal, sales and promotional letters, and handwritten thank-you note and envelope.
d. Critique business letters; proofread, edit, and make corrections.
e. Plan, organize, and create formal and simplified memos.
f. Research a management related topic, using electronic sources, and create a business report in APA style.
    (1) Examine online research techniques.
        a. Use a search engine.
        b. Critique electronic resources for credibility, timeliness, viewpoint/bias, accuracy, usefulness, appropriateness, depth and scope of information and the use of cited, reputable sources.
    (2) Preview report styles.
    (3) Plan, organize, and create a business report using word processing software.
    (4) Critique the report; proofread, edit, and make corrections.

Unit 4: Business Procedures

1. Demonstrate business use of mail, telecommunication systems, and office equipment. (DOK 2)
    a. Research the origins of the U.S. Postal Service.
    b. Classify and process incoming, outgoing, and confidential correspondence.
    c. Demonstrate the use of a facsimile machine.
    d. Demonstrate ethical, appropriate use of business e-mail.
    e. Create an acceptable use policy using online resources and word processing software.
    f. Describe the impact of science and technology on the historical development of business communication systems in the United States.
    g. Use the Internet to research and compare features and prices of photocopier systems.
    h. Given a business scenario, select a photocopier appropriate for a specified purpose, and provide a rationale for the selection.
2. Investigate time management concepts. (DOK 3)
    a. Explain guidelines to follow when scheduling appointments.
    b. Research and compare common time management techniques.
3. Conduct formal meetings, and prepare related documents using technology. (DOK 3)
    a. Describe the process of planning and scheduling formal meetings.
    b. Prepare an agenda in an acceptable format using word processing software.

   c. List the steps to follow in planning a business meeting.
   d. Conduct a business meeting according to Robert's Rules of Order.
   e. Prepare minutes in an acceptable format using word processing software.
   f. Discuss the similarities of business meeting procedures with the operations of the U.S. Congress.
4. Plan a trip using online resources. (DOK 3)
   a. Prepare a travel itinerary for a selected destination using word processing software.
   b. Prepare a travel budget and portfolio for the destination using word processing software.

Unit 5: Business Operations and Security

1. Explain the functions of business operations. (DOK 1)
   a. Discuss the types of business operations to include facilities management, logistics, scheduling, and safety.
   b. Discuss the role of ethics in operations.
   c. Describe the use of technology in operations.
2. Discuss health and safety regulations in the workplace and procedures for reporting noncompliance. (DOK 1)
   a. Identify health concerns.
   b. Review safety procedures for a given career field.
   c. Investigate federal safety regulations and procedures for reporting noncompliance.
3. Discuss purchasing activities to obtain business supplies, equipment, and services. (DOK 1)
   a. Explain purchasing procedures.
   b. Discuss procedures for maintaining an inventory of supplies.
   c. Discuss production.
   d. Describe production activities.
4. Implement quality-control processes to minimize errors and to expedite workflow. (DOK 4)
   a. Identify quality-control measures.
   b. Utilize quality-control methods at work.
   c. Describe the role of management in the achievement of quality.
   d. Establish efficient operating systems.
5. Implement expense-control strategies to enhance a business's financial well-being. (DOK 4)
   a. Explain the nature of overhead/operating costs.
   b. Explain the employee's role in expense control.

Unit 6: Information Management

1. Apply filing procedures. (DOK 3)
    a. Use the Internet to research federal laws related to confidentiality of records, and present findings.
    b. Discuss the importance of ethical conduct when working with sensitive information.
    c. Identify filing systems.
    d. Discuss classification, retention of records, storage methods for useful, important, and vital records.
    e. File records according to basic indexing rules for personal and business names manually and electronically.
    f. Discuss electronic filing and storage media used for filing systems.

Unit 7: Management Applications

1. Investigate the role of American business in a global society. (DOK 3)
    a. Determine the role of entrepreneurship in today's multicultural, global society.
    b. Analyze and discuss entrepreneurial opportunities in future trends.
    c. Outline the channels of distribution.
    d. Analyze the various types of businesses in the channels of distribution.
    e. Discuss the emergence of the United States' global business connections and the impact on U.S. business development and production.
2. Explore the various business ventures, and justify the selection. (DOK 3)
    a. Investigate the advantages/disadvantages of buying an established business and starting a business.
    b. Evaluate various business opportunities.
    c. Investigate the challenges of entering a family business.
    d. Determine benefits and drawbacks of buying an established business as opposed to starting a new business.
    e. Discuss the responsibilities of starting a business for one's self.
    f. Discuss the importance of the global marketplace, and determine where there are opportunities.
    g. Determine key factors to consider when doing business with another country.
3. Conduct marketing research. (DOK 3)
    a. Discuss the types of marketing research.
    b. Outline the steps in the research process.
    c. Analyze strengths and weaknesses of competitors.
    d. Complete a customer profile.
    e. Complete a customer needs analysis.

4. Produce a business plan. (DOK 3)
    a. Explain the purpose of a business plan.
    b. Analyze the parts of a business plan.
    c. Prepare a business plan using word processing software.
    d. Present the business plan using formal presentation techniques and electronic presentation software.
5. Investigate procedures for establishing a business. (DOK 3)
    a. Investigate registration of the business name and licensing procedures.
    b. Research the process for becoming a registered employer with the state and federal government.
    c. Investigate state and federal tax reporting procedures.
    d. Investigate options for financing a small business.
6. Apply concepts for managing a business. (DOK 4)
    a. Develop an organizational chart.
    b. Develop job descriptions for each position on the chart.
    c. Investigate planning, organizing, staffing, and controlling.
    d. Explain the meaning of legal and social responsibility.
7. Demonstrate business use of financial statements. (DOK 4)
    a. Demonstrate the use of petty cash in a business.
    b. Demonstrate the use of balance sheets and income statements in a business.
    c. Demonstrate the use of purchase orders and invoices in a business.

Appendix A: 21st Century Skills Standards

CSS1-21st Century Themes

CS1 Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
2. Exercising the rights and obligations of citizenship at local, state, national, and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals
5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

1. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems
2. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.)
3. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions
4. Take individual and collective action towards addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues)

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

1. Think creatively
2. Work creatively with others

3. Implement innovations

CS7 Critical Thinking and Problem Solving

1. Reason effectively
2. Use systems thinking
3. Make judgments and decisions
4. Solve problems

CS8 Communication and Collaboration

1. Communicate clearly
2. Collaborate with others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy

1. Access and evaluate information
2. Use and manage information

CS10 Media Literacy

1. Analyze media
2. Create media products

CS11 ICT Literacy

1. Apply technology effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to change
2. Be flexible

CS13 Initiative and Self-Direction

1. Manage goals and time
2. Work independently
3. Be self-directed learners

CS14 Social and Cross-Cultural Skills

1. Interact effectively with others
2. Work effectively in diverse teams

CS15 Productivity and Accountability

1. Manage projects
2. Produce results

CS16 Leadership and Responsibility

1. Guide and lead others
2. Be responsible to others

Appendix B: MS Academic Standards

MISSISSIPPI SCIENCE FRAMEWORK COMPETENCIES

Marine and Aquatic Science

AQ 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
AQ 2	Develop an understanding of physical and chemical properties of water and aquatic environments.
AQ 3	Apply an understanding of the diverse organisms found in aquatic environments.
AQ 4	Draw conclusions about the relationships between human activity and aquatic organisms.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
   a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
      - Safety rules and symbols
      - Proper use and care of the compound light microscope, slides, chemicals, etc.
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers

   b. Formulate questions that can be answered through research and experimental design. (DOK 3)
   c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
   d. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
   e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
   f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
   g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. **Develop an understanding of physical and chemical properties of water and aquatic environments.**
   a. Analyze the physical and chemical properties of water, and justify why it is essential to living organisms. (DOK 1)
   b. Explain the causes and characteristics of tides. (DOK 1)
   c. Research, create diagrams, and summarize principles related to waves and current characteristics and formation. (DOK 2)

d. Compare and contrast the physical and chemical parameters of dissolved O2, pH, temperature, salinity, and results obtained through analysis of different water column depths/zones. (DOK 2)
e. Investigate the causes and effects of erosion and discuss conclusions. (DOK 2)
f. Describe and differentiate among the major geologic features of specific aquatic environments. (DOK 1)
   - Plate tectonics
   - Rise, slope, elevation, and depth
   - Formation of dunes, reefs, barrier/volcanic islands, and coastal/flood plains
   - Watershed formation as it relates to bodies of freshwater
g. Compare and contrast the unique abiotic and biotic characteristics of selected aquatic ecosystems. (DOK 2)
   - Barrier island, coral reef, tidal pool, and ocean
   - River, stream, lake, pond, and swamp
   - Bay, sound, estuary, and marsh

3. <u>Apply an understanding of the diverse organisms found in aquatic environments.</u>

a. Analyze and explain the diversity and interactions among aquatic life. (DOK 3)
   - Adaptations of representative organisms for their aquatic environments
   - Relationship of organisms in food chains/webs within aquatic environments
b. Research, calculate, and interpret population data. (DOK 2)
c. Research and compare reproductive processes in aquatic organisms. (DOK 2)
d. Differentiate among characteristics of planktonic, nektonic, and benthic organisms. (DOK 1)
e. Explore the taxonomy of aquatic organisms, and use dichotomous keys to differentiate among the organisms. (DOK 2)
f. Research and explain the symbiotic relationships in aquatic ecosystems. (DOK 3)

4. <u>Draw conclusions about the relationships between human activity and aquatic organisms.</u>

a. Describe the impact of natural and human activity on aquatic ecosystems, and evaluate the effectiveness of various solutions to environmental problems. (DOK 3)
   - Sources of pollution in aquatic environments and methods to reduce the effects of the pollution
   - Effectiveness of a variety of methods of environmental management and stewardship
   - Effects of urbanization on aquatic ecosystems and the effects of continued expansion
b. Research and cite evidence of the effects of natural phenomena such as hurricanes, floods, or drought on aquatic habitats and organisms. (DOK 3)
c. Discuss the advantages and disadvantages involved in applications of modern technology in aquatic science. (DOK 2)
   - Careers related to aquatic science
   - Modern technology within aquatic science (e.g., mariculture and aquaculture)
   - Contributions of aquatic technology to industry and government

Biology I

BIOI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BIOI 2	Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
BIOI 3	Investigate and evaluate the interaction between living organisms and their environment.
BIOI 4	Analyze and explain the structures and function of the levels of biological organization.
BIOI 5	Demonstrate an understanding of the molecular basis of heredity.
BIOI 6	Demonstrate an understanding of principles that explain the diversity of life and biological evolution.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
   a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
      - Safety rules and symbols
      - Proper use and care of the compound light microscope, slides, chemicals, etc.
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers

   d. Formulate questions that can be answered through research and experimental design. (DOK 3)
   e. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 2)
   f. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
   g. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
   h. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
   i. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. **<u>Describe the biochemical basis of life, and explain how energy flows within and between the living systems.</u>**
   a. Explain and compare, using examples, the types of bond formation (e.g., covalent, ionic, hydrogen, etc.) between or among atoms. (DOK 2)
      - Subatomic particles and arrangement in atoms
      - Importance of ions in biological processes
   b. Develop a logical argument defending water as an essential component of living systems (e.g., unique bonding and properties including polarity, high specific heat, surface tension, hydrogen bonding, adhesion, cohesion, and expansion upon freezing). (DOK 2)
   c. Classify solutions as acidic, basic, or neutral, and relate the significance of the pH scale to an organism's survival (e.g., consequences of having different concentrations of hydrogen and hydroxide ions). (DOK 2)
   d. Compare and contrast the structure, properties, and principle functions of carbohydrates, lipids, proteins, and nucleic acids in living organisms. (DOK 2)
      - Basic chemical composition of each group
      - Building components of each group (e.g., amino acids, monosaccharides, nucleotides, etc.)
      - Basic functions (e.g., energy, storage, cellular, heredity) of each group
   e. Examine the life processes to conclude the role enzymes play in regulating biochemical reactions. (DOK 2)
      - Enzyme structure
      - Enzyme function, including enzyme-substrate specificity and factors that affect enzyme function (pH and temperature)
   f. Describe the role of adenosine triphosphate (ATP) in making energy available to cells. (DOK 1)
      - ATP structure
      - ATP function
   g. Analyze and explain the biochemical process of photosynthesis and cellular respiration, and draw conclusions about the roles of the reactant and products in each. (DOK 3)
      - Photosynthesis and respiration (reactants and products)
      - Light-dependent reactions and light independent reactions in photosynthesis, including requirements and products of each
      - Aerobic and anaerobic processes in cellular respiration, including products each and energy differences
3. **<u>Investigate and evaluate the interaction between living organisms and their environment.</u>**
   a. Compare and contrast the characteristics of the world's major biomes (e.g., deserts, tundra, taiga, grassland, temperate forest, tropical rainforest). (DOK 2)
      - Plant and animal species
      - Climate (temperature and rainfall)
      - Adaptations of organisms
   b. Provide examples to justify the interdependence among environmental elements. (DOK 2)
      - Biotic and abiotic factors in an ecosystem (e.g., water, carbon, oxygen, mold, leaves)

- Energy flow in ecosystems (e.g., energy pyramids and photosynthetic organisms to herbivores, carnivores, and decomposers)
- Roles of beneficial bacteria
- Interrelationships of organisms (e.g., cooperation, predation, parasitism, commensalism, symbiosis, and mutualism)

c. Examine and evaluate the significance of natural events and human activities on major ecosystems (e.g., succession, population growth, technology, loss of genetic diversity, consumption of resources). (DOK 2)

4. <u>Analyze and explain the structures and function of the levels of biological organization.</u>

a. Differentiate among plant and animal cells and eukaryotic and prokaryotic cells. (DOK 2)
   - Functions of all major cell organelles and structures (e.g., nucleus, mitochondrion, rough ER, smooth ER, ribosomes, Golgi bodies, vesicles, lysosomes, vacuoles, microtubules, microfiliaments, chloroplast, cytoskeleton, centrioles, nucleolus, chromosomes, nuclear membrane, cell wall, cell membrane [active and passive transport], cytosol)
   - Components of mobility (e.g., cilia, flagella, pseudopodia)

b. Differentiate between types of cellular reproduction. (DOK 1)
   - Main events in the cell cycle and cell mitosis (including differences in plant and animal cell divisions)
   - Binary fission (e.g., budding, vegetative propagation, etc.)
   - Significance of meiosis in sexual reproduction
   - Significance of crossing over

c. Describe and differentiate among the organizational levels of organisms (e.g., cells, tissues, organs, systems, types of tissues.) (DOK 1)

d. Explain and describe how plant structures (vascular and nonvascular) and cellular functions are related to the survival of plants (e.g., movement of materials, plant reproduction). (DOK 1)

5. <u>Demonstrate an understanding of the molecular basis of heredity.</u>

a. Analyze and explain the molecular basis of heredity and the inheritance of traits to successive generations by using the Central Dogma of Molecular Biology. (DOK 3)
   - Structures of DNA and RNA
   - Processes of replication, transcription, and translation
   - Messenger RNA codon charts

b. Utilize Mendel's laws to evaluate the results of monohybrid Punnett squares involving complete dominance, incomplete dominance, codominance, sex linked, and multiple alleles (including outcome percentage of both genotypes and phenotypes). (DOK 2)

c. Examine inheritance patterns using current technology (e.g., pedigrees, karyotypes, gel electrophoresis). (DOK 2)

d. Discuss the characteristics and implications of both chromosomal and gene mutations. (DOK 2)
   - Significance of nondisjunction, deletion, substitutions, translocation, frame shift mutation in animals

- Occurrence and significance of genetic disorders such as sickle cell anemia, Tay-Sachs disorder, cystic fibrosis, hemophilia, Down syndrome, color blindness

6. **<u>Demonstrate an understanding of principles that explain the diversity of life and biological evolution.</u>**
   a. Draw conclusions about how organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their evolutionary relationships. (DOK 2)
      - Characteristics of the six kingdoms
      - Major levels in the hierarchy of taxa (e.g., kingdom, phylum/division, class, order, family, genus, and species)
      - Body plans (symmetry)
      - Methods of sexual reproduction (e.g., conjugation, fertilization, pollination)
      - Methods of asexual reproduction (e.g., budding, binary fission, regeneration, spore formation)
   b. Critique data (e.g., comparative anatomy, Biogeography, molecular biology, fossil record, etc.) used by scientists (e.g., Redi, Needham, Spallanzani, Pasteur) to develop an understanding of evolutionary processes and patterns. (DOK 3)
   c. Research and summarize the contributions of scientists (including Darwin, Malthus, Wallace, Lamarck, and Lyell) whose work led to the development of the theory of evolution. (DOK 2)
   d. Analyze and explain the roles of natural selection, including the mechanisms of speciation (e.g., mutations, adaptations, geographic isolation) and applications of speciation (e.g., pesticide and antibiotic resistance). (DOK 3)
   e. Differentiate among chemical evolution, organic evolution, and the evolutionary steps along the way to aerobic heterotrophs and photosynthetic autotrophs. (DOK 2)

Biology II

BIOII 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BIOII 2	Describe and contrast the structures, functions, and chemical processes of the cell.
BIOII 3	Investigate and discuss the molecular basis of heredity.
BIOII 4	Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.
BIOII 5	Develop an understanding of organism classification.

1. **<u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>**
   a. Use current technologies such as CD-ROM, DVD, Internet, and on-line data search to explore current research related to a specific topic. (DOK 3)
   b. Clarify research questions and design laboratory investigations. (DOK 3)
   c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)

d. Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. <u>Describe and contrast the structures, functions, and chemical processes of the cell.</u>

a. Relate the structure and function of a selectively permeable membrane to its role in diffusion and osmosis. (DOK 2)
b. Summarize how cell regulation controls and coordinates cell growth and division. (DOK 2)
c. Analyze and describe the function of enzymes in biochemical reactions. (DOK 2)
   - The impact of enzymatic reactions on biochemical processes
   - Factors that affect enzyme function (e.g., pH, concentration, temperature, etc.)
d. Differentiate between photosynthesis and cellular respiration. (DOK 2)
   - Cellular sites and major pathways of anaerobic and aerobic respiration (with reactants, products, and ATP per monosaccharide)
   - Cellular respiration with respect to the sites at which they take place, the reactions involved, and the energy input and output in each stage (e.g., glycolysis, Krebs cycle, electron transport chain)
   - Pigments, absorption, reflection of light, and light-dependent and light-independent reactions of photosynthesis
     - Oxidation and reduction reactions

3. <u>Investigate and discuss the molecular basis of heredity.</u>

a. Explain how the process of meiosis clarifies the mechanism underlying Mendel's conclusions about segregation and independent assortment on a molecular level. (DOK 1)
b. Research and explain how major discoveries led to the determination of DNA structure. (DOK 2)
c. Relate gene expression (e.g., replication, transcription, translation) to protein structure and function. (DOK 2)
   - Translation of a messenger RNA strand into a protein
   - Processing by organelles so that the protein is appropriately packaged, labeled, and eventually exported by the cell
   - Messenger RNA codon charts to determine the effects of different types of mutations on amino acid sequence and protein structure (e.g., sickle cell anemia resulting from base substitution mutation)
   - Gene expression regulated in organisms so that specific proteins are synthesized only when they are needed by the cell (e.g., allowing cell specialization)

d. Assess the potential implications of DNA technology with respect to its impact on society. (DOK 3)
   - Modern DNA technologies (e.g., polymerase chain reaction (PCR), gene splicing, gel electrophoresis, transformation, recombinant DNA) in agriculture, medicine, and forensics

e. Develop a logical argument defending or refuting bioethical issues arising from applications of genetic technology (e.g., the human genome project, cloning, gene therapy, stem cell research). (DOK 3)

4. <u>Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.</u>

a. Explain the history of life on earth, and infer how geological changes provide opportunities and constraints for biological evolution. (DOK 2)
   - Main periods of the geologic timetable of earth's history
   - Roles of catastrophic and gradualistic processes in shaping planet Earth

b. Provide support for the argument based upon evidence from anatomy, embryology, biochemistry, and paleontology that organisms descended with modification from common ancestry. (DOK 2)

c. Identify and provide supporting evidence for the evolutionary relationships among various organisms using phylogenetic trees and cladograms. (DOK 2)

d. Formulate a scientific explanation based on fossil records of ancient life-forms, and describe how new species could originate as a result of geological isolation and reproductive isolation. (DOK 2)

e. Compare and contrast the basic types of selection (e.g., disruptive, stabilizing, directional, etc.). (DOK 2)

f. Cite examples to justify behaviors that have evolved through natural selection (e.g., migration, parental care, use of tools, etc.). (DOK 1)

g. Research and explain the contributions of 19th century scientists (e.g., Malthus, Wallace, Lyell, and Darwin) on the formulation of ideas about evolution. (DOK 2)

h. Develop a logical argument describing ways in which the influences of 20th century science have impacted the development of ideas about evolution (e.g., synthetic theory of evolution, molecular biology). (DOK 3)

i. Analyze changes in an ecosystem resulting from natural causes (succession), changes in climate, human activity (pollution and recycling), or introduction of nonnative species. (DOK 2)

5. <u>Develop an understanding of organism classification.</u>

a. Classify organisms according to traditional Linnaean classification characteristics (e.g., cell structure, biochemistry, anatomy, fossil record, methods of reproduction) and the cladistic approach. (DOK 2)

b. Categorize organisms according to the characteristics that distinguish them as Bacteria, Archaea, or Eucarya. (DOK 1)
   - Bacteria, fungi, and protists
   - Characteristics of invertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to phyla (e.g., Porifera, Cnidarians, Nematoda, Annelida, Platyhelmenthes, and Arthropoda) and classes (e.g., Insecta, Crustacea, Arachnida, Mollusca, Echinodermata)

- Characteristics of vertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to classes (e.g., Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, Mammalia)
- Nomenclature of various types of plants (e.g., Bryophyta, Tracheophyta, Gymnospermae, Angiospermae, Monocotyledonae, Dicotyledonae, vascular plants, nonvascular plants)

Botany

BO 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BO 2	Distinguish among the characteristics of botanical organization, structure, and function.
BO 3	Demonstrate an understanding of plant reproduction.
BO 4	Draw conclusions about the factors that affect the adaptation and survival of plants.
BO 5	Relate an understanding of plant genetics to its uses in modern living.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
   a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
      - Safety rules and symbols
      - Proper use and care of the compound light microscope, slides, chemicals, etc.
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers

   b. Formulate questions that can be answered through research and experimental design. (DOK 3)
   c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
   d. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
   e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
   f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
   g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Distinguish among the characteristics of botanical organization, structure, and function.**
   a. Relate plant cell structures to their functions (e.g., major organelles, cell wall components, photosynthetic chemical reactions, plant pigments, plant tissues, roots, stems, leaves, flowers). (DOK 1)
   b. Differentiate the characteristics found in various plant divisions. (DOK 2)

- Differences and similarities of nonvascular plants
- Characteristics of seed-bearing and non-seed bearing vascular plants relative to taxonomy
- Major vegetative structures and their modifications in angiosperms and gymnosperms

c. Compare and contrast leaf modifications of gymnosperms and angiosperms (e.g., needles, overlapping scales, simple leaves, compound leaves, evergreen trees, and deciduous trees). (DOK 2)

d. Apply the modern classification scheme utilized in naming plants to identify plant specimens. (DOK 2)
- Classification scheme used in botany
- Classification of native Mississippi plants

e. Use inquiry to investigate and discuss the physical and chemical processes of plants. (DOK 3)
- Relationships among photosynthesis, cellular respiration, and translocation
- Importance of soil type and soil profiles to plant survival
- Mechanism of water movement in plants
- Effects of environmental conditions for plant survival
- Tropic responses of a plant organ to a given stimulus

3. <u>Demonstrate an understanding of plant reproduction.</u>

a. Compare and contrast reproductive structures (e.g., cones, flowers). (DOK 2)

b. Differentiate among the vegetative organs of monocots, herbaceous dicots, and woody dicots. (DOK 1)

c. Differentiate between the structures and processes of sexual and asexual reproduction in plants. (DOK 1)
- Reproductive structures, their modifications, and the mechanisms involved in plant reproduction
- Functions of flower parts, seeds, cones
- Spore production in bryophytes and ferns

d. Explain and provide examples of the concept of alternation of generations and its examples. (DOK 2)

e. Categorize types of fruits and methods of seed distribution in plants. (DOK 1)

f. Research and compare various methods of plant propagation. (DOK 2)

4. <u>Draw conclusions about the factors that affect the adaptation and survival of plants.</u>

a. List and assess several adaptations of plants to survive in a given biome. (DOK 2)

b. Design and conduct an experiment to determine the effects of environmental factors on photosynthesis. (DOK 3)

c. Explain how natural selection and the evolutionary consequences (e.g., adaptation or extinction) support scientific explanations for similarities of ancient life-forms in the fossil record and molecular similarities present in living organisms. (DOK 2)

d. Research factors that might influence or alter plant stability, and propose actions that may reduce the negative impacts of human activity. (DOK 2)

5. <u>Relate an understanding of plant genetics to its uses in modern living.</u>

a. Research, prepare, and present a position relating to issues surrounding the current botanical trends involving biotechnology. (DOK 3)
b. Apply an understanding of the principles of plant genetics to analyze monohybrid and dihybrid crosses, and predict the potential effects the crosses might have on agronomy and agriculture. (DOK 3)
c. Discuss the effects of genetic engineering of plants on society. (DOK 2)
d. Describe the chemical compounds extracted from plants, their economical importance, and the impact on humans. (DOK 3)
    - Plant extracts, their function, and origin
    - Impact of the timber industry on local and national economy

Chemistry I

CHI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
CHI 2	Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.
CHI 3	Develop an understanding of the periodic table.
CHI 4.	Analyze the relationship between microscopic and macroscopic models of matter.
CHI 5	Compare factors associated with acid/base and oxidation/reduction reactions.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
    a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
    b. Clarify research questions and design laboratory investigations. (DOK 3)
    c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
    d. Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
    e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
    f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
    g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)
2. **Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.**
    a. Describe and classify matter based on physical and chemical properties and interactions between molecules or atoms. (DOK 1)
        - Physical properties (e.g., melting points, densities, boiling points) of a variety of substances

- Substances and mixtures
- Three states of matter in terms of internal energy, molecular motion, and the phase transitions between them

b. Research and explain crucial contributions and critical experiments of Dalton, Thomson, Rutherford, Bohr, de Broglie, and Schrődinger, and describe how each discovery contributed to the current model of atomic and nuclear structure. (DOK 2)

c. Develop a model of atomic and nuclear structure based on theory and knowledge of fundamental particles. (DOK 2)
   - Properties and interactions of the three fundamental particles of the atom
   - Laws of conservation of mass, constant composition, definite proportions, and multiple proportions

d. Write appropriate equations for nuclear decay reactions, describe how the nucleus changes during these reactions, and compare the resulting radiation with regard to penetrating ability. (DOK 1)
   - Three major types of radioactive decay (e.g., alpha, beta, gamma) and the properties of the emissions (e.g., composition, mass, charge, penetrating power)
   - The concept of half-life for a radioactive isotope (e.g., carbon-14 dating) based on the principle that the decay of any individual atom is a random process

e. Compare the properties of compounds according to their type of bonding. (DOK 1)
   - Covalent, ionic, and metallic bonding
   - Polar and nonpolar covalent bonding
   - Valence electrons and bonding atoms

f. Compare different types of intermolecular forces, and explain the relationship between intermolecular forces, boiling points, and vapor pressure when comparing differences in properties of pure substances. (DOK 1)

g. Develop a three-dimensional model of molecular structure. (DOK 2)
   - Lewis dot structures for simple molecules and ionic compounds
   - Valence shell electron pair repulsion theory (VSEPR)

3. <u>Develop an understanding of the periodic table.</u>

a. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)

b. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
   - Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
   - Average atomic mass calculations
   - Chemical characteristics of each region
   - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius)

c. Classify chemical reactions by type. (DOK 2)

- Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
- Products (given reactants) or reactants (given products) for each reaction type
- Solubility rules for precipitation reactions and the activity series for single and double displacement reactions

d. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)
   - Difference between chemical reactions and chemical equations
   - Formulas and calculations of the molecular (molar) masses
   - Empirical formula given the percent composition of elements
   - Molecular formula given the empirical formula and molar mass

4. <u>Analyze the relationship between microscopic and macroscopic models of matter.</u>

a. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)

b. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
   - Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
   - Average atomic mass calculations
   - Chemical characteristics of each region
   - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius)

c. Classify chemical reactions by type. (DOK 2)
   - Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
   - Products (given reactants) or reactants (given products) for each reaction type
   - Solubility rules for precipitation reactions and the activity series for single and double displacement reactions

d. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)
   - Difference between chemical reactions and chemical equations
   - Formulas and calculations of the molecular (molar) masses
   - Empirical formula given the percent composition of elements
   - Molecular formula given the empirical formula and molar mass

5. <u>Compare factors associated with acid/base and oxidation/reduction reactions.</u>

a. Analyze and explain acid/base reactions. (DOK 2)
   - Properties of acids and bases, including how they affect indicators and the relative pH of the solution
   - Formation of acidic and basic solutions
   - Definition of pH in terms of the hydronium ion concentration and the hydroxide ion concentration

- The pH or pOH from the hydrogen ion or hydroxide ion concentrations of solution
- How a buffer works and examples of buffer solutions

b. Classify species in aqueous solutions according to the Arrhenius and Bronsted-Lowry definitions respectively, and predict products for aqueous neutralization reactions. (DOK 2)

c. Analyze a reduction/oxidation reaction (REDOX) to assign oxidation numbers (states) to reaction species, and identify the species oxidized and reduced, the oxidizing agent, and reducing agent. (DOK 2)

Organic Chemistry

ORGC 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.

ORGC 2 Demonstrate an understanding of the properties, structure, and function of organic compounds.

ORGC 3 Discuss the versatility of polymers and the diverse application of organic chemicals.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
   a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
      - Safety rules and symbols
      - Proper use and care of the compound light microscope, slides, chemicals, etc.
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers

   b. Formulate questions that can be answered through research and experimental design. (DOK 3)

   c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)

   d. Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)

   e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)

   f. Recognize and analyze alternative explanations for experimental results, and make predictions based on observations and prior knowledge. (DOK 3)

   g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. **Demonstrate an understanding of the properties, structure, and function of organic compounds.**
   a. Apply International Union of Pure and Applied Chemistry (IUPAC) nomenclature, and differentiate the structure of aliphatic, aromatic, and cyclic hydrocarbon compounds. (DOK 1)

- Structures of hydrocarbon compounds
- Isomerism in hydrocarbon compounds

b. Relate structure to physical and chemical properties of hydrocarbon. (DOK 1)

c. Apply principles of geometry and hybridization to organic molecules. (DOK 2)
   - Lewis structures for organic molecules
   - Bond angles
   - Hybridization (as it applies to organic molecules)

d. Write, complete, and classify common reactions for aliphatic, aromatic, and cyclic hydrocarbons. (DOK 1)

e. Construct, solve, and explain equations representing combustion reactions, substitution reactions, dehydrogenation reactions, and addition reactions. (DOK 2)

f. Classify functional groups (e.g., alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines, amides, and nitrides) by their structure and properties. (DOK 2)
   - Structural formulas from functional group names and vice versa
   - Chemical and physical properties of compounds containing functional groups
   - Equations representing the transformation of one functional group into another

3. <u>Discuss the versatility of polymers and the diverse application of organic chemicals.</u>

a. Describe and classify the synthesis, properties, and uses of polymers. (DOK 2)
   - Common polymers
   - Synthesis of polymers from monomers by addition or condensation
   - Condensations of plastics according to their commercial types
   - Elasticity and other polymer properties

b. Develop a logical argument supporting the use of organic chemicals and their application in industry, drug manufacture, and biological chemistry. (DOK 1)
   - Common uses of polymers and organic compounds in medicine, drugs, and personal care products
   - Compounds that have the property to dye materials
   - Petrochemical production
   - Biologically active compounds in terms of functional group substrate interaction

c. Research and summarize the diversity, applications, and economics of industrial chemicals (solvents, coatings, surfactants, etc.). (DOK 3)

Earth and Space Science

E1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
E2	Develop an understanding of the history and evolution of the universe and earth.
E3	Discuss factors that are used to explain the geological history of earth.
E4	Demonstrate an understanding of earth systems relating to weather and climate.
E5	Apply an understanding of ecological factors to explain relationships between earth systems.

1. **<u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>**
   a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
      - Safety rules and symbols
      - Proper use and care of the compound light microscope, slides, chemicals, etc.
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers.
   b. Formulate questions that can be answered through research and experimental design. (DOK 3)
   c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
   d. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
   e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
   f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
   g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **<u>Develop an understanding of the history and evolution of the universe and earth.</u>**
   a. Summarize the origin and evolution of the universe. (DOK 2)
      - Big bang theory
      - Microwave background radiation
      - The Hubble constant
      - Evidence of the existence of dark matter and dark energy in the universe and the history of the universe
   b. Differentiate methods used to measure space distances, including astronomical unit, light-year, stellar parallax, Cepheid variables, and the red shift. (DOK 1)
   c. Interpret how gravitational attraction played a role in the formation of the planetary bodies and how the fusion of hydrogen and other processes in “ordinary” stars and supernovae lead to the formation of all other elements. (DOK 2)
   d. Summarize the early evolution of the earth, including the formation of Earth’s solid layers (e.g., core, mantle, and crust), the distribution of major elements, the origin of internal heat sources, and the initiation of plate tectonics. (DOK 2)
      - How the decay of radioactive isotopes is used to determine the age of rocks, earth, and the solar system
      - How Earth acquired its initial oceans and atmosphere
3. **<u>Discuss factors which are used to explain the geological history of earth.</u>**
   a. Develop an understanding of how plate tectonics create certain geological features, materials, and hazards. (DOK 1)
      - Plate tectonic boundaries (e.g., divergent, convergent, and transform)
      - Modern and ancient geological features to each kind of plate tectonic boundary

- Production of particular groups of igneous and metamorphic rocks and mineral resources
- Sedimentary basins created and destroyed through time

b. Compare and contrast types of mineral deposits/groups (e.g., oxides, carbonates, halides, sulfides, sulfates, silicates, phosphates). (DOK 2)
c. Categorize minerals and rocks by determining their physical and/or chemical characteristics. (DOK 2)
d. Justify the causes of certain geological hazards (e.g., earthquakes, volcanoes, tsunamis) to their effects on specific plate tectonic locations. (DOK 2)
e. Interpret and explain how rock relationships and fossils are used to reconstruct the geologic history of the earth. (DOK 2)
f. Apply principles of relative age (e.g., superposition, original horizontality, crosscutting relations, and original lateral continuity) to support an opinion related to earth's geological history. (DOK 3)
    - Types of unconformity (e.g., disconformity, angular unconformity, nonconformity)
    - Geological timetable
g. Apply the principle of uniformitarianism to relate sedimentary rock associations and their fossils to the environments in which the rocks were deposited. (DOK 2)
h. Compare and contrast the relative and absolute dating methods (e.g., the principle of fossil succession, radiometric dating, and paleomagnetism) for determining the age of the earth. (DOK 1)

4. <u>Demonstrate an understanding of earth systems relating to weather and climate.</u>

a. Explain the interaction of earth systems that affect weather and climate. (DOK 1)
    - Latitudinal variations in solar heating
    - The effects of Coriolis forces on ocean currents, cyclones, anticyclones, ocean currents, topography, and air masses (e.g., warm fronts, cold fronts, stationary fronts, and occluded fronts).
b. Interpret the patterns in temperature and precipitation that produce the climate regions on earth, and relate them to the hazards associated with extreme weather events and climate change (e.g., hurricanes, tornadoes, El Niño/La Niña, global warming). (DOK 2)
c. Justify how changes in global climate and variation in earth/sun relationships contribute to natural and anthropogenic (human-caused) modification of atmospheric composition. (DOK 2)
d. Summarize how past and present actions of ice, wind, and water contributed to the types and distributions of erosional and depositional features in landscapes. (DOK 1)
e. Research and explain how external forces affect earth's topography. (DOK 2)
    - How surface water and groundwater act as the major agents of physical and chemical weathering
    - How soil results from weathering and biological processes
    - Processes and hazards associated with both sudden and gradual mass wasting

5. <u>Apply an understanding of ecological factors to explain relationships between earth systems.</u>

a. Draw conclusions about how life on earth shapes earth systems and responds to the interaction of earth systems (lithosphere, hydrosphere, atmosphere, and

biosphere). (DOK 3)
    - Nature and distribution of life on earth, including humans, to the chemistry and availability of water
    - Distribution of biomes (e.g., terrestrial, freshwater, and marine) to climate regions through time
    - Geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) that interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming and channeling of rivers)
  b. Interpret the record of shared ancestry (fossils), evolution, and extinction as related to natural selection. (DOK 2)
  c. Identify the cause and effect relationships of the evolutionary innovations that most profoundly shaped earth systems. (DOK 1)
    - Photosynthesis and the atmosphere
    - Multicellular animals and marine environments
    - Land plants and terrestrial environments
  d. Cite evidence about how dramatic changes in earth's atmosphere influenced the evolution of life. (DOK 1)

Environmental Science

ES 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
ES 2	Develop an understanding of the relationship of ecological factors that affect an ecosystem.
ES 3	Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
  a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
    - Safety rules and symbols
    - Proper use and care of the compound light microscope, slides, chemicals, etc.
    - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
  b. Formulate questions that can be answered through research and experimental design. (DOK 3)
  c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
  d. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
  e. Analyze procedures, data, and conclusions to determine the scientific validity of

research. (DOK 3)

f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK3)

2. <u>Develop an understanding of the relationship of ecological factors that affect an ecosystem.</u>

a. Compare ways in which the three layers of the biosphere change over time and their influence on an ecosystem's ability to support life. (DOK 2)
b. Explain the flow of matter and energy in ecosystems. (DOK 2)
   - Interactions between biotic and abiotic factors
   - Indigenous plants and animals and their roles in various ecosystems
   - Biogeochemical cycles within the environment
c. Predict the impact of the introduction, removal, and reintroduction of an organism on an ecosystem. (DOK 3)
d. Develop a logical argument explaining the relationships and changes within an ecosystem. (DOK 2)
   - How a species adapts to its niche
   - Process of primary and secondary succession and its effects on a population
   - How changes in the environment might affect organisms
e. Explain the causes and effects of changes in population dynamics (e.g., natural selection, exponential growth, predator/prey relationships) to carrying capacity and limiting factors. (DOK 2)
f. Research and explain how habitat destruction leads to the loss of biodiversity. (DOK 2)
g. Compare and contrast the major biomes of the world's ecosystems, including location, climate, adaptations and diversity. (DOK 1)

3. <u>Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.</u>

a. Summarize the effects of human activities on resources in the local environments. (DOK 2)
   - Sources, uses, quality, and conservation of water
   - Renewable and nonrenewable resources
   - Effects of pollution (e.g., water, noise, air, etc.) on the ecosystem
b. Research and evaluate the impacts of human activity and technology on the lithosphere, hydrosphere, and atmosphere, and develop a logical argument to support how communities restore ecosystems. (DOK 3)
c. Research and evaluate the use of renewable and nonrenewable resources, and critique efforts to conserve natural resources and reduce global warming in the United States including (but not limited to) Mississippi. (DOK 3)

Genetics

G 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
G 2	Analyze the structure and function of the cell and cellular organelles.

G 3 Apply the principles of heredity to demonstrate genetic understandings.

1. **<u>Use critical thinking and scientific problem solving in designing and performing biological research and experimentation. (L, P, E)</u>**
   a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
   b. Clarify research questions and design laboratory investigations. (DOK 3)
   c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
   d. Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for pie, bar, and line graphs) to draw conclusions and make inferences. (DOK 3)
   e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
   f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
   g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)
2. **<u>Review the structure and function of the cell as it applies to genetics. (L)</u>**
   a. Cite evidence to illustrate how the structure and function of cells are involved in the maintenance of life. (DOK 2)
   b. Describe how organic components are integral to biochemical processes. (DOK 2)
   c. Differentiate among the processes by which plants and animals reproduce. (DOK 1)
      - Cell cycle and mitosis
      - Meiosis, spermatogenesis, and oogenesis
   d. Explain the significance of the discovery of nucleic acids. (DOK 1)
   e. Analyze and explain the structure and function of DNA and RNA in replication, transcription, translation and DNA repair. (DOK 2)
   f. Cite examples to compare the consequences of the different types of mutations. (DOK 1)
   g. Draw conclusions about the importance and potential impacts of the process of gene transfer used in biotechnology. (DOK 3)
3. **<u>Analyze the structure and function of DNA and RNA molecules. (L, P)</u>**
   a. Cite evidence that supports the significance of Mendel's concept of "particulate inheritance" to explain the understanding of heredity. (DOK 1)
   b. Apply classical genetics principles to solve basic genetic problems. (DOK 2)
      - Genes and alleles, dominance, recessiveness, the laws of segregation, and independent assortment
      - Inheritance of autosomal and sex-linked traits
      - Inheritance of traits influenced by multiple alleles and traits with polygenetic inheritance
      - Chromosomal theory of inheritance
   c. Apply population genetic concepts to summarize variability of multicellular organisms. (DOK 2)

- Genetic variability
- Hardy-Weinberg formula
- Migration and genetic drift
- Natural selection in humans

d. Distinguish and explain the applications of various tools and techniques used in DNA manipulation. (DOK 1)
   - Steps in genetic engineering experiments
   - Use of restriction enzymes
   - Role of vectors in genetic research
   - Use of transformation techniques

e. Research and present a justifiable explanation of the practical uses of biotechnology (e.g., chromosome mapping, karyotyping, and pedigrees). (DOK 2)

f. Develop and present a scientifically-based logical argument for or against moral and ethical issues related to genetic engineering. (DOK 3)

g. Research genomics (human and other organisms), and predict benefits and medical advances that may result from the use of genome projects. (DOK 2)

Geology

GE1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
GE2	Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.

1. <u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>

a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
   - Safety rules and symbols
   - Proper use and care of the compound light microscope, slides, chemicals, etc.
   - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers

b. Formulate questions that can be answered through research and experimental design. (DOK 3)

c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)

d. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)

e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)

f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. <u>Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.</u>

a. Differentiate the components of the earth's atmosphere and lithosphere. (DOK 1)
b. Research and summarize explanations of how earth acquired its initial atmosphere and oceans. (DOK 2)
c. Compare the causes and effects of internal and external components that shape earth's topography. (DOK 2)
   - Physical weathering (e.g., atmospheric, glacial, etc.)
   - Chemical weathering agents (e.g., acid precipitation, carbon dioxide, oxygen, water, etc.)
d. Develop an understanding of how plate tectonics create certain geologic features, materials, and hazards. (DOK 2)
   - Types of crustal movements and the resulting landforms (e.g., seafloor spreading, paleomagnetic measurements, and orogenesis)
   - Processes that create earthquakes and volcanoes
   - Asthenosphere
e. Summarize the theories of plate development and continental drift, and describe the causes and effects involved in each. (DOK 2)
f. Develop a logical argument to explain how geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming, and channeling of rivers). (DOK 2)
g. Interpret how the earth's geological time scale relates to geological history, landforms, and life-forms. (DOK 2)
h. Research and describe different techniques for determining relative and absolute age of the earth (e.g., index of fossil layers, superposition, radiometric dating, etc.). (DOK 1)
i. Summarize the geological activity of the New Madrid fault line, and compare and contrast it to geological activity in other parts of the world. (DOK 2)
j. Identify and differentiate the major geological features in Mississippi (e.g., Delta, Coastal Areas, etc.). (DOK 1)
k. Evaluate an emergency preparedness plan for natural disasters associated with crustal movement. (DOK 3)

<u>Physical Science</u>

PS 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
PS 2	Describe and explain how forces affect motion.
PS 3	Demonstrate an understanding of general properties and characteristics of waves.
PS 4	Develop an understanding of the atom.

PS 5 Investigate and apply principles of physical and chemical changes in matter.

1. **<u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>**
   a. Use appropriate laboratory safety symbols and procedures to design and conduct a scientific investigation. (DOK 2)
      - Safety symbols and safety rules in all laboratory activities
      - Proper use and care of the compound light microscope
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
   b. Identify questions that can be answered through scientific investigations. (DOK 3)
   c. Identify and apply components of scientific methods in classroom investigations. (DOK 3)
      - Predicting, gathering data, drawing conclusions
      - Recording outcomes and organizing data from a variety of sources (e.g., scientific articles, magazines, student experiments, etc.)
      - Critically analyzing current investigations/problems using periodicals and scientific scenarios
   d. Interpret and generate graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
   e. Analyze procedures and data to draw conclusions about the validity of research. (DOK 3)
   f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
   g. Communicate effectively to present and explain scientific results, using appropriate terminology and graphics. (DOK 3)
2. **<u>Describe and explain how forces affect motion.</u>**
   a. Demonstrate and explain the basic principles of Newton's three laws of motion including calculations of acceleration, force, and momentum. (DOK 2)
      - Inertia and distance-time graphs to determine average speed
      - Net force (accounting for gravity, friction, and air resistance) and the resulting motion of objects
      - Effects of the gravitational force on objects on Earth and effects on planetary and lunar motion
      - Simple harmonic motion (oscillation)
   b. Explain the connection between force, work, and energy. (DOK 2)
      - Force exerted over a distance (results in work done)
      - Force-distance graph (to determine work)
      - Network on an object that contributes to change in kinetic energy (work-to-energy theorem)
   c. Describe (with supporting details and diagrams) how the kinetic energy of an object can be converted into potential energy (the energy of position) and how energy is transferred or transformed (conservation of energy). (DOK 2)
   d. Draw and assess conclusions about charges and electric current. (DOK 2)
      - Static/current electricity and direct current/alternating current

- Elements in an electric circuit that are in series or parallel
- Conductors and insulators
- Relationship between current flowing through a resistor and voltage flowing across a resistor

e. Cite evidence and explain the application of electric currents and magnetic fields as they relate to their use in everyday living (e.g., the application of fields in motors and generators and the concept of electric current using Ohm's law). (DOK 2)

3. <u>Demonstrate an understanding of general properties and characteristics of waves.</u>

a. Differentiate among transverse, longitudinal, and surface waves as they propagate through a medium (e.g., string, air, water, steel beam). (DOK 1)

b. Compare properties of waves (e.g., superposition, interference, refraction, reflection, diffraction, Doppler effect), and explain the connection among the quantities (e.g., wavelength, frequency, period, amplitude, and velocity). (DOK 2)

c. Classify the electromagnetic spectrum's regions according to frequency and/or wavelength, and draw conclusions about their impact on life. (DOK 2)
- The emission of light by electrons when moving from higher to lower levels
- Energy (photons as quanta of light)
- Additive and subtractive properties of colors
- Relationship of visible light to the color spectrum

d. Explain how sound intensity is measured and its relationship to the decibel scale. (DOK 1)

4. <u>Develop an understanding of the atom.</u>

a. Cite evidence to summarize the atomic theory. (DOK 1)
- Models for atoms
- Hund's rule and Aufbau process to specify the electron configuration of elements
- Building blocks of matter (e.g., proton, neutron, and electron) and elementary particles (e.g., positron, mesons, neutrinos, etc.)
- Atomic orbitals (s, p, d, f) and their basic shapes

b. Explain the difference between chemical and physical changes, and demonstrate how these changes can be used to separate mixtures and compounds into their components. (DOK 2)

c. Research the history of the periodic table of the elements, and summarize the contributions that led to the atomic theory. (DOK 2)
- Contributions of scientists (e.g., John Dalton, J.J. Thomson, Ernest Rutherford, Newton, Einstein, Neils, Bohr, Louis de Broglie, Erwin Schrödinger, etc.)
- Technology (e.g., X-rays, cathode-ray tubes, spectroscopes)
- Experiments (e.g., gold-foil, cathode-ray, etc.)

d. Utilize the periodic table to predict and explain patterns and draw conclusions about the structure, properties, and organization of matter. (DOK 2)
- Atomic composition and valence electron configuration (e.g., atomic number, mass number of protons, neutrons, electrons, isotopes, and ions)
- Periodic trends using the periodic table (e.g., valence, reactivity, atomic radius)
- Average atomic mass from isotopic abundance
- Solids, liquids, and gases

- Periodic properties of elements (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius) and how they relate to position in the periodic table

5. **Investigate and apply principles of physical and chemical changes in matter.**
   a. Write chemical formulas for compounds comprising monatomic and polyatomic ions. (DOK 1)
   b. Balance chemical equations. (DOK 2)
   c. Classify types of chemical reactions (e, g., composition, decomposition, single displacement, double displacement, combustion, acid/base reactions). (DOK 2)

Physics I

PHYI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
PHYI 2	Develop an understanding of concepts related to forces and motion.
PHYI 3	Develop an understanding of concepts related to work and energy.
PHYI 4	Discuss the characteristics and properties of light and sound.
PHYI 5	Apply an understanding of magnetism, electric fields, and electricity.
PHYI 6	Analyze and explain concepts of nuclear physics.

1. **Investigate and apply principles of physical and chemical changes in matter.**
   a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
   b. Clarify research questions, and design laboratory investigations. (DOK 3)
   c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
   d. Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
   e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
   f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
   g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)
2. **Develop an understanding of concepts related to forces and motion.**
   a. Use inquiry to investigate and develop an understanding of the kinematics and dynamics of physical bodies. (DOK 3)
      - Vector and scalar quantities
      - Vector problems (solved mathematically and graphically)
      - Vector techniques and free-body diagrams to determine the net force on a body when several forces are acting on it
      - Relations among mass, inertia, and weight

b. Analyze, describe, and solve problems by creating and utilizing graphs of one-dimensional motion (e.g., position, distance, displacement, time, speed, velocity, acceleration, the special case of free fall). (DOK 2)
c. Analyze real-world applications to draw conclusions about Newton's three laws of motion. (DOK 2)
d. Apply the effects of the universal gravitation law to graph and interpret the force between two masses, acceleration due to gravity, and planetary motion. (DOK 2)
   - Situations where g is constant (falling bodies)
   - Concept of centripetal acceleration undergoing uniform circular motion
   - Kepler's third law
   - Oscillatory motion and the mechanics of waves

3. <u>Develop an understanding of concepts related to work and energy.</u>

a. Explain and apply the conservation of energy and momentum. (DOK 2)
   - Concept of work and applications
   - Concept of kinetic energy, using the elementary work-energy theorem
   - Concept of conservation of energy with simple examples
   - Concepts of energy, work, and power (qualitatively and quantitatively)
   - Principles of impulse in inelastic and elastic collisions
b. Analyze real-world applications to draw conclusions about mechanical potential energy (the energy of configuration). (DOK 3)
c. Apply the principles of impulse, and compare conservation of momentum and conservation of kinetic energy in perfectly inelastic and elastic collisions. (DOK 1)
d. Investigate and summarize the principles of thermodynamics. (DOK 2)
   - How heat energy is transferred from higher temperature to lower temperature until equilibrium is reached
   - Temperature and thermal energy as related to molecular motion and states of matter
   - Problems involving specific heat and heat capacity
   - First and second laws of thermodynamics as related to heat engines, refrigerators, and thermal efficiency
e. Develop the kinetic theory of ideal gases and explain the concept of Carnot efficiency. (DOK 2)

4. <u>Discuss the characteristics and properties of light and sound.</u>

a. Describe and model the characteristics and properties of mechanical waves. (DOK 2)
   - Simple harmonic motion
   - Relationships among wave characteristics such as velocity, period, frequency, amplitude, phase, and wavelength
   - Energy of a wave in terms of amplitude and frequency.
   - Standing waves and waves in specific media (e.g., stretched string, water surface, air, etc.)
b. Differentiate and explain the Doppler effect as it relates to a moving source and to a moving observer. (DOK 1)
c. Explain the laws of reflection and refraction, and apply Snell's law to describe the relationship between the angles of incidence and refraction. (DOK 2)

d. Use ray tracing and the thin lens equation to solve real-world problems involving object distance from lenses. (DOK 2)
e. Investigate and draw conclusions about the characteristics and properties of electromagnetic waves. (DOK 2)

5. <u>Apply an understanding of magnetism, electric fields, and electricity.</u>

a. Analyze and explain the relationship between electricity and magnetism. (DOK 2)
   - Characteristics of static charge and how a static charge is generated
   - Electric field, electric potential, current, voltage, and resistance as related to Ohm's law
   - Magnetic poles, magnetic flux and field, Ampère's law and Faraday's law
   - Coulomb's law
b. Use schematic diagrams to analyze the current flow in series and parallel electric circuits, given the component resistances and the imposed electric potential. (DOK 2)
c. Analyze and explain the relationship between magnetic fields and electrical current by induction, generators, and electric motors. (DOK 2)

6. <u>Analyze and explain concepts of nuclear physics.</u>

a. Analyze and explain the principles of nuclear physics. (DOK 1)
   - The mass number and atomic number of the nucleus of an isotope of a given chemical element
   - The conservation of mass and the conservation of charge
   - Nuclear decay
b. Defend the wave-particle duality model of light, using observational evidence. (DOK 3)
   - Quantum energy and emission spectra
   - Photoelectric and Compton effects

<u>Spatial Information Science</u>

SP 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.

SP 2 Develop an understanding of geographic information systems.

1. <u>Demonstrate the basic concepts of global positioning systems (GPS). (E)</u>

a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
b. Clarify research questions, and design laboratory investigations. (DOK 3)
c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
d. Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences). (DOK 3)
e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)

f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBLs, etc.). (DOK 3)

2. **Demonstrate the basic concepts of remote sensing. (E, P)**
   a. Describe the characteristics of the electromagnetic spectrum.
   b. Using images and graphs, interpret the absorption/reflection spectrum.
   c. Distinguish between passive vs. active sensor systems.
   d. Analyze the effects of changes in spatial, temporal, and spectral resolution.
   e. Analyze the effects on images due to changes in scale.
   f. Identify the types of sensor platforms.

Zoology

ZO 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
ZO 2	Develop an understanding of levels of organization and animal classification.
ZO 3	Differentiate among animal life cycles, behaviors, adaptations, and relationships.
ZO 4	Demonstrate an understanding of the principles of animal genetic diversity and evolution.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
   a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
      - Safety rules and symbols
      - Proper use and care of the compound light microscope, slides, chemicals, etc.
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
   b. Formulate questions that can be answered through research and experimental design. (DOK 3)
   c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
   d. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
   e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
   f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
   g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Develop an understanding of levels of organization and animal classification.**
   a. Explain how organisms are classified, and identify characteristics of major

groups. (DOK 1)
    - Levels of organization of structures in animals (e.g., cells, tissues, organs, and systems)
    - Characteristics used to classify organisms (e.g., cell structure, biochemistry, anatomy, fossil record, and methods of reproduction)
  b. Identify and describe characteristics of the major phyla. (DOK 1)
    - Symmetry and body plan
    - Germ layers and embryonic development
    - Organ systems (e.g., digestive, circulatory, excretory, and reproductive)
    - Locomotion and coordination
  c. Distinguish viruses from bacteria and protists, and give examples. (DOK 1)
  d. Differentiate among the characteristics of bacteria, archaea, and eucarya. (DOK 1)
    - Phylogenic sequencing of the major phyla
    - Invertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following phyla: Porifera, Cnidarians, Nematoda, Annelida, Platyhelmenthes, Arthropoda, Insecta, Crustacea, Arachnida, Mollusca [Bivalvia and Gastropoda], and Echinodermata)
    - Vertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following classes: Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, and Mammalia

3. <u>Differentiate among animal life cycles, behaviors, adaptations, and relationships.</u>

  a. Describe life cycles, alternation of generations, and metamorphosis of various animals, and evaluate the advantages and disadvantages of asexual and sexual reproduction. (DOK 1)
  b. Describe and explain concepts of animal behavior, and differentiate between learned and innate behavior. (DOK 1)
    - Division of labor within a group of animals
    - Communication within animals groups
    - Degree of parental care given in animal groups
  c. Evaluate the unique protective adaptations of animals as they relate to survival. (DOK 2)
  d. Compare and contrast ecological relationships, and make predictions about the survival of populations under given circumstances. (DOK 3)
    - Terrestrial and aquatic ecosystems
    - Herbivores, carnivores, omnivores, decomposers and other feeding relationships
    - Symbiotic relationships such as mutualism, commensalisms, and parasitism
  e. Contrast food chains and food webs. (DOK 2)

4. <u>Demonstrate an understanding of the principles of animal genetic diversity and evolution.</u>

  a. Categorize and explain sources of genetic variation on the cellular level (e.g., mutations, crossing over, and nondisjunction) and the population level (e.g., nonrandom mating, migration, etc.). (DOK 2)
    - Relationship between natural selection and evolution
    - Mutations, crossing over, nondisjunction
    - Nonrandom mating, migration, etc.

- Effects of genetic drift on evolution

b. Develop a logical argument defending or refuting issues related to genetic engineering of animals. (DOK 3)

Appendix C: ACT College Readiness Standards

English

E1 Topic Development in Terms of Purpose and Focus

- Identify the basic purpose or role of a specified phrase or sentence.
- Delete a clause or sentence because it is obviously irrelevant to the essay.
- Identify the central idea or main topic of a straightforward piece of writing.
- Determine relevancy when presented with a variety of sentence-level details.
- Identify the focus of a simple essay, applying that knowledge to add a sentence that sharpens that focus or to determine if an essay has met a specified goal.
- Delete material primarily because it disturbs the flow and development of the paragraph.
- Add a sentence to accomplish a fairly straightforward purpose such as illustrating a given statement.
- Apply an awareness of the focus and purpose of a fairly involved essay to determine the rhetorical effect and suitability of an existing phrase or sentence or to determine the need to delete plausible but irrelevant material.
- Add a sentence to accomplish a subtle rhetorical purpose such as to emphasize, to add supporting detail, or to express meaning through connotation.
- Determine whether a complex essay has accomplished a specific purpose.
- Add a phrase or sentence to accomplish a complex purpose, often expressed in terms of the main focus of the essay.

E2 Organization, Unity, and Coherence

- Use conjunctive adverbs or phrases to show time relationship in simple narrative essays (e.g., *then, this time*, etc.).
- Select the most logical place to add a sentence in a paragraph.
- Use conjunctive adverbs or phrases to express straightforward logical relationships (e.g., *first, afterward, in response*).
- Decide the most logical place to add a sentence in an essay.
- Add a sentence that introduces a simple paragraph.
- Determine the need for conjunctive adverbs or phrases to create subtle logical connections between sentences (e.g., *therefore, however, in addition*).
- Rearrange the sentences in a fairly uncomplicated paragraph for the sake of logic.
- Add a sentence to introduce or conclude the essay or to provide a transition between paragraphs when the essay is fairly straightforward.
- Make sophisticated distinctions concerning the logical use of conjunctive adverbs or phrases, particularly when signaling a shift between paragraphs.
- Rearrange sentences to improve the logic and coherence of a complex paragraph.
- Add a sentence to introduce or conclude a fairly complex paragraph.
- Consider the need for introductory sentences or transitions, basing decisions on a thorough understanding of both the logic and rhetorical effect of the paragraph and essay.

E3 Word Choice in Terms of Style, Tone, Clarity, and Economy

- Revise sentences to correct awkward and confusing arrangements of sentence elements.
- Revise vague nouns and pronouns that create obvious logic problems.
- Delete obviously synonymous and wordy material in a sentence.
- Revise expressions that deviate from the style of an essay.
- Delete redundant material when information is repeated in different parts of speech (e.g., *alarmingly startled*).
- Use the word or phrase most consistent with the style and tone of a fairly straightforward essay.
- Determine the clearest and most logical conjunction to link clauses.
- Revise a phrase that is redundant in terms of the meaning and logic of the entire sentence.
- Identify and correct ambiguous pronoun references.
- Use the word or phrase most appropriate in terms of the content of the sentence and tone of the essay.
- Correct redundant material that involves sophisticated vocabulary and sounds acceptable as conversational English (e.g., *an aesthetic viewpoint* versus *the outlook of an aesthetic viewpoint*).
- Correct vague and wordy or clumsy and confusing writing containing sophisticated language.
- Delete redundant material that involves subtle concepts or that is redundant in terms of the paragraph as a whole.

E4 Sentence Structure and Formation

- Use conjunctions or punctuation to join simple clauses.
- Revise shifts in verb tense between simple clauses in a sentence or between simple adjoining sentences.
- Determine the need for punctuation and conjunctions to avoid awkward sounding sentence fragments and fused sentences.
- Decide the appropriate verb tense and voice by considering the meaning of the entire sentence.
- Recognize and correct marked disturbances of sentence flow and structure (e.g., participial phrase fragments, missing or incorrect relative pronouns, dangling or misplaced modifiers).
- Revise to avoid faulty placement of phrases and faulty coordination and subordination of clauses in sentences with subtle structural problems.
- Maintain consistent verb tense and pronoun person on the basis of the preceding clause or sentence.
- Use sentence-combining techniques, effectively avoiding problematic comma splices, run-on sentences, and sentence fragments, especially in sentences containing compound subjects or verbs.
- Maintain a consistent and logical use of verb tense and pronoun person on the basis of information in the paragraph or essay as a whole.

- Work comfortably with long sentences and complex clausal relationships within sentences, avoiding weak conjunctions between independent clauses and maintaining parallel structure between clauses.

E5 Conventions of Usage

- Solve such basic grammatical problems as how to form the past and past participle of irregular but commonly used verbs and how to form comparative and superlative adjectives.
- Solve such grammatical problems as whether to use an adverb or adjective form, how to ensure straightforward subject–verb and pronoun–antecedent agreement, and which preposition to use in simple contexts.
- Recognize and use the appropriate word in frequently confused pairs such as *there* and *their*, *past* and *passed*, and *led* and *lead*.
- Use idiomatically appropriate prepositions, especially in combination with verbs (e.g., *long for*, *appeal to*).
- Ensure that a verb agrees with its subject when there is some text between the two.
- Ensure that a pronoun agrees with its antecedent when the two occur in separate clauses or sentences.
- Identify the correct past and past participle forms of irregular and infrequently used verbs, and form present–perfect verbs by using *have* rather than *of*.
- Correctly use reflexive pronouns, the possessive pronouns *its* and *your*, and the relative pronouns *who* and *whom*.
- Ensure that a verb agrees with its subject in unusual situations (e.g., when the subject–verb order is inverted or when the subject is an indefinite pronoun).
- Provide idiomatically and contextually appropriate prepositions following verbs in situations involving sophisticated language or ideas.
- Ensure that a verb agrees with its subject when a phrase or clause between the two suggests a different number for the verb.

E6 Conventions of Punctuation

- Delete commas that create basic sense problems (e.g., between verb and direct object).
- Provide appropriate punctuation in straightforward situations (e.g., items in a series).
- Delete commas that disturb the sentence flow (e.g., between modifier and modified element).
- Use commas to set off simple parenthetical phrases.
- Delete unnecessary commas when an incorrect reading of the sentence suggests a pause that should be punctuated (e.g., between verb and direct object clause).
- Use punctuation to set off complex parenthetical phrases.
- Recognize and delete unnecessary commas based on a careful reading of a complicated sentence (e.g., between the elements of a compound subject or compound verb joined by *and*).
- Use apostrophes to indicate simple possessive nouns.
- Recognize inappropriate uses of colons and semicolons.
- Use commas to set off a nonessential/nonrestrictive appositive or clause.

- Deal with multiple punctuation problems (e.g., compound sentences containing unnecessary commas and phrases that may or may not be parenthetical).
- Use an apostrophe to show possession, especially with irregular plural nouns.
- Use a semicolon to indicate a relationship between closely related independent clauses.
- Use a colon to introduce an example or an elaboration.

Math

M1 Basic Operations and Applications

- Perform one-operation computation with whole numbers and decimals.
- Solve problems in one or two steps using whole numbers.
- Perform common conversions (e.g., inches to feet or hours to minutes).
- Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent.
- Solve some routine two-step arithmetic problems.
- Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average.
- Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour).
- Solve word problems containing several rates, proportions, or percentages.
- Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings).

M2 Probability, Statistics, and Data Analysis

- Calculate the average of a list of positive whole numbers.
- Perform a single computation using information from a table or chart.
- Calculate the average of a list of numbers.
- Calculate the average, given the number of data values and the sum of the data values.
- Read tables and graphs.
- Perform computations on data from tables and graphs.
- Use the relationship between the probability of an event and the probability of its complement.
- Calculate the missing data value, given the average and all data values but one.
- Translate from one representation of data to another (e.g., a bar graph to a circle graph).
- Determine the probability of a simple event.
- Exhibit knowledge of simple counting techniques.*
- Calculate the average, given the frequency counts of all the data values.
- Manipulate data from tables and graphs.
- Compute straightforward probabilities for common situations.
- Use Venn diagrams in counting.*
- Calculate or use a weighted average.
- Interpret and use information from figures, tables, and graphs.

- Apply counting techniques.
- Compute a probability when the event and/or sample space is not given or obvious.
- Distinguish between mean, median, and mode for a list of numbers.
- Analyze and draw conclusions based on information from figures, tables, and graphs.
- Exhibit knowledge of conditional and joint probability.

M3 Numbers: Concepts and Properties

- Recognize equivalent fractions and fractions in lowest terms.
- Recognize one-digit factors of a number.
- Identify a digit's place value.
- Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor.
- Find and use the least common multiple.
- Order fractions.
- Work with numerical factors.
- Work with scientific notation.
- Work with squares and square roots of numbers.
- Work problems involving positive integer exponents.*
- Work with cubes and cube roots of numbers.*
- Determine when an expression is undefined.*
- Exhibit some knowledge of the complex numbers.†
- Apply number properties involving prime factorization.
- Apply number properties involving even and odd numbers and factors and multiples.
- Apply number properties involving positive and negative numbers.
- Apply rules of exponents.
- Multiply two complex numbers.†
- Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers.
- Exhibit knowledge of logarithms and geometric sequences.
- Apply properties of complex numbers.

M4 Expressions, Equations, and Inequalities

- Exhibit knowledge of basic expressions (e.g., identify an expression for a total as $b + g$).
- Solve equations in the form $x + a = b$, where a and b are whole numbers or decimals.
- Substitute whole numbers for unknown quantities to evaluate expressions.
- Solve one-step equations having integer or decimal answers.
- Combine like terms (e.g., $2x + 5x$).
- Evaluate algebraic expressions by substituting integers for unknown quantities.
- Add and subtract simple algebraic expressions.
- Solve routine first-degree equations.
- Perform straightforward word-to-symbol translations.
- Multiply two binomials.*
- Solve real-world problems using first-degree equations.

- Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions).
- Identify solutions to simple quadratic equations.
- Add, subtract, and multiply polynomials.*
- Factor simple quadratics (e.g., the difference of squares and perfect square trinomials).*
- Solve first-degree inequalities that do not require reversing the inequality sign.*
- Manipulate expressions and equations.
- Write expressions, equations, and inequalities for common algebra settings.
- Solve linear inequalities that require reversing the inequality sign.
- Solve absolute value equations.
- Solve quadratic equations.
- Find solutions to systems of linear equations.
- Write expressions that require planning and/or manipulating to accurately model a situation.
- Write equations and inequalities that require planning, manipulating, and/or solving.
- Solve simple absolute value inequalities.

M5 Graphical Representations

- Identify the location of a point with a positive coordinate on the number line.
- Locate points on the number line and in the first quadrant.
- Locate points in the coordinate plane.
- Comprehend the concept of length on the number line.*
- Exhibit knowledge of slope.*
- Identify the graph of a linear inequality on the number line.*
- Determine the slope of a line from points or equations.*
- Match linear graphs with their equations.*
- Find the midpoint of a line segment.*
- Interpret and use information from graphs in the coordinate plane.
- Match number line graphs with solution sets of linear inequalities.
- Use the distance formula.
- Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point.
- Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle).†
- Match number-line graphs with solution sets of simple quadratic inequalities.
- Identify characteristics of graphs based on a set of conditions or on a general equation such as y = ax2 + c.
- Solve problems integrating multiple algebraic and/or geometric concepts.
- Analyze and draw conclusions based on information from graphs in the coordinate plane.

M6 Properties of Plane Figures

- Exhibit some knowledge of the angles associated with parallel lines.

- Find the measure of an angle using properties of parallel lines.
- Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°).
- Use several angle properties to find an unknown angle measure.
- Recognize Pythagorean triples.*
- Use properties of isosceles triangles.*
- Apply properties of 30°-60°-90°, 45°-45°-90°, similar, and congruent triangles.
- Use the Pythagorean theorem.
- Draw conclusions based on a set of conditions.
- Solve multistep geometry problems that involve integrating concepts, planning, visualization, and/or making connections with other content areas.
- Use relationships among angles, arcs, and distances in a circle.

M7 Measurement

- Estimate or calculate the length of a line segment based on other lengths given on a geometric figure.
- Compute the perimeter of polygons when all side lengths are given.
- Compute the area of rectangles when whole number dimensions are given.
- Compute the area and perimeter of triangles and rectangles in simple problems.
- Use geometric formulas when all necessary information is given.
- Compute the area of triangles and rectangles when one or more additional simple steps are required.
- Compute the area and circumference of circles after identifying necessary information.
- Compute the perimeter of simple composite geometric figures with unknown side lengths.*
- Use relationships involving area, perimeter, and volume of geometric figures to compute another measure.
- Use scale factors to determine the magnitude of a size change.
- Compute the area of composite geometric figures when planning or visualization is required.

M8 Functions

- Evaluate quadratic functions, expressed in function notation, at integer values.
- Evaluate polynomial functions, expressed in function notation, at integer values.†
- Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths.†
- Evaluate composite functions at integer values.†
- Apply basic trigonometric ratios to solve right-triangle problems.†
- Write an expression for the composite of two simple functions.†
- Use trigonometric concepts and basic identities to solve problems.†
- Exhibit knowledge of unit circle trigonometry.†
- Match graphs of basic trigonometric functions with their equations.

Notes

- Students who score in the 1–12 range are most likely beginning to develop the knowledge and skills assessed in the other ranges.
- Standards followed by an asterisk (*) apply to the PLAN and ACT Mathematics tests only.
- Standards followed by a dagger (†) apply to the ACT Mathematics test only.

Reading

R1 Main Ideas and Author's Approach

- Recognize a clear intent of an author or narrator in uncomplicated literary narratives.
- Identify a clear main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Infer the main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in uncomplicated passages.
- Identify a clear main idea or purpose of any paragraph or paragraphs in uncomplicated passages.
- Infer the main idea or purpose of straightforward paragraphs in more challenging passages.
- Summarize basic events and ideas in more challenging passages.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in more challenging passages.
- Infer the main idea or purpose of more challenging passages or their paragraphs.
- Summarize events and ideas in virtually any passage.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in virtually any passage.
- Identify clear main ideas or purposes of complex passages or their paragraphs.

R2 Supporting Details

- Locate basic facts (e.g., names, dates, events) clearly stated in a passage.
- Locate simple details at the sentence and paragraph level in uncomplicated passages.
- Recognize a clear function of a part of an uncomplicated passage.
- Locate important details in uncomplicated passages.
- Make simple inferences about how details are used in passages.
- Locate important details in more challenging passages.
- Locate and interpret minor or subtly stated details in uncomplicated passages.
- Discern which details, though they may appear in different sections throughout a passage, support important points in more challenging passages.
- Locate and interpret minor or subtly stated details in more challenging passages.
- Use details from different sections of some complex informational passages to support a specific point or argument.
- Locate and interpret details in complex passages.
- Understand the function of a part of a passage when the function is subtle or complex.

R3 Sequential, Comparative, and Cause–Effect Relationships

- Determine when (e.g., first, last, before, after) or if an event occurred in uncomplicated passages.
- Recognize clear cause–effect relationships described within a single sentence in a passage.

- Identify relationships between main characters in uncomplicated literary narratives.
- Recognize clear cause–effect relationships within a single paragraph in uncomplicated literary narratives.
- Order simple sequences of events in uncomplicated literary narratives.
- Identify clear relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear cause–effect relationships in uncomplicated passages.
- Order sequences of events in uncomplicated passages.
- Understand relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear relationships between characters, ideas, and so forth in more challenging literary narratives.
- Understand implied or subtly stated cause–effect relationships in uncomplicated passages.
- Identify clear cause–effect relationships in more challenging passages.
- Order sequences of events in more challenging passages.
- Understand the dynamics between people, ideas, and so forth in more challenging passages.
- Understand implied or subtly stated cause–effect relationships in more challenging passages.
- Order sequences of events in complex passages.
- Understand the subtleties in relationships between people, ideas, and so forth in virtually any passage.
- Understand implied, subtle, or complex cause–effect relationships in virtually any passage.

R4 Meaning of Words

- Understand the implication of a familiar word or phrase and of simple descriptive language.
- Use context to understand basic figurative language.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in uncomplicated passages.
- Use context to determine the appropriate meaning of virtually any word, phrase, or statement in uncomplicated passages.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in more challenging passages.
- Determine the appropriate meaning of words, phrases, or statements from figurative or somewhat technical contexts.
- Determine, even when the language is richly figurative and the vocabulary is difficult, the appropriate meaning of context-dependent words, phrases, or statements in virtually any passage.

R5 Generalizations and Conclusions

- Draw simple generalizations and conclusions about the main characters in uncomplicated literary narratives.
- Draw simple generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw simple generalizations and conclusions using details that support the main points of more challenging passages.
- Draw subtle generalizations and conclusions about characters, ideas, and so forth in uncomplicated literary narratives.
- Draw generalizations and conclusions about people, ideas, and so forth in more challenging passages.
- Use information from one or more sections of a more challenging passage to draw generalizations and conclusions about people, ideas, and so forth.
- Draw complex or subtle generalizations and conclusions about people, ideas, and so forth, often by synthesizing information from different portions of the passage.
- Understand and generalize about portions of a complex literary narrative.

Science

S1 Interpretation of Data

- Select a single piece of data (numerical or non-numerical) from a simple data presentation (e.g., a table or graph with two or three variables, a food web diagram).
- Identify basic features of a table, graph, or diagram (e.g., headings, units of measurement, axis labels).
- Select two or more pieces of data from a simple data presentation.
- Understand basic scientific terminology.
- Find basic information in a brief body of text.
- Determine how the value of one variable changes as the value of another variable changes in a simple data presentation.
- Select data from a complex data presentation (e.g., a table or graph with more than three variables, a phase diagram).
- Compare or combine data from a simple data presentation (e.g., order or sum data from a table).
- Translate information into a table, graph, or diagram.
- Compare or combine data from two or more simple data presentations (e.g., categorize data from a table using a scale from another table).
- Compare or combine data from a complex data presentation.
- Interpolate between data points in a table or graph.
- Determine how the value of one variable changes as the value of another variable changes in a complex data presentation.
- Identify and/or use a simple (e.g., linear) mathematical relationship between data.
- Analyze given information when presented with new, simple information.

- Compare or combine data from a simple data presentation with data from a complex data presentation.
- Identify and/or use a complex (e.g., nonlinear) mathematical relationship between data.
- Extrapolate from data points in a table or graph.
- Compare or combine data from two or more complex data presentations.
- Analyze given information when presented with new, complex information.

S2 Scientific Investigation

- Understand the methods and tools used in a simple experiment.
- Understand the methods and tools used in a moderately complex experiment.
- Understand a simple experimental design.
- Identify a control in an experiment.
- Identify similarities and differences between experiments.
- Understand the methods and tools used in a complex experiment.
- Understand a complex experimental design.
- Predict the results of an additional trial or measurement in an experiment.
- Determine the experimental conditions that would produce specified results.
- Determine the hypothesis for an experiment.
- Identify an alternate method for testing a hypothesis.
- Understand precision and accuracy issues.
- Predict how modifying the design or methods of an experiment will affect results.
- Identify an additional trial or experiment that could be performed to enhance or evaluate experimental results.

S3 Evaluation of Models, Inferences, and Experimental Results

- Select a simple hypothesis, prediction, or conclusion that is supported by a data presentation or a model.
- Identify key issues or assumptions in a model.
- Select a simple hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a simple hypothesis or conclusion and why.
- Identify strengths and weaknesses in one or more models.
- Identify similarities and differences between models.
- Determine which model(s) is/are supported or weakened by new information.
- Select a data presentation or a model that supports or contradicts a hypothesis, prediction, or conclusion.
- Select a complex hypothesis, prediction, or conclusion that is supported by a data presentation or model.
- Determine whether new information supports or weakens a model and why.
- Use new information to make a prediction based on a model.
- Select a complex hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a complex hypothesis or conclusion and why.

Writing

W1 Expressing Judgments

- Show a little understanding of the persuasive purpose of the task, but neglect to take or to maintain a position on the issue in the prompt.
- Show limited recognition of the complexity of the issue in the prompt.
- Show a basic understanding of the persuasive purpose of the task by taking a position on the issue in the prompt but may not maintain that position.
- Show a little recognition of the complexity of the issue in the prompt by acknowledging, but only briefly describing, a counterargument to the writer's position.
- Show understanding of the persuasive purpose of the task by taking a position on the issue in the prompt.
- Show some recognition of the complexity of the issue in the prompt by doing the following:
    - Acknowledging counterarguments to the writer's position
    - Providing some response to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a broad context for discussion.
- Show recognition of the complexity of the issue in the prompt by doing the following:
    - Partially evaluating implications and/or complications of the issue
    - Posing and partially responding to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a critical context for discussion.
- Show understanding of the complexity of the issue in the prompt by doing the following:
    - Examining different perspectives
    - Evaluating implications or complications of the issue
    - Posing and fully discussing counterarguments to the writer's position

W2 Focusing on the Topic

- Maintain a focus on the general topic in the prompt through most of the essay.
- Maintain a focus on the general topic in the prompt throughout the essay.
- Maintain a focus on the general topic in the prompt throughout the essay, and attempt a focus on the specific issue in the prompt.
- Present a thesis that establishes focus on the topic.
- Maintain a focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a thesis that establishes a focus on the writer's position on the issue.
- Maintain a clear focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a critical thesis that clearly establishes the focus on the writer's position on the issue.

W3 Developing a Position

- Offer a little development, with one or two ideas; if examples are given, they are general and may not be clearly relevant; resort often to merely repeating ideas.
- Show little or no movement between general and specific ideas and examples.
- Offer limited development of ideas using a few general examples; resort sometimes to merely repeating ideas.
- Show little movement between general and specific ideas and examples.
- Develop ideas by using some specific reasons, details, and examples.
- Show some movement between general and specific ideas and examples.
- Develop most ideas fully, using some specific and relevant reasons, details, and examples.
- Show clear movement between general and specific ideas and examples.
- Develop several ideas fully, using specific and relevant reasons, details, and examples.
- Show effective movement between general and specific ideas and examples.

W4 Organizing Ideas

- Provide a discernible organization with some logical grouping of ideas in parts of the essay.
- Use a few simple and obvious transitions.
- Present a discernible, though minimally developed, introduction and conclusion.
- Provide simple organization with logical grouping of ideas in parts of the essay.
- Use some simple and obvious transitional words, though they may at times be inappropriate or misleading.
- Present a discernible, though underdeveloped, introduction and conclusion.
- Provide an adequate but simple organization with logical grouping of ideas in parts of the essay but with little evidence of logical progression of ideas.
- Use some simple and obvious, but appropriate, transitional words and phrases.
- Present a discernible introduction and conclusion with a little development.
- Provide unity and coherence throughout the essay, sometimes with a logical progression of ideas.
- Use relevant, though at times simple and obvious, transitional words and phrases to convey logical relationships between ideas.
- Present a somewhat developed introduction and conclusion.
- Provide unity and coherence throughout the essay, often with a logical progression of ideas.
- Use relevant transitional words, phrases, and sentences to convey logical relationships between ideas.
- Present a well-developed introduction and conclusion.

W5 Using Language

- Show limited control of language by doing the following:
    - Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes significantly impede understanding

- Using simple vocabulary
- Using simple sentence structure
- Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes impede understanding
- Using simple but appropriate vocabulary
- Using a little sentence variety, though most sentences are simple in structure
- Correctly employing many of the conventions of standard English grammar, usage, and mechanics but with some distracting errors that may occasionally impede understanding
- Using appropriate vocabulary
- Using varied kinds of sentence structures to vary pace
- Correctly employing most conventions of standard English grammar, usage, and mechanics with a few distracting errors but none that impede understanding
- Using some precise and varied vocabulary
- Using several kinds of sentence structures to vary pace and to support meaning
- Correctly employing most conventions of standard English grammar, usage, and mechanics with just a few, if any, errors
- Using precise and varied vocabulary
- Using a variety of kinds of sentence structures to vary pace and to support meaning

Appendix D: Pathway Content Standards

National Business Core Standards[1]

Business Core

BC1 Understands the responsibility of business to know, abide by, and enforce laws, regulations, and ethical behavior that affect business operations and transactions

BC2 Understands the concepts, strategies, and systems used to obtain and convey ideas and information

BC3 Understands the techniques and strategies used to foster positive, ongoing relationships with customers

BC4 Understands the economic principles and concepts fundamental to business operations

BC5 Understands techniques, strategies, and systems used to foster self-understanding and enhance relationships with others

BC6 Understands the concepts, processes, and skills associated with identifying new ideas, opportunities, and methods and with creating or starting a new project or venture

BC7 Understands tools, strategies, and systems used to maintain, monitor, control, and plan the use of financial resources

BC8 Understands the tools, techniques, and systems that businesses use to plan, staff, lead, and organize its human resources

BC9 Understands tools, strategies, and systems needed to access, process, maintain, evaluate, and disseminate information to assist in business decision making

BC10 Understands the tools, techniques, and systems that businesses use to create exchanges and satisfy organizational objectives

BC11 Understands the processes and systems implemented to monitor, plan, and control the day-to-day activities required for continued business functioning

BC12 Understands concepts, tools, and strategies used to explore, obtain, and develop in a business career

BC13 Understands the concepts and processes needed to move, store, locate, and/or transfer ownership of goods and services

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[1] *Business Management and Administration Career Cluster Status Report – Marketing Education Resource Center*. (2008). Retrieved November 27, 2007, from http://www.mark-ed.org. Reprinted with permission. ©2008, MarkED/Career Paths. Columbus, OH www.Mark-ED.org

BC14 Understands tools, techniques, and systems that affect a business's ability to plan, control, and organize an organization/department

MA 1 Business Management and Administration Core

- Understands the techniques and strategies used to foster positive, ongoing relationships with customers
- Understands the systems, strategies, and techniques used to collect, organize, analyze, and share information known in an organization
- Understands tools, techniques, and systems that are used to plan, implement, monitor, and evaluate business projects
- Understands the need for standards and the strategies and techniques used to implement, monitor, and evaluate them
- Understands risk-management strategies and techniques used to implement, monitor, and evaluate them
- Understands risk-management strategies and techniques used to minimize business loss

MA 2 Administrative Services

- Understands the concepts, strategies, and systems used in administrative services to obtain and convey ideas and information
- Understands techniques, strategies, and systems used in administrative services to foster self-understanding and enhance relationships with others
- Understands the tools, techniques, and systems that administrative service supervisors use to plan, staff, lead, and organize their human resources
- Understands tools, strategies, and systems administrative service employees need to access, process, maintain, evaluate, and disseminate information to support managers
- Understands the processes and systems implemented to monitor, plan, and control the day-to-day administrative activities required for continued business functioning
- Understands concepts, tools, and strategies used to explore, obtain, and develop in an administrative services career

MA 3 Business Information Management

- Understands business's responsibility to know, abide by, and enforce laws and regulations that affect business operations and transactions
- Understands tools, strategies, and systems used to maintain, monitor, control, and plan the use of financial resources
- Understands tools, strategies, and systems needed to access, process, maintain, evaluate, and disseminate information to assist business decision making
- Understands the processes and systems implemented to monitor, plan, and control the day-to-day activities required for continued business functioning
- Understands concepts, tools, and strategies used to explore, obtain, and develop in a business information management career
- Understands tools, techniques, and systems that affect a business's ability to plan, control, and organize an organization/department

MA 4 General Management

- Understands business's responsibility to know, abide by, and enforce laws and regulations that affect business operations and transactions
- Understands the concepts, strategies, and systems used by management to obtain and convey ideas and information
- Understands the economic principles and concepts fundamental to business operations
- Understands techniques, strategies, and systems used by management to foster self-understanding and enhance relationships with others
- Understands tools, strategies, and systems managers use to maintain, monitor, control, and plan the use of financial resources
- Understands the processes and systems that managers implement to monitor, plan, and control the day-to-day business activities required for continued business functioning
- Understands concepts, tools, and strategies used to explore, obtain, and develop in a management career
- Understands tools, techniques, and systems that affect a manager's ability to plan, control, and organize

MA 5 Human Resource Management

- Understands business's responsibility to know, abide by, and enforce laws and regulations that affect business operations and transactions
- Understands the concepts, strategies, and systems used by management to obtain and convey ideas and information
- Understands techniques, strategies, and systems used by human resources management to foster self-understanding and enhance relationships with others
- Understands tools, strategies, and systems managers use to maintain, monitor, control, and plan the use of financial resources
- Understands the tools techniques, and systems that businesses use to plan, staff, lead, and organize human resources
- Understands tools, strategies, and systems human resources management needs to access, process, maintain, evaluate, and disseminate information to support managers
- Understands the tools, techniques, and systems that businesses use to create, communicate, and deliver value to customers and to manage customer relationships in ways that benefit the organization and its stakeholders
- Understands the processes and systems that human resources management implements to monitor, plan, and control the day-to-day business activities required for continued business functioning
- Understands concepts, tools, and strategies used to explore, obtain, and develop in a human resources management career
- Understands tools, techniques, and systems that affect human resources management's ability to plan, control, and organize

MA 6 Operations Management

- Understands business's responsibility to know, abide by, and enforce laws and regulations that affect business operations and transactions
- Understands the techniques and strategies used to foster positive, ongoing relationships with customers
- Understands tools, strategies, and systems used to maintain, monitor, control, and plan the use of financial resources
- Understands tools, strategies, and systems needed to access, process, maintain, evaluate, and disseminate information to assist operations management decision making
- Understands the processes and systems that operations managers implement to monitor, plan, and control the day-to-day business activities required for continued business functioning
- Understands concepts, tools, and strategies used to explore, obtain, and develop in an operations management career

Appendix E: National Educational Technology Standards for Students

T1 Creativity and Innovation
T2 Communication and Collaboration
T3 Research and Information Fluency
T4 Critical Thinking, Problem Solving, and Decision Making
T5 Digital Citizenship
T6 Technology Operations and Concepts

T1 Creativity and Innovation

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students do the following:

a. Apply existing knowledge to generate new ideas, products, or processes.
b. Create original works as a means of personal or group expression.
c. Use models and simulations to explore complex systems and issues.
d. Identify trends and forecast possibilities.

T2 Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students do the following:

a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
c. Develop cultural understanding and global awareness by engaging with learners of other cultures.
d. Contribute to project teams to produce original works or solve problems.

T3 Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information. Students do the following:

a. Plan strategies to guide inquiry.
b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
d. Process data and report results.

T4 Critical Thinking, Problem Solving, and Decision Making

Students use critical-thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students do the following:

a. Identify and define authentic problems and significant questions for investigation.

b. Plan and manage activities to develop a solution or complete a project.
c. Collect and analyze data to identify solutions and/or make informed decisions.
d. Use multiple processes and diverse perspectives to explore alternative solutions.

T5 Digital Citizenship

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students do the following:

a. Advocate and practice safe, legal, and responsible use of information and technology.
b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.
c. Demonstrate personal responsibility for lifelong learning.
d. Exhibit leadership for digital citizenship.

T6 Technology Operations and Concepts

Students demonstrate a sound understanding of technology concepts, systems, and operations. Students do the following:

a. Understand and use technology systems.
b. Select and use applications effectively and productively.
c. Troubleshoot systems and applications.
d. Transfer current knowledge to learning of new technologies.

FRAMEWORKS FOR

CAREER-TECHNICAL PROGRAMS

REVISED IN

2011

SECONDARY

EXECUTIVE SUMMARY

2011

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Foreword

Secondary career-technical education programs in Mississippi are faced with many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, Mississippi Code of 1972, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, ch. 487, §14; Laws, 1991, ch. 423, §1; Laws, 1992, ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act III, 1998; and No Child Left Behind Act of 2001).

Each secondary career-technical course consists of a series of instructional units which focus on a common theme. All units have been written using a common format which includes the following components:

- Unit Number and Title
- Suggested Time on Task - An estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75-80 percent of the time in the course.
- Competencies and Suggested Objectives
  - A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies.
  - The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.
- Suggested Teaching Strategies - This section of each unit indicates strategies that can be used to enable students to master each competency. Emphasis has been placed on strategies which reflect active learning methodologies. Teachers should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.
- Suggested Assessment Strategies - This section indicates strategies that can be used to measure student mastery. Examples of suggested strategies could include rubrics, class participation, reflection, and journaling. Again, teachers should feel free to modify or enhance these suggested assessment strategies based on local needs and resources.
- Integrated Academic Topics, Workplace Skills, Technology Standards, and Occupational Standards - This section identifies related academic topics as required in the Subject Area Assessment Program (SATP) in Algebra I, Biology I, English II, and U. S. History from 1877, which are integrated into the content of the unit. It also identifies the 21st Century

Skills, which were developed by the Partnership for 21st Century Skills, a group of business and education organizations concerned about the gap between the knowledge and skills learned in school and those needed in communities and the workplace. A portion of the 21st Century Skills addresses learning skills needed in the 21st century, including information and communication skills, thinking and problem-solving skills, and interpersonal and self-directional skills. The need for these types of skills have been recognized for some time. The 21st Century Skills are adapted in part from the 1991 report from the U.S. Secretary of Labor's Commission on Achieving Necessary Skills (SCANS). Another important aspect of learning and working in the 21st century involves technology skills. The International Society for Technology in Education, developers of the National Education Technology Standards (NETS), were strategic partners in the Partnership for 21st Century Skills.

- References - A list of suggested references is provided for each unit. The list includes some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested and the list may be modified or enhanced based on needs and abilities of students and on available resources.

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Entrepreneurship

Entrepreneurship Executive Summary

Course Description

Entrepreneurship is a course in the Business career cluster. This course introduces students to the rewards and risks of owning or operating a business enterprise. Emphasis is placed on the mastery of skills needed to plan, organize, manage, and finance a small business. Skills in communication, technical writing, mathematics, research, and problem-solving are reinforced as each student prepares his/her own business plan. Work-based learning strategies appropriate for this course will be provided through the Career Pathway Experience (CPE) program. Simulations, projects, teamwork, and FBLA leadership activities, meetings, conferences, and competitions provide opportunities for application of instructional competencies.

Course Outline

Entrepreneurship (One Carnegie Unit)

Unit		Title	Hours
1		Introduction, Safety, and Orientation	5
2		Entrepreneurial Skills	5
3		Ready Skills: Business Foundations and Communication Skills	10
4		Ready Skills: Economics	15
5		Ready Skills: Financial Literacy	15
6		Ready Skills: Professional Development	5
7		Business Functions: Financial Management	10
8		Business Functions: Human Resource Management	10
9		Business Functions: Marketing Management	10
10		Business Functions: Operations and Strategic Management	20
11		Business Plan	35
		Teacher Selected Curriculum Activities	10
			140

Entrepreneurship Competencies and Objectives

Unit 1: Introduction, Safety, and Orientation

1. Identify course expectations and school and course policies.(DOK1)
   a. Identify school rules, policies and procedures and identify and establish course guidelines and procedures. (DOK 1).
   b. Review course standards and affiliated national standards. (DOK 1)
   c. Review the comparison of self- and course expectations. (DOK 1)
2. Demonstrate the proper use and care for classroom equipment. (DOK1)
   a. Identify describe, and demonstrate the importance of safety and the proper use of lab and classroom equipment. (DOK1)
   b. Describe the operating procedures for the equipment utilized in the course. (DOK1)
   c. Compare and contrast safety issues in the classroom to safety issues in industry. (DOK1)
3. Explore personality development and the classroom environment in relation to interpersonal skills, others, and the world of work. (DOK 1)
   a. Identify forces that shape personality development including personality traits, heredity, and environment. (DOK 2)
   b. Identify learning styles. (DOK 1)
4. Develop and incorporate 21st Century Skills throughout the Entrepreneurship course. (DOK 3)
   a. Define the four elements and outcomes of 21st Century Skills. (DOK 1)
   b. Distinguish the qualities and behaviors of an effective leader and identify opportunities to develop leadership skills. (DOK 2)
   c. Distinguish and practice effective leadership, and teambuilding skills. (DOK 3)
   d. Demonstrate appreciation and respect for diversity. (DOK 3)
   e. Explore the entrepreneurship profession and individual career development (DOK 2)

Unit 2: Entrepreneurial Skills

1. Define the concept of entrepreneurship and entrepreneurial opportunity. (DOK1)
   a. Compare and contrast the types of entrepreneurs and research roles, personal traits, and characteristics of an entrepreneur. (DOK 2)
   b. Classify the advantages and disadvantages of entrepreneurship (DOK 3).
   c. Understand the entrepreneurship process. (DOK 1)
2. Understand the concepts and processes associated with successful entrepreneurial performance. (DOK 2)
   a. Analyze and understand cultural differences, responsibilities, and ethical behaviors. (DOK 2)

   b. Use self-confidence and self-improvement tactics to recognize personal strengths and to reflect on interests and talents. (DOK 2)
   c. Develop networking skills and investigate mentoring programs. (DOK 2)
3. Understand the risks and rewards of different types of businesses. (DOK 2)
   a. Define risk, rewards, and potential for return on investment and minimizing loss. (DOK 2)
   b. Know the costs of limiting risks and maximizing reward. (DOK 1)
   c. Be able to compare data using probability, uncertainty, estimation, and approximation and solve problems that do not require exact answers. (DOK 3)

Unit 3: Ready Skills: Business Foundations and Communication Skills

1. Understand essential business concepts that affect business planning and decision making. (DOK 2)
   a. Identify different types of companies and compare the differences in manufacturing, wholesale, retail, and service companies. (DOK 2)
   b. Research, define, analyze, and compare ownership strategies as well as categories of businesses such as: sole proprietorship, partnership, corporation, nonprofit corporation, and cooperative businesses. (DOK 2)
   c. Categorize the regulations of business ownership and understand ethical business decisions. (DOK 2)
2. Develop effective listening, oral, non-verbal, and written communication skills. (DOK 3)
   a. Demonstrate an understanding of reading and writing for information and understanding. (DOK 1)
   b. Presents information clearly and effectively interacts with others while using listening, speaking, and writing skills for persuasion, information, and analysis. (DOK 2)
   c. Compare the fundamentals of communication, ethics in communication, group working relationships, and dealing with conflict in an entrepreneurial venture. (DOK 3)
3. Understand concepts, tools and procedures needed for basic computer operations and to access, process, maintain, evaluate, and disseminate information for good business decisions. (DOK 2)
   a. Show good computer basics, computer applications for business tasks and use correct technology etiquette with telephones, voice mail, and e-mail. (DOK 2)
   b. Use Internet resources effectively and practice online research, locating data online, understanding new technologies and trends. (DOK 2)
   c. Create multimedia presentations using graphics, text features, and online research. (DOK 2)
   d. Understand customer databases and distinguish record keeping, technology use, and information acquisition. (DOK 2)

Unit 4: Ready Skills: Economics

1. Understand the economic principles and concepts fundamental to entrepreneurship and small-business ownership. (DOK 1)
   a. Define and analyze basic entrepreneurship concepts, the economic way of thinking, cost-profit relationships, economic indicators/trends, economic systems, and international concepts. (DOK 2)
   b. Identify supply, demand, competition driven by demand, monopolies, market share, mindshare, free market economy, and command economy. (DOK 1)
   c. Understand the roles of profit and risk, the function of price, trends in the global marketplace, characteristics of a market economy, and the role of government in business. (DOK 2)
2. Determine if a business strategy is successful. (DOK 1)
   a. Know how to calculate gross profit, cost/profit/loss and return on investment, and calculate currency exchange rates. (DOK 2)
   b. Identify a unit of sale in different types of businesses, determine the cost of labor as factored into the unit of sale and determine price per unit to compare prices (DOK 2)
   c. Understand fixed costs, variable costs, profits, losses, ROI, EOU, saving, and differentiate between different funding sources. (DOK 2)

Unit 5: Ready Skills: Financial Literacy

1. Investigate the incorporation of a business. (DOK 1)
   a. Identify and compare corporation, stock holders, board of directors, dividends, corporate liability. (DOK 1)
   b. Investigate the resources and determine cash needs for funding an entrepreneurial venture, and interpret financial statements. (DOK 2)
2. Compare personal money-management concepts, procedures and strategies. (DOK 2)
   a. Analyze money basics, financial services, and personal money management, and calculate financial mathematical operations, using percentages and rounding numbers. (DOK 2)
   b. Use problem solving creatively, interpret graphs and charts, and use diagrams to develop strategies. (DOK 2)

Unit 6: Ready Skills: Professional Development

1. Understand the concepts and strategies needed for career exploration, development, and growth. (DOK 1)

   a. Assess the importance of educational attainment in an entrepreneurial venture and compare the credibility of workers with education and certifications. (DOK 1)
   b. Compare career planning skills and job-seeking skills, and practice appropriate business interviewing skills. (DOK 2)
   c. Understand the concept of writing for social interaction. (DOK 3)
2. Recognize business organizations and their importance to entrepreneurs. (DOK 3)
   a. Understand the importance of business incubators and the importance of having and being a mentor. (DOK 2)
   b. Investigate social networking through the Internet, and civic and social organizations. (DOK 1)
   c. Explore area recycling programs and other community-related or civic issues and activities. (DOK 1)
   d. Compare local cause-related marketing strategies. (DOK 3)

Unit 7: Business Functions: Financial Management

1. Understand financial concepts and tools used in making business decisions. (DOK 2)
   a. Understand accounting tools, finance tools, and money management. (DOK 2)
   b. Understand financial spreadsheet formulas. (DOK 1)
   c. Use mental math, numeration, and operations for financial management. (DOK 2)
2. Understand accounting fundamentals. (DOK 3)
   a. Identify types of business records. (DOK 1)
   b. Set up business records such as, receipts, invoices, income statements, balance sheets, and cash flow statements. (DOK 2)
   c. Understand profit margin, same size analysis, and projected income. (DOK 3)

Unit 8: Business Functions: Human Resources Management

1. Investigate indicators of effective workplaces. (DOK 2)
   a. Express knowledge of workers and their needs, comparing safety in working environments. (DOK 2)
   b. Understand team building and be able to explain the benefits of building networks. (DOK 2)
   c. Understand the concepts of diversity and cultural differences, and investigate the Americans with Disabilities Act. (DOK 2)
   d. Research ways to deal with criticism, develop listening skills, and understand harassment in the workplace. (DOK 2)
2. Understand the concepts, systems, and strategies needed to acquire, motivate, develop and terminate staff. (DOK 2)

   a. Research organizing, staffing, training/development, morale/motivation, and evaluation. (DOK 2)
   b. Understand hiring employees and building teams within a business. (DOK 1)
   c. Research monitoring achievement within an organization. (DOK 1)

Unit 9: Business Functions: Marketing

1. Identify the four Ps of Marketing (product, place, price, promotion). (DOK 2)
   a. Compare the place where the business is located and all aspects of the competition. (DOK 2)
   b. Understand market research, market share via marketing, market analysis, and marketing plan. (DOK 2)
   c. Understand the types of advertising and recognize the value of good advertising compared to poor advertising. (DOK 1)
   d. Show product/service creation, marketing-information management, promotion, pricing, and selling. (DOK 2)
2. Understand the concepts, processes, and systems needed to determine and satisfy customer needs/wants/expectations, meet business goals/objectives, and create new product/service ideas. (DOK 3)
   a. Understand customer needs, the importance of the demographics of buyers, and all aspects of selling. (DOK 2)
   b. Research reaching, keeping, and increasing the market, and import/export opportunities. (DOK 2)
   c. Understand predicting trends in the global marketplace. (DOK 3)
3. Explore inventions and innovations. (DOK 1)
   a. Discuss patents, trademarks, intellectual property. (DOK 1)
   b. Discuss intelligence and hard work, innovative thinking, and the innovation supply chain. (DOK 1)

Unit 10: Business Functions: Operations and Strategic Management

1. Estimate the start-up of an entrepreneurial business. (DOK 3)
   a. Predict the competitive advantage of an entrepreneurial business. (DOK 3)
   b. Understand the processes of business systems, channel management, and purchasing/procurement, in order to facilitate daily operations. (DOK1)
   c. Relate common entrepreneurial mistakes and ways to avoid them. (DOK 2)
2. Demonstrate the knowledge of good accounting and record keeping. (DOK 2)
   a. Show an understanding of taxes, why taxes are used, different tax forms used, and sources of tax assistance. (DOK 1)

   b. Show an understanding of insurance, why insurance is needed, and the different types of insurance. (DOK 1)
   c. Understand how to perform management operations using math formulas including percent of purchases, interest charges and income tax rates. (DOK 2)
   d. Understand how to calculate simple interest, rounding numbers and proportional reasoning, measurement, and reasoning. (DOK 2)
3. Understand the processes, strategies, and systems needed to guide the overall business organization. (DOK 1)
   a. Research planning and controlling and compare types of management styles. (DOK 1)
   b. Research appropriate job descriptions, sales interviews, and good hiring practices. (DOK 1)
   c. Understand formal disciplinary processes and appropriate firing techniques. (DOK 1)

Unit 11: Business Plans

1. Develop and write a business plan. (DOK 4)
   a. Distinguish places to seek business assistance such as from the IRS, SBDC, chambers, and competition. (DOK 1)
   b. Understand the importance of formulating a business plan.
   c. Prepare a business plan using word processing software. (DOK 4)
2. Develop supporting arguments for a business plan with details and evidence. (DOK 2)
   a. Interpret graphs, diagrams, and charts and use them to develop business strategies and present these to others. (DOK 3)
   b. Research entrepreneurial exit strategies. (DOK 2)

Appendix A: 21st Century Skills Standards

CSS1-21st Century Themes

CS1 Global Awareness

4. Using 21st century skills to understand and address global issues
5. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
6. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business and Entrepreneurial Literacy

4. Knowing how to make appropriate personal economic choices
5. Understanding the role of the economy in society
6. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

4. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
5. Exercising the rights and obligations of citizenship at local, state, national, and global levels
6. Understanding the local and global implications of civic decisions

CS4 Health Literacy

6. Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health
7. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
8. Using available information to make appropriate health-related decisions
9. Establishing and monitoring personal and family health goals
10. Understanding national and international public health and safety issues

CS5 Environmental Literacy

5. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems
6. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.)
7. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions
8. Take individual and collective action towards addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues)

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

4. Think creatively
5. Work creatively with others

6. Implement innovations

CS7 Critical Thinking and Problem Solving

5. Reason effectively
6. Use systems thinking
7. Make judgments and decisions
8. Solve problems

CS8 Communication and Collaboration

3. Communicate clearly
4. Collaborate with others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy

3. Access and evaluate information
4. Use and manage information

CS10 Media Literacy

3. Analyze media
4. Create media products

CS11 ICT Literacy

2. Apply technology effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

3. Adapt to change
4. Be flexible

CS13 Initiative and Self-Direction

4. Manage goals and time
5. Work independently
6. Be self-directed learners

CS14 Social and Cross-Cultural Skills

3. Interact effectively with others
4. Work effectively in diverse teams

CS15 Productivity and Accountability

3. Manage projects
4. Produce results

CS16 Leadership and Responsibility

3. Guide and lead others
4. Be responsible to others

Appendix B: MS Academic Standards

MISSISSIPPI SCIENCE FRAMEWORK COMPETENCIES

Marine and Aquatic Science

AQ 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
AQ 2	Develop an understanding of physical and chemical properties of water and aquatic environments.
AQ 3	Apply an understanding of the diverse organisms found in aquatic environments.
AQ 4	Draw conclusions about the relationships between human activity and aquatic organisms.

2. <u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>

a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
   - Safety rules and symbols
   - Proper use and care of the compound light microscope, slides, chemicals, etc.
   - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers

b. Formulate questions that can be answered through research and experimental design. (DOK 3)

c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)

d. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)

e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)

f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)

g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. <u>Develop an understanding of physical and chemical properties of water and aquatic environments.</u>

h. Analyze the physical and chemical properties of water, and justify why it is essential to living organisms. (DOK 1)

i. Explain the causes and characteristics of tides. (DOK 1)

j. Research, create diagrams, and summarize principles related to waves and current characteristics and formation. (DOK 2)

k. Compare and contrast the physical and chemical parameters of dissolved O2, pH, temperature, salinity, and results obtained through analysis of different water column depths/zones. (DOK 2)
l. Investigate the causes and effects of erosion and discuss conclusions. (DOK 2)
m. Describe and differentiate among the major geologic features of specific aquatic environments. (DOK 1)
   - Plate tectonics
   - Rise, slope, elevation, and depth
   - Formation of dunes, reefs, barrier/volcanic islands, and coastal/flood plains
   - Watershed formation as it relates to bodies of freshwater
n. Compare and contrast the unique abiotic and biotic characteristics of selected aquatic ecosystems. (DOK 2)
   - Barrier island, coral reef, tidal pool, and ocean
   - River, stream, lake, pond, and swamp
   - Bay, sound, estuary, and marsh

3. <u>Apply an understanding of the diverse organisms found in aquatic environments.</u>

g. Analyze and explain the diversity and interactions among aquatic life. (DOK 3)
   - Adaptations of representative organisms for their aquatic environments
   - Relationship of organisms in food chains/webs within aquatic environments
h. Research, calculate, and interpret population data. (DOK 2)
i. Research and compare reproductive processes in aquatic organisms. (DOK 2)
j. Differentiate among characteristics of planktonic, nektonic, and benthic organisms. (DOK 1)
k. Explore the taxonomy of aquatic organisms, and use dichotomous keys to differentiate among the organisms. (DOK 2)
l. Research and explain the symbiotic relationships in aquatic ecosystems. (DOK 3)

4. <u>Draw conclusions about the relationships between human activity and aquatic organisms.</u>

j. Describe the impact of natural and human activity on aquatic ecosystems, and evaluate the effectiveness of various solutions to environmental problems. (DOK 3)
   - Sources of pollution in aquatic environments and methods to reduce the effects of the pollution
   - Effectiveness of a variety of methods of environmental management and stewardship
   - Effects of urbanization on aquatic ecosystems and the effects of continued expansion
k. Research and cite evidence of the effects of natural phenomena such as hurricanes, floods, or drought on aquatic habitats and organisms. (DOK 3)
l. Discuss the advantages and disadvantages involved in applications of modern technology in aquatic science. (DOK 2)
   - Careers related to aquatic science
   - Modern technology within aquatic science (e.g., mariculture and aquaculture)
   - Contributions of aquatic technology to industry and government

Biology I

BIOI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BIOI 2	Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
BIOI 3	Investigate and evaluate the interaction between living organisms and their environment.
BIOI 4	Analyze and explain the structures and function of the levels of biological organization.
BIOI 5	Demonstrate an understanding of the molecular basis of heredity.
BIOI 6	Demonstrate an understanding of principles that explain the diversity of life and biological evolution.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
   b. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
      - Safety rules and symbols
      - Proper use and care of the compound light microscope, slides, chemicals, etc.
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers

   m. Formulate questions that can be answered through research and experimental design. (DOK 3)
   n. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 2)
   o. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
   p. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
   q. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
   r. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. **<u>Describe the biochemical basis of life, and explain how energy flows within and between the living systems.</u>**
   h. Explain and compare with the use of examples the types of bond formation (e.g., covalent, ionic, hydrogen, etc.) between or among atoms. (DOK 2)
      - Subatomic particles and arrangement in atoms
      - Importance of ions in biological processes
   i. Develop a logical argument defending water as an essential component of living systems (e.g., unique bonding and properties including polarity, high specific heat, surface tension, hydrogen bonding, adhesion, cohesion, and expansion upon freezing). (DOK 2)
   j. Classify solutions as acidic, basic, or neutral, and relate the significance of the pH scale to an organism's survival (e.g., consequences of having different concentrations of hydrogen and hydroxide ions). (DOK 2)
   k. Compare and contrast the structure, properties, and principle functions of carbohydrates, lipids, proteins, and nucleic acids in living organisms. (DOK 2)
      - Basic chemical composition of each group
      - Building components of each group (e.g., amino acids, monosaccharides, nucleotides, etc.)
      - Basic functions (e.g., energy, storage, cellular, heredity) of each group
   l. Examine the life processes to conclude the role enzymes play in regulating biochemical reactions. (DOK 2)
      - Enzyme structure
      - Enzyme function, including enzyme-substrate specificity and factors that affect enzyme function (pH and temperature)
   m. Describe the role of adenosine triphosphate (ATP) in making energy available to cells. (DOK 1)
      - ATP structure
      - ATP function
   n. Analyze and explain the biochemical process of photosynthesis and cellular respiration, and draw conclusions about the roles of the reactant and products in each. (DOK 3)
      - Photosynthesis and respiration (reactants and products)
      - Light-dependent reactions and light independent reactions in photosynthesis, including requirements and products of each
      - Aerobic and anaerobic processes in cellular respiration, including products of each and energy differences
3. **<u>Investigate and evaluate the interaction between living organisms and their environment.</u>**
   d. Compare and contrast the characteristics of the world's major biomes (e.g., deserts, tundra, taiga, grassland, temperate forest, tropical rainforest). (DOK 2)
      - Plant and animal species
      - Climate (temperature and rainfall)
      - Adaptations of organisms
   e. Provide examples to justify the interdependence among environmental

elements. (DOK 2)

- Biotic and abiotic factors in an ecosystem (e.g., water, carbon, oxygen, mold, leaves)
- Energy flow in ecosystems (e.g., energy pyramids and photosynthetic organisms to herbivores, carnivores, and decomposers)
- Roles of beneficial bacteria
- Interrelationships of organisms (e.g., cooperation, predation, parasitism, commensalism, symbiosis, and mutualism)

f. Examine and evaluate the significance of natural events and human activities on major ecosystems (e.g., succession, population growth, technology, loss of genetic diversity, consumption of resources). (DOK 2)

4. <u>Analyze and explain the structures and function of the levels of biological organization.</u>

e. Differentiate among plant and animal cells and eukaryotic and prokaryotic cells. (DOK 2)

- Functions of all major cell organelles and structures (e.g., nucleus, mitochondrion, rough ER, smooth ER, ribosomes, Golgi bodies, vesicles, lysosomes, vacuoles, microtubules, microfiliaments, chloroplast, cytoskeleton, centrioles, nucleolus, chromosomes, nuclear membrane, cell wall, cell membrane [active and passive transport], cytosol)
- Components of mobility (e.g., cilia, flagella, pseudopodia)

f. Differentiate between types of cellular reproduction. (DOK 1)

- Main events in the cell cycle and cell mitosis (including differences in plant and animal cell divisions)
- Binary fission (e.g., budding, vegetative propagation, etc.)
- Significance of meiosis in sexual reproduction
- Significance of crossing over

g. Describe and differentiate among the organizational levels of organisms (e.g., cells, tissues, organs, systems, types of tissues.) (DOK 1)

h. Explain and describe how plant structures (vascular and nonvascular) and cellular functions are related to the survival of plants (e.g., movement of materials, plant reproduction). (DOK 1)

5. <u>Demonstrate an understanding of the molecular basis of heredity.</u>

e. Analyze and explain the molecular basis of heredity and the inheritance of traits to successive generations by using the Central Dogma of Molecular Biology. (DOK 3)

- Structures of DNA and RNA
- Processes of replication, transcription, and translation
- Messenger RNA codon charts

f. Utilize Mendel's laws to evaluate the results of monohybrid Punnett squares involving complete dominance, incomplete dominance, codominance, sex linked, and multiple alleles (including outcome percentage of both genotypes and phenotypes). (DOK 2)

g. Examine inheritance patterns using current technology (e.g., pedigrees, karyotypes, gel electrophoresis). (DOK 2)

h. Discuss the characteristics and implications of both chromosomal and gene mutations. (DOK 2)
   - Significance of nondisjunction, deletion, substitutions, translocation, frame shift mutation in animals
   - Occurrence and significance of genetic disorders such as sickle cell anemia, Tay-Sachs disorder, cystic fibrosis, hemophilia, Down syndrome, color blindness

6. <u>Demonstrate an understanding of principles that explain the diversity of life and biological evolution.</u>

f. Draw conclusions about how organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their evolutionary relationships. (DOK 2)
   - Characteristics of the six kingdoms
   - Major levels in the hierarchy of taxa (e.g., kingdom, phylum/division, class, order, family, genus, and species)
   - Body plans (symmetry)
   - Methods of sexual reproduction (e.g., conjugation, fertilization, pollination)
   - Methods of asexual reproduction (e.g., budding, binary fission, regeneration, spore formation)

g. Critique data (e.g., comparative anatomy, biogeography, molecular biology, fossil record, etc.) used by scientists (e.g., Redi, Needham, Spallanzani, Pasteur) to develop an understanding of evolutionary processes and patterns. (DOK 3)

h. Research and summarize the contributions of scientists (including Darwin, Malthus, Wallace, Lamarck, and Lyell) whose work led to the development of the theory of evolution. (DOK 2)

i. Analyze and explain the roles of natural selection, including the mechanisms of speciation (e.g., mutations, adaptations, geographic isolation) and applications of speciation (e.g., pesticide and antibiotic resistance). (DOK 3)

j. Differentiate among chemical evolution, organic evolution, and the evolutionary steps along the way to aerobic heterotrophs and photosynthetic autotrophs. (DOK 2)

<u>Biology II</u>

BIOII 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BIOII 2	Describe and contrast the structures, functions, and chemical processes of the cell.
BIOII 3	Investigate and discuss the molecular basis of heredity.
BIOII 4	Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.
BIOII 5	Develop an understanding of organism classification.

1. <u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>

h. Use current technologies such as CD-ROM, DVD, Internet, and on-line data search to explore current research related to a specific topic. (DOK 3)

i. Clarify research questions and design laboratory investigations. (DOK 3)

j. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
k. Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
l. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
m. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
n. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. <u>Describe and contrast the structures, functions, and chemical processes of the cell.</u>

e. Relate the structure and function of a selectively permeable membrane to its role in diffusion and osmosis. (DOK 2)
f. Summarize how cell regulation controls and coordinates cell growth and division. (DOK 2)
g. Analyze and describe the function of enzymes in biochemical reactions. (DOK 2)
   - The impact of enzymatic reactions on biochemical processes
   - Factors that affect enzyme function (e.g., pH, concentration, temperature, etc.)
h. Differentiate between photosynthesis and cellular respiration. (DOK 2)
   - Cellular sites and major pathways of anaerobic and aerobic respiration (with reactants, products, and ATP per monosaccharide)
   - Cellular respiration with respect to the sites at which they take place, the reactions involved, and the energy input and output in each stage (e.g., glycolysis, Krebs cycle, electron transport chain)
   - Pigments, absorption, reflection of light, and light-dependent and light-independent reactions of photosynthesis
   - Oxidation and reduction reactions

3. <u>Investigate and discuss the molecular basis of heredity.</u>

f. Explain how the process of meiosis clarifies the mechanism underlying Mendel's conclusions about segregation and independent assortment on a molecular level. (DOK 1)
g. Research and explain how major discoveries led to the determination of DNA structure. (DOK 2)
h. Relate gene expression (e.g., replication, transcription, translation) to protein structure and function. (DOK 2)
   - Translation of a messenger RNA strand into a protein
   - Processing by organelles so that the protein is appropriately packaged, labeled, and eventually exported by the cell
   - Messenger RNA codon charts to determine the effects of different types of mutations on amino acid sequence and protein structure (e.g., sickle cell anemia resulting from base substitution mutation)

- Gene expression regulated in organisms so that specific proteins are synthesized only when they are needed by the cell (e.g., allowing cell specialization)

i. Assess the potential implications of DNA technology with respect to its impact on society. (DOK 3)
   - Modern DNA technologies (e.g., polymerase chain reaction (PCR), gene splicing, gel electrophoresis, transformation, recombinant DNA) in agriculture, medicine, and forensics

j. Develop a logical argument defending or refuting bioethical issues arising from applications of genetic technology (e.g., the human genome project, cloning, gene therapy, stem cell research). (DOK 3)

4. <u>Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.</u>

j. Explain the history of life on earth, and infer how geological changes provide opportunities and constraints for biological evolution. (DOK 2)
   - Main periods of the geologic timetable of earth's history
     - Roles of catastrophic and gradualistic processes in shaping planet Earth

k. Provide support for the argument based upon evidence from anatomy, embryology, biochemistry, and paleontology that organisms descended with modification from common ancestry. (DOK 2)

l. Identify and provide supporting evidence for the evolutionary relationships among various organisms using phylogenetic trees and cladograms. (DOK 2)

m. Formulate a scientific explanation based on fossil records of ancient life-forms, and describe how new species could originate as a result of geological isolation and reproductive isolation. (DOK 2)

n. Compare and contrast the basic types of selection (e.g., disruptive, stabilizing, directional, etc.). (DOK 2)

o. Cite examples to justify behaviors that have evolved through natural selection (e.g., migration, parental care, use of tools, etc.). (DOK 1)

p. Research and explain the contributions of 19th century scientists (e.g., Malthus, Wallace, Lyell, and Darwin) on the formulation of ideas about evolution. (DOK 2)

q. Develop a logical argument describing ways in which the influences of 20th century science have impacted the development of ideas about evolution (e.g., synthetic theory of evolution, molecular biology). (DOK 3)

r. Analyze changes in an ecosystem resulting from natural causes (succession), changes in climate, human activity (pollution and recycling), or introduction of nonnative species. (DOK 2)

5. <u>Develop an understanding of organism classification.</u>

c. Classify organisms according to traditional Linnaean classification characteristics (e.g., cell structure, biochemistry, anatomy, fossil record, methods of reproduction) and the cladistic approach. (DOK 2)

d. Categorize organisms according to the characteristics that distinguish them as Bacteria, Archaea, or Eucarya. (DOK 1)
   - Bacteria, fungi, and protists

- Characteristics of invertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to phyla (e.g., Porifera, Cnidarians, Nematoda, Annelida, Platyhelmenthes, and Arthropoda) and classes (e.g., Insecta, Crustacea, Arachnida, Mollusca, Echinodermata)
- Characteristics of vertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to classes (e.g., Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, Mammalia)
- Nomenclature of various types of plants (e.g., Bryophyta, Tracheophyta, Gymnospermae, Angiospermae, Monocotyledonae, Dicotyledonae, vascular plants, nonvascular plants)

Botany

BO 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BO 2	Distinguish among the characteristics of botanical organization, structure, and function.
BO 3	Demonstrate an understanding of plant reproduction.
BO 4	Draw conclusions about the factors that affect the adaptation and survival of plants.
BO 5	Relate an understanding of plant genetics to its uses in modern living.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
   h. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
      - Safety rules and symbols
      - Proper use and care of the compound light microscope, slides, chemicals, etc.
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
   i. Formulate questions that can be answered through research and experimental design. (DOK 3)
   j. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
   k. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
   l. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
   m. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
   n. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Distinguish among the characteristics of botanical organization, structure, and function.**

f. Relate plant cell structures to their functions (e.g., major organelles, cell wall components, photosynthetic chemical reactions, plant pigments, plant tissues, roots, stems, leaves, flowers). (DOK 1)
g. Differentiate the characteristics found in various plant divisions. (DOK 2)
   - Differences and similarities of nonvascular plants
   - Characteristics of seed-bearing and non-seed bearing vascular plants relative to taxonomy
   - Major vegetative structures and their modifications in angiosperms and gymnosperms
h. Compare and contrast leaf modifications of gymnosperms and angiosperms (e.g., needles, overlapping scales, simple leaves, compound leaves, evergreen trees, and deciduous trees). (DOK 2)
i. Apply the modern classification scheme utilized in naming plants to identify plant specimens. (DOK 2)
   - Classification scheme used in botany
   - Classification of native Mississippi plants
j. Use inquiry to investigate and discuss the physical and chemical processes of plants. (DOK 3)
   - Relationships among photosynthesis, cellular respiration, and translocation
   - Importance of soil type and soil profiles to plant survival
   - Mechanism of water movement in plants
   - Effects of environmental conditions for plant survival
   - Tropic responses of a plant organ to a given stimulus

3. <u>Demonstrate an understanding of plant reproduction.</u>

g. Compare and contrast reproductive structures (e.g., cones, flowers). (DOK 2)
h. Differentiate among the vegetative organs of monocots, herbaceous dicots, and woody dicots. (DOK 1)
i. Differentiate between the structures and processes of sexual and asexual reproduction in plants. (DOK 1)
   - Reproductive structures, their modifications, and the mechanisms involved in plant reproduction
   - Functions of flower parts, seeds, cones
   - Spore production in bryophytes and ferns
j. Explain and provide examples of the concept of alternation of generations and its examples. (DOK 2)
k. Categorize types of fruits and methods of seed distribution in plants. (DOK 1)
l. Research and compare various methods of plant propagation. (DOK 2)

4. <u>Draw conclusions about the factors that affect the adaptation and survival of plants.</u>

e. List and assess several adaptations of plants to survive in a given biome. (DOK 2)
f. Design and conduct an experiment to determine the effects of environmental factors on photosynthesis. (DOK 3)
g. Explain how natural selection and the evolutionary consequences (e.g., adaptation or extinction) support scientific explanations for similarities of ancient life-forms in the fossil record and molecular similarities present in living organisms. (DOK 2)

h. Research factors that might influence or alter plant stability, and propose actions that may reduce the negative impacts of human activity. (DOK 2)

5. <u>Relate an understanding of plant genetics to its uses in modern living.</u>

e. Research, prepare, and present a position relating to issues surrounding the current botanical trends involving biotechnology. (DOK 3)

f. Apply an understanding of the principles of plant genetics to analyze monohybrid and dihybrid crosses, and predict the potential effects the crosses might have on agronomy and agriculture. (DOK 3)

g. Discuss the effects of genetic engineering of plants on society. (DOK 2)

h. Describe the chemical compounds extracted from plants, their economical importance, and the impact on humans. (DOK 3)

- Plant extracts, their function, and origin
- Impact of the timber industry on local and national economy

Chemistry I

CHI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
CHI 2	Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.
CHI 3	Develop an understanding of the periodic table.
CHI 4	Analyze the relationship between microscopic and macroscopic models of matter.
CHI 5	Compare factors associated with acid/base and oxidation/reduction reactions.

1. <u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>

h. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)

i. Clarify research questions and design laboratory investigations. (DOK 3)

j. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)

k. Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)

l. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)

m. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)

n. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. <u>Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.</u>

h. Describe and classify matter based on physical and chemical properties and interactions between molecules or atoms. (DOK 1)
   - Physical properties (e.g., melting points, densities, boiling points) of a variety of substances
   - Substances and mixtures
   - Three states of matter in terms of internal energy, molecular motion, and the phase transitions between them
i. Research and explain crucial contributions and critical experiments of Dalton, Thomson, Rutherford, Bohr, de Broglie, and Schrődinger, and describe how each discovery contributed to the current model of atomic and nuclear structure. (DOK 2)
j. Develop a model of atomic and nuclear structure based on theory and knowledge of fundamental particles. (DOK 2)
   - Properties and interactions of the three fundamental particles of the atom
   - Laws of conservation of mass, constant composition, definite proportions, and multiple proportions
k. Write appropriate equations for nuclear decay reactions, describe how the nucleus changes during these reactions, and compare the resulting radiation with regard to penetrating ability. (DOK 1)
   - Three major types of radioactive decay (e.g., alpha, beta, gamma) and the properties of the emissions (e.g., composition, mass, charge, penetrating power)
   - The concept of half-life for a radioactive isotope (e.g., carbon-14 dating) based on the principle that the decay of any individual atom is a random process
l. Compare the properties of compounds according to their type of bonding. (DOK 1)
   - Covalent, ionic, and metallic bonding
   - Polar and nonpolar covalent bonding
   - Valence electrons and bonding atoms
m. Compare different types of intermolecular forces, and explain the relationship between intermolecular forces, boiling points, and vapor pressure when comparing differences in properties of pure substances. (DOK 1)
n. Develop a three-dimensional model of molecular structure. (DOK 2)
   - Lewis dot structures for simple molecules and ionic compounds
   - Valence shell electron pair repulsion theory (VSEPR)

3. <u>Develop an understanding of the periodic table.</u>

e. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)
f. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
   - Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
   - Average atomic mass calculations
   - Chemical characteristics of each region

- Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius)

g. Classify chemical reactions by type. (DOK 2)
   - Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
   - Products (given reactants) or reactants (given products) for each reaction type
   - Solubility rules for precipitation reactions and the activity series for single and double displacement reactions

h. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)
   - Difference between chemical reactions and chemical equations
   - Formulas and calculations of the molecular (molar) masses
   - Empirical formula given the percent composition of elements
   - Molecular formula given the empirical formula and molar mass

4. <u>Analyze the relationship between microscopic and macroscopic models of matter.</u>

e. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)

f. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
   - Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
   - Average atomic mass calculations
   - Chemical characteristics of each region
   - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius)

g. Classify chemical reactions by type. (DOK 2)
   - Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
   - Products (given reactants) or reactants (given products) for each reaction type
   - Solubility rules for precipitation reactions and the activity series for single and double displacement reactions

h. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)
   - Difference between chemical reactions and chemical equations
   - Formulas and calculations of the molecular (molar) masses
   - Empirical formula given the percent composition of elements
   - Molecular formula given the empirical formula and molar mass

5. <u>Compare factors associated with acid/base and oxidation/reduction reactions.</u>

d. Analyze and explain acid/base reactions. (DOK 2)

- Properties of acids and bases, including how they affect indicators and the relative pH of the solution
- Formation of acidic and basic solutions
- Definition of pH in terms of the hydronium ion concentration and the hydroxide ion concentration
- The pH or pOH from the hydrogen ion or hydroxide ion concentrations of solution
- How a buffer works and examples of buffer solutions

e. Classify species in aqueous solutions according to the Arrhenius and Bronsted-Lowry definitions respectively, and predict products for aqueous neutralization reactions. (DOK 2)

f. Analyze a reduction/oxidation reaction (REDOX) to assign oxidation numbers (states) to reaction species, and identify the species oxidized and reduced, the oxidizing agent, and reducing agent. (DOK 2)

Organic Chemistry

ORGC 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.

ORGC 2 Demonstrate an understanding of the properties, structure, and function of organic compounds.

ORGC 3 Discuss the versatility of polymers and the diverse application of organic chemicals.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

h. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
- Safety rules and symbols
- Proper use and care of the compound light microscope, slides, chemicals, etc.
- Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers

i. Formulate questions that can be answered through research and experimental design. (DOK 3)

j. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)

k. Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)

l. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)

m. Recognize and analyze alternative explanations for experimental results, and make predictions based on observations and prior knowledge. (DOK 3)

n. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. **<u>Demonstrate an understanding of the properties, structure, and function of organic compounds.</u>**
   g. Apply International Union of Pure and Applied Chemistry (IUPAC) nomenclature, and differentiate the structure of aliphatic, aromatic, and cyclic hydrocarbon compounds. (DOK 1)
      - Structures of hydrocarbon compounds
      - Isomerism in hydrocarbon compounds
   h. Relate structure to physical and chemical properties of hydrocarbon. (DOK 1)
   i. Apply principles of geometry and hybridization to organic molecules. (DOK 2)
      - Lewis structures for organic molecules
      - Bond angles
      - Hybridization (as it applies to organic molecules)
   j. Write, complete, and classify common reactions for aliphatic, aromatic, and cyclic hydrocarbons. (DOK 1)
   k. Construct, solve, and explain equations representing combustion reactions, substitution reactions, dehydrogenation reactions, and addition reactions. (DOK 2)
   l. Classify functional groups (e.g., alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines, amides, and nitrides) by their structure and properties. (DOK 2)
      - Structural formulas from functional group names and vice versa
      - Chemical and physical properties of compounds containing functional groups
      - Equations representing the transformation of one functional group into another
3. **<u>Discuss the versatility of polymers and the diverse application of organic chemicals.</u>**
   d. Describe and classify the synthesis, properties, and uses of polymers. (DOK 2)
      - Common polymers
      - Synthesis of polymers from monomers by addition or condensation
      - Condensations of plastics according to their commercial types
      - Elasticity and other polymer properties
   e. Develop a logical argument supporting the use of organic chemicals and their application in industry, drug manufacture, and biological chemistry. (DOK 1)
      - Common uses of polymers and organic compounds in medicine, drugs, and personal care products
      - Compounds that have the property to dye materials
      - Petrochemical production
      - Biologically active compounds in terms of functional group substrate interaction
   f. Research and summarize the diversity, applications, and economics of industrial chemicals (solvents, coatings, surfactants, etc.). (DOK 3)

Earth and Space Science

E1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
E2	Develop an understanding of the history and evolution of the universe and earth.
E3	Discuss factors that are used to explain the geological history of earth.
E4	Demonstrate an understanding of earth systems relating to weather and climate.

E5 Apply an understanding of ecological factors to explain relationships between earth systems.

1. **<u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>**
   h. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
      - Safety rules and symbols
      - Proper use and care of the compound light microscope, slides, chemicals, etc.
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers.
   i. Formulate questions that can be answered through research and experimental design. (DOK 3)
   j. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
   k. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
   l. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
   m. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
   n. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **<u>Develop an understanding of the history and evolution of the universe and earth.</u>**
   e. Summarize the origin and evolution of the universe. (DOK 2)
      - Big bang theory
      - Microwave background radiation
      - The Hubble constant
      - Evidence of the existence of dark matter and dark energy in the universe and the history of the universe
   f. Differentiate methods used to measure space distances, including astronomical unit, light-year, stellar parallax, Cepheid variables, and the red shift. (DOK 1)
   g. Interpret how gravitational attraction played a role in the formation of the planetary bodies and how the fusion of hydrogen and other processes in “ordinary” stars and supernovae lead to the formation of all other elements. (DOK 2)
   h. Summarize the early evolution of the earth, including the formation of Earth’s solid layers (e.g., core, mantle, and crust), the distribution of major elements, the origin of internal heat sources, and the initiation of plate tectonics. (DOK 2)
      - How the decay of radioactive isotopes is used to determine the age of rocks, earth, and the solar system
      - How Earth acquired its initial oceans and atmosphere
3. **<u>Discuss factors which are used to explain the geological history of earth.</u>**

i. Develop an understanding of how plate tectonics create certain geological features, materials, and hazards. (DOK 1)
   - Plate tectonic boundaries (e.g., divergent, convergent, and transform)
   - Modern and ancient geological features to each kind of plate tectonic boundary
   - Production of particular groups of igneous and metamorphic rocks and mineral resources
   - Sedimentary basins created and destroyed through time

j. Compare and contrast types of mineral deposits/groups (e.g., oxides, carbonates, halides, sulfides, sulfates, silicates, phosphates). (DOK 2)

k. Categorize minerals and rocks by determining their physical and/or chemical characteristics. (DOK 2)

l. Justify the causes of certain geological hazards (e.g., earthquakes, volcanoes, tsunamis) to their effects on specific plate tectonic locations. (DOK 2)

m. Interpret and explain how rock relationships and fossils are used to reconstruct the geologic history of the earth. (DOK 2)

n. Apply principles of relative age (e.g., superposition, original horizontality, crosscutting relations, and original lateral continuity) to support an opinion related to earth's geological history. (DOK 3)
   - Types of unconformity (e.g., disconformity, angular unconformity, nonconformity)
   - Geological timetable

o. Apply the principle of uniformitarianism to relate sedimentary rock associations and their fossils to the environments in which the rocks were deposited. (DOK 2)

p. Compare and contrast the relative and absolute dating methods (e.g., the principle of fossil succession, radiometric dating, and paleomagnetism) for determining the age of the earth. (DOK 1)

4. <u>Demonstrate an understanding of earth systems relating to weather and climate.</u>

f. Explain the interaction of earth systems that affect weather and climate. (DOK 1)
   - Latitudinal variations in solar heating
   - The effects of Coriolis forces on ocean currents, cyclones, anticyclones, ocean currents, topography, and air masses (e.g., warm fronts, cold fronts, stationary fronts, and occluded fronts).

g. Interpret the patterns in temperature and precipitation that produce the climate regions on earth, and relate them to the hazards associated with extreme weather events and climate change (e.g., hurricanes, tornadoes, El Niño/La Niña, global warming). (DOK 2)

h. Justify how changes in global climate and variation in earth/sun relationships contribute to natural and anthropogenic (human-caused) modification of atmospheric composition. (DOK 2)

i. Summarize how past and present actions of ice, wind, and water contributed to the types and distributions of erosional and depositional features in landscapes. (DOK 1)

j. Research and explain how external forces affect earth's topography. (DOK 2)
   - How surface water and groundwater act as the major agents of physical and chemical weathering
   - How soil results from weathering and biological processes
   - Processes and hazards associated with both sudden and gradual mass wasting

5. **<u>Apply an understanding of ecological factors to explain relationships between earth systems.</u>**
   e. Draw conclusions about how life on earth shapes earth systems and responds to the interaction of earth systems (lithosphere, hydrosphere, atmosphere, and biosphere). (DOK 3)
      - Nature and distribution of life on earth, including humans, to the chemistry and availability of water
      - Distribution of biomes (e.g., terrestrial, freshwater, and marine) to climate regions through time
      - Geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) that interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming and channeling of rivers)
   f. Interpret the record of shared ancestry (fossils), evolution, and extinction as related to natural selection. (DOK 2)
   g. Identify the cause and effect relationships of the evolutionary innovations that most profoundly shaped earth systems. (DOK 1)
      - Photosynthesis and the atmosphere
      - Multicellular animals and marine environments
      - Land plants and terrestrial environments
   h. Cite evidence about how dramatic changes in earth's atmosphere influenced the evolution of life. (DOK 1)

<u>Environmental Science</u>

ES 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
ES 2	Develop an understanding of the relationship of ecological factors that affect an ecosystem.
ES 3	Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

1. **<u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>**
   h. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
      - Safety rules and symbols
      - Proper use and care of the compound light microscope, slides, chemicals, etc.
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
   i. Formulate questions that can be answered through research and experimental design. (DOK 3)

j. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
k. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
l. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
m. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
n. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK3)

2. <u>Develop an understanding of the relationship of ecological factors that affect an ecosystem.</u>

h. Compare ways in which the three layers of the biosphere change over time and their influence on an ecosystem's ability to support life. (DOK 2)
i. Explain the flow of matter and energy in ecosystems. (DOK 2)
   - Interactions between biotic and abiotic factors
   - Indigenous plants and animals and their roles in various ecosystems
   - Biogeochemical cycles within the environment
j. Predict the impact of the introduction, removal, and reintroduction of an organism on an ecosystem. (DOK 3)
k. Develop a logical argument explaining the relationships and changes within an ecosystem. (DOK 2)
   - How a species adapts to its niche
   - Process of primary and secondary succession and its effects on a population
   - How changes in the environment might affect organisms
l. Explain the causes and effects of changes in population dynamics (e.g., natural selection, exponential growth, predator/prey relationships) to carrying capacity and limiting factors. (DOK 2)
m. Research and explain how habitat destruction leads to the loss of biodiversity. (DOK 2)
n. Compare and contrast the major biomes of the world's ecosystems, including location, climate, adaptations and diversity. (DOK 1)

3. <u>Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.</u>

d. Summarize the effects of human activities on resources in the local environments. (DOK 2)
   - Sources, uses, quality, and conservation of water
   - Renewable and nonrenewable resources
   - Effects of pollution (e.g., water, noise, air, etc.) on the ecosystem
e. Research and evaluate the impacts of human activity and technology on the lithosphere, hydrosphere, and atmosphere, and develop a logical argument to support how communities restore ecosystems. (DOK 3)

f. Research and evaluate the use of renewable and nonrenewable resources, and critique efforts to conserve natural resources and reduce global warming in the United States including (but not limited) to Mississippi. (DOK 3)

Genetics

G 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
G 2	Analyze the structure and function of the cell and cellular organelles.
G 3	Apply the principles of heredity to demonstrate genetic understandings.

1. **Use critical thinking and scientific problem solving in designing and performing biological research and experimentation. (L, P, E)**
   h. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
   i. Clarify research questions and design laboratory investigations. (DOK 3)
   j. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
   k. Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for pie, bar, and line graphs) to draw conclusions and make inferences. (DOK 3)
   l. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
   m. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
   n. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)
2. **Review the structure and function of the cell as it applies to genetics. (L)**
   h. Cite evidence to illustrate how the structure and function of cells are involved in the maintenance of life. (DOK 2)
   i. Describe how organic components are integral to biochemical processes. (DOK 2)
   j. Differentiate among the processes by which plants and animals reproduce. (DOK 1)
      - Cell cycle and mitosis
      - Meiosis, spermatogenesis, and oogenesis
   k. Explain the significance of the discovery of nucleic acids. (DOK 1)
   l. Analyze and explain the structure and function of DNA and RNA in replication, transcription, translation and DNA repair. (DOK 2)
   m. Cite examples to compare the consequences of the different types of mutations. (DOK 1)
   n. Draw conclusions about the importance and potential impacts of the process of gene transfer used in biotechnology. (DOK 3)
3. **Analyze the structure and function of DNA and RNA molecules. (L, P)**
   h. Cite evidence that supports the significance of Mendel's concept of "particulate inheritance" to explain the understanding of heredity. (DOK 1)
   i. Apply classical genetics principles to solve basic genetic problems. (DOK 2)

- Genes and alleles, dominance, recessiveness, the laws of segregation, and independent assortment
- Inheritance of autosomal and sex-linked traits
- Inheritance of traits influenced by multiple alleles and traits with polygenetic inheritance
- Chromosomal theory of inheritance

j. Apply population genetic concepts to summarize variability of multicellular organisms. (DOK 2)
   - Genetic variability
   - Hardy-Weinberg formula
   - Migration and genetic drift
   - Natural selection in humans

k. Distinguish and explain the applications of various tools and techniques used in DNA manipulation. (DOK 1)
   - Steps in genetic engineering experiments
   - Use of restriction enzymes
   - Role of vectors in genetic research
   - Use of transformation techniques

l. Research and present a justifiable explanation the practical uses of biotechnology (e.g., chromosome mapping, karyotyping, and pedigrees). (DOK 2)

m. Develop and present a scientifically-based logical argument for or against moral and ethical issues related to genetic engineering. (DOK 3)

n. Research genomics (human and other organisms), and predict benefits and medical advances that may result from the use of genome projects. (DOK 2)

Geology

GE1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
GE2	Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.

1. <u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>

h. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
   - Safety rules and symbols
   - Proper use and care of the compound light microscope, slides, chemicals, etc.
   - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers

i. Formulate questions that can be answered through research and experimental design. (DOK 3)
j. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
k. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
l. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
m. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
n. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. <u>Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.</u>

l. Differentiate the components of the earth's atmosphere and lithosphere. (DOK 1)
m. Research and summarize explanations of how earth acquired its initial atmosphere and oceans. (DOK 2)
n. Compare the causes and effects of internal and external components that shape earth's topography. (DOK 2)
   - Physical weathering (e.g., atmospheric, glacial, etc.)
   - Chemical weathering agents (e.g., acid precipitation, carbon dioxide, oxygen, water, etc.)
o. Develop an understanding of how plate tectonics create certain geologic features, materials, and hazards. (DOK 2)
   - Types of crustal movements and the resulting landforms (e.g., seafloor spreading, paleomagnetic measurements, and orogenesis)
   - Processes that create earthquakes and volcanoes
   - Asthenosphere
p. Summarize the theories of plate development and continental drift, and describe the causes and effects involved in each. (DOK 2)
q. Develop a logical argument to explain how geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming, and channeling of rivers). (DOK 2)
r. Interpret how the earth's geological time scale relates to geological history, landforms, and life-forms. (DOK 2)
s. Research and describe different techniques for determining relative and absolute age of the earth (e.g., index of fossil layers, superposition, radiometric dating, etc.). (DOK 1)
t. Summarize the geological activity of the New Madrid fault line, and compare and contrast it to geological activity in other parts of the world. (DOK 2)
u. Identify and differentiate the major geological features in Mississippi (e.g., Delta, Coastal Areas, etc.). (DOK 1)
v. Evaluate an emergency preparedness plan for natural disasters associated with crustal movement. (DOK 3)

Physical Science

PS 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
PS 2	Describe and explain how forces affect motion.
PS 3	Demonstrate an understanding of general properties and characteristics of waves.
PS 4	Develop an understanding of the atom.
PS 5	Investigate and apply principles of physical and chemical changes in matter.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
   h. Use appropriate laboratory safety symbols and procedures to design and conduct a scientific investigation. (DOK 2)
      - Safety symbols and safety rules in all laboratory activities
      - Proper use and care of the compound light microscope
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
   i. Identify questions that can be answered through scientific investigations. (DOK 3)
   j. Identify and apply components of scientific methods in classroom investigations. (DOK 3)
      - Predicting, gathering data, drawing conclusions
      - Recording outcomes and organizing data from a variety of sources (e.g., scientific articles, magazines, student experiments, etc.)
      - Critically analyzing current investigations/problems using periodicals and scientific scenarios
   k. Interpret and generate graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
   l. Analyze procedures and data to draw conclusions about the validity of research. (DOK 3)
   m. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
   n. Communicate effectively to present and explain scientific results, using appropriate terminology and graphics. (DOK 3)
2. **Describe and explain how forces affect motion.**
   f. Demonstrate and explain the basic principles of Newton's three laws of motion including calculations of acceleration, force, and momentum. (DOK 2)
      - Inertia and distance-time graphs to determine average speed
      - Net force (accounting for gravity, friction, and air resistance) and the resulting motion of objects
      - Effects of the gravitational force on objects on Earth and effects on planetary and lunar motion
      - Simple harmonic motion (oscillation)
   g. Explain the connection between force, work, and energy. (DOK 2)
      - Force exerted over a distance (results in work done)

- Force-distance graph (to determine work)
- Network on an object that contributes to change in kinetic energy (work-to-energy theorem)

h. Describe (with supporting details and diagrams) how the kinetic energy of an object can be converted into potential energy (the energy of position) and how energy is transferred or transformed (conservation of energy). (DOK 2)

i. Draw and assess conclusions about charges and electric current. (DOK 2)
   - Static/current electricity and direct current/alternating current
   - Elements in an electric circuit that are in series or parallel
   - Conductors and insulators
   - Relationship between current flowing through a resistor and voltage flowing across a resistor

j. Cite evidence and explain the application of electric currents and magnetic fields as they relate to their use in everyday living (e.g., the application of fields in motors and generators and the concept of electric current using Ohm's law). (DOK 2)

3. <u>Demonstrate an understanding of general properties and characteristics of waves.</u>

e. Differentiate among transverse, longitudinal, and surface waves as they propagate through a medium (e.g., string, air, water, steel beam). (DOK 1)

f. Compare properties of waves (e.g., superposition, interference, refraction, reflection, diffraction, Doppler effect), and explain the connection among the quantities (e.g., wavelength, frequency, period, amplitude, and velocity). (DOK 2)

g. Classify the electromagnetic spectrum's regions according to frequency and/or wavelength, and draw conclusions about their impact on life. (DOK 2)
   - The emission of light by electrons when moving from higher to lower levels
   - Energy (photons as quanta of light)
   - Additive and subtractive properties of colors
   - Relationship of visible light to the color spectrum

h. Explain how sound intensity is measured and its relationship to the decibel scale. (DOK 1)

4. <u>Develop an understanding of the atom.</u>

e. Cite evidence to summarize the atomic theory. (DOK 1)
   - Models for atoms
   - Hund's rule and Aufbau process to specify the electron configuration of elements
   - Building blocks of matter (e.g., proton, neutron, and electron) and elementary particles (e.g., positron, mesons, neutrinos, etc.)
   - Atomic orbitals (s, p, d, f) and their basic shapes

f. Explain the difference between chemical and physical changes, and demonstrate how these changes can be used to separate mixtures and compounds into their components. (DOK 2)

g. Research the history of the periodic table of the elements, and summarize the contributions that led to the atomic theory. (DOK 2)
   - Contributions of scientists (e.g., John Dalton, J.J. Thomson, Ernest Rutherford, Newton, Einstein, Neils, Bohr, Louis de Broglie, Erwin Schrödinger, etc.)
   - Technology (e.g., X-rays, cathode-ray tubes, spectroscopes)

- Experiments (e.g., gold-foil, cathode-ray, etc.)

h. Utilize the periodic table to predict and explain patterns and draw conclusions about the structure, properties, and organization of matter. (DOK 2)
   - Atomic composition and valence electron configuration (e.g., atomic number, mass number of protons, neutrons, electrons, isotopes, and ions)
   - Periodic trends using the periodic table (e.g., valence, reactivity, atomic radius)
   - Average atomic mass from isotopic abundance
   - Solids, liquids, and gases
   - Periodic properties of elements (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius) and how they relate to position in the periodic table

5. <u>Investigate and apply principles of physical and chemical changes in matter.</u>

d. Write chemical formulas for compounds comprising monatomic and polyatomic ions. (DOK 1)
e. Balance chemical equations. (DOK 2)
f. Classify types of chemical reactions (e, g., composition, decomposition, single displacement, double displacement, combustion, acid/base reactions). (DOK 2)

<u>Physics I</u>

PHYI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
PHYI 2	Develop an understanding of concepts related to forces and motion.
PHYI 3	Develop an understanding of concepts related to work and energy.
PHYI 4	Discuss the characteristics and properties of light and sound.
PHYI 5	Apply an understanding of magnetism, electric fields, and electricity.
PHYI 6	Analyze and explain concepts of nuclear physics.

1. <u>Investigate and apply principles of physical and chemical changes in matter.</u>

h. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
i. Clarify research questions, and design laboratory investigations. (DOK 3)
j. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
k. Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
l. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
m. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
n. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. **<u>Develop an understanding of concepts related to forces and motion.</u>**
   e. Use inquiry to investigate and develop an understanding of the kinematics and dynamics of physical bodies. (DOK 3)
      - Vector and scalar quantities
      - Vector problems (solved mathematically and graphically)
      - Vector techniques and free-body diagrams to determine the net force on a body when several forces are acting on it
      - Relations among mass, inertia, and weight
   f. Analyze, describe, and solve problems by creating and utilizing graphs of one-dimensional motion (e.g., position, distance, displacement, time, speed, velocity, acceleration, the special case of free fall). (DOK 2)
   g. Analyze real-world applications to draw conclusions about Newton's three laws of motion. (DOK 2)
   h. Apply the effects of the universal gravitation law to graph and interpret the force between two masses, acceleration due to gravity, and planetary motion. (DOK 2)
      - Situations where g is constant (falling bodies)
      - Concept of centripetal acceleration undergoing uniform circular motion
      - Kepler's third law
      - Oscillatory motion and the mechanics of waves
3. **<u>Develop an understanding of concepts related to work and energy.</u>**
   f. Explain and apply the conservation of energy and momentum. (DOK 2)
      - Concept of work and applications
      - Concept of kinetic energy, using the elementary work-energy theorem
      - Concept of conservation of energy with simple examples
      - Concepts of energy, work, and power (qualitatively and quantitatively)
      - Principles of impulse in inelastic and elastic collisions
   g. Analyze real-world applications to draw conclusions about mechanical potential energy (the energy of configuration). (DOK 3)
   h. Apply the principles of impulse, and compare conservation of momentum and conservation of kinetic energy in perfectly inelastic and elastic collisions. (DOK 1)
   i. Investigate and summarize the principles of thermodynamics. (DOK 2)
      - How heat energy is transferred from higher temperature to lower temperature until equilibrium is reached
      - Temperature and thermal energy as related to molecular motion and states of matter
      - Problems involving specific heat and heat capacity
      - First and second laws of thermodynamics as related to heat engines, refrigerators, and thermal efficiency
   j. Develop the kinetic theory of ideal gases and explain the concept of Carnot efficiency. (DOK 2)
4. **<u>Discuss the characteristics and properties of light and sound.</u>**
   f. Describe and model the characteristics and properties of mechanical waves. (DOK 2)
      - Simple harmonic motion
      - Relationships among wave characteristics such as velocity, period, frequency, amplitude, phase, and wavelength

- Energy of a wave in terms of amplitude and frequency.
- Standing waves and waves in specific media (e.g., stretched string, water surface, air, etc.)

g. Differentiate and explain the Doppler effect as it relates to a moving source and to a moving observer. (DOK 1)

h. Explain the laws of reflection and refraction, and apply Snell's law to describe the relationship between the angles of incidence and refraction. (DOK 2)

i. Use ray tracing and the thin lens equation to solve real-world problems involving object distance from lenses. (DOK 2)

j. Investigate and draw conclusions about the characteristics and properties of electromagnetic waves. (DOK 2)

5. <u>Apply an understanding of magnetism, electric fields, and electricity.</u>

d. Analyze and explain the relationship between electricity and magnetism. (DOK 2)
- Characteristics of static charge and how a static charge is generated
- Electric field, electric potential, current, voltage, and resistance as related to Ohm's law
- Magnetic poles, magnetic flux and field, Ampère's law and Faraday's law
- Coulomb's law

e. Use schematic diagrams to analyze the current flow in series and parallel electric circuits, given the component resistances and the imposed electric potential. (DOK 2)

f. Analyze and explain the relationship between magnetic fields and electrical current by induction, generators, and electric motors. (DOK 2)

6. <u>Analyze and explain concepts of nuclear physics.</u>

c. Analyze and explain the principles of nuclear physics. (DOK 1)
- The mass number and atomic number of the nucleus of an isotope of a given chemical element
- The conservation of mass and the conservation of charge
- Nuclear decay

d. Defend the wave-particle duality model of light, using observational evidence. (DOK 3)
- Quantum energy and emission spectra
- Photoelectric and Compton effects

<u>Spatial Information Science</u>

SP 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.

SP 2 Develop an understanding of geographic information systems.

1. <u>Demonstrate the basic concepts of global positioning systems (GPS). (E)</u>

h. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)

i. Clarify research questions, and design laboratory investigations. (DOK 3)

j. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)

k. Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences). (DOK 3)
l. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
m. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
n. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBLs, etc.). (DOK 3)

2. <u>Demonstrate the basic concepts of remote sensing. (E, P)</u>

g. Describe the characteristics of the electromagnetic spectrum.
h. Using images and graphs, interpret the absorption/reflection spectrum.
i. Distinguish between passive vs. active sensor systems.
j. Analyze the effects of changes in spatial, temporal, and spectral resolution.
k. Analyze the effects on images due to changes in scale.
l. Identify the types of sensor platforms.

Zoology

ZO 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
ZO 2	Develop an understanding of levels of organization and animal classification.
ZO 3	Differentiate among animal life cycles, behaviors, adaptations, and relationships.
ZO 4	Demonstrate an understanding of the principles of animal genetic diversity and evolution.

1. <u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>

h. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
   - Safety rules and symbols
   - Proper use and care of the compound light microscope, slides, chemicals, etc.
   - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
i. Formulate questions that can be answered through research and experimental design. (DOK 3)
j. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
k. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
l. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)

m. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
n. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. <u>Develop an understanding of levels of organization and animal classification.</u>

e. Explain how organisms are classified, and identify characteristics of major groups. (DOK 1)
   - Levels of organization of structures in animals (e.g., cells, tissues, organs, and systems)
   - Characteristics used to classify organisms (e.g., cell structure, biochemistry, anatomy, fossil record, and methods of reproduction)
f. Identify and describe characteristics of the major phyla. (DOK 1)
   - Symmetry and body plan
   - Germ layers and embryonic development
   - Organ systems (e.g., digestive, circulatory, excretory, and reproductive)
   - Locomotion and coordination
g. Distinguish viruses from bacteria and protists, and give examples. (DOK 1)
h. Differentiate among the characteristics of bacteria, archaea, and eucarya. (DOK 1)
   - Phylogenic sequencing of the major phyla
   - Invertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following phyla: Porifera, Cnidarians, Nematoda, Annelida, Platyhelmenthes, Arthropoda, Insecta, Crustacea, Arachnida, Mollusca [Bivalvia and Gastropoda], and Echinodermata)
   - Vertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following classes: Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, and Mammalia

3. <u>Differentiate among animal life cycles, behaviors, adaptations, and relationships.</u>

f. Describe life cycles, alternation of generations, and metamorphosis of various animals, and evaluate the advantages and disadvantages of asexual and sexual reproduction. (DOK 1)
g. Describe and explain concepts of animal behavior, and differentiate between learned and innate behavior. (DOK 1)
   - Division of labor within a group of animals
   - Communication within animals groups
   - Degree of parental care given in animal groups
h. Evaluate the unique protective adaptations of animals as they relate to survival. (DOK 2)
i. Compare and contrast ecological relationships, and make predictions about the survival of populations under given circumstances. (DOK 3)
   - Terrestrial and aquatic ecosystems
   - Herbivores, carnivores, omnivores, decomposers and other feeding relationships
   - Symbiotic relationships such as mutualism, commensalisms, and parasitism
j. Contrast food chains and food webs. (DOK 2)

4. <u>Demonstrate an understanding of the principles of animal genetic diversity and evolution.</u>

c. Categorize and explain sources of genetic variation on the cellular level (e.g., mutations, crossing over, and nondisjunction) and the population level (e.g., nonrandom mating, migration, etc.). (DOK 2)
   - Relationship between natural selection and evolution
   - Mutations, crossing over, nondisjunction
   - Nonrandom mating, migration, etc.
   - Effects of genetic drift on evolution
d. Develop a logical argument defending or refuting issues related to genetic engineering of animals. (DOK 3)

Appendix C: ACT College Readiness Standards

English

E1 Topic Development in Terms of Purpose and Focus

- Identify the basic purpose or role of a specified phrase or sentence.
- Delete a clause or sentence because it is obviously irrelevant to the essay.
- Identify the central idea or main topic of a straightforward piece of writing.
- Determine relevancy when presented with a variety of sentence-level details.
- Identify the focus of a simple essay, applying that knowledge to add a sentence that sharpens that focus or to determine if an essay has met a specified goal.
- Delete material primarily because it disturbs the flow and development of the paragraph.
- Add a sentence to accomplish a fairly straightforward purpose such as illustrating a given statement.
- Apply an awareness of the focus and purpose of a fairly involved essay to determine the rhetorical effect and suitability of an existing phrase or sentence or to determine the need to delete plausible but irrelevant material.
- Add a sentence to accomplish a subtle rhetorical purpose such as to emphasize, to add supporting detail, or to express meaning through connotation.
- Determine whether a complex essay has accomplished a specific purpose.
- Add a phrase or sentence to accomplish a complex purpose, often expressed in terms of the main focus of the essay.

E2 Organization, Unity, and Coherence

- Use conjunctive adverbs or phrases to show time relationship in simple narrative essays (e.g., *then, this time*, etc.).
- Select the most logical place to add a sentence in a paragraph.
- Use conjunctive adverbs or phrases to express straightforward logical relationships (e.g., *first, afterward, in response*).
- Decide the most logical place to add a sentence in an essay.
- Add a sentence that introduces a simple paragraph.
- Determine the need for conjunctive adverbs or phrases to create subtle logical connections between sentences (e.g., *therefore, however, in addition*).
- Rearrange the sentences in a fairly uncomplicated paragraph for the sake of logic.
- Add a sentence to introduce or conclude the essay or to provide a transition between paragraphs when the essay is fairly straightforward.
- Make sophisticated distinctions concerning the logical use of conjunctive adverbs or phrases, particularly when signaling a shift between paragraphs.
- Rearrange sentences to improve the logic and coherence of a complex paragraph.
- Add a sentence to introduce or conclude a fairly complex paragraph.
- Consider the need for introductory sentences or transitions, basing decisions on a thorough understanding of both the logic and rhetorical effect of the paragraph and essay.

E3 Word Choice in Terms of Style, Tone, Clarity, and Economy

- Revise sentences to correct awkward and confusing arrangements of sentence elements.
- Revise vague nouns and pronouns that create obvious logic problems.
- Delete obviously synonymous and wordy material in a sentence.
- Revise expressions that deviate from the style of an essay.
- Delete redundant material when information is repeated in different parts of speech (e.g., *alarmingly startled*).
- Use the word or phrase most consistent with the style and tone of a fairly straightforward essay.
- Determine the clearest and most logical conjunction to link clauses.
- Revise a phrase that is redundant in terms of the meaning and logic of the entire sentence.
- Identify and correct ambiguous pronoun references.
- Use the word or phrase most appropriate in terms of the content of the sentence and tone of the essay.
- Correct redundant material that involves sophisticated vocabulary and sounds acceptable as conversational English (e.g., *an aesthetic viewpoint* versus *the outlook of an aesthetic viewpoint*).
- Correct vague and wordy or clumsy and confusing writing containing sophisticated language.
- Delete redundant material that involves subtle concepts or that is redundant in terms of the paragraph as a whole.

E4 Sentence Structure and Formation

- Use conjunctions or punctuation to join simple clauses.
- Revise shifts in verb tense between simple clauses in a sentence or between simple adjoining sentences.
- Determine the need for punctuation and conjunctions to avoid awkward sounding sentence fragments and fused sentences.
- Decide the appropriate verb tense and voice by considering the meaning of the entire sentence.
- Recognize and correct marked disturbances of sentence flow and structure (e.g., participial phrase fragments, missing or incorrect relative pronouns, dangling or misplaced modifiers).
- Revise to avoid faulty placement of phrases and faulty coordination and subordination of clauses in sentences with subtle structural problems.
- Maintain consistent verb tense and pronoun person on the basis of the preceding clause or sentence.
- Use sentence-combining techniques, effectively avoiding problematic comma splices, run-on sentences, and sentence fragments, especially in sentences containing compound subjects or verbs.
- Maintain a consistent and logical use of verb tense and pronoun person on the basis of information in the paragraph or essay as a whole.

- Work comfortably with long sentences and complex clausal relationships within sentences, avoiding weak conjunctions between independent clauses, and maintaining parallel structure between clauses.

E5 Conventions of Usage

- Solve such basic grammatical problems as how to form the past and past participle of irregular but commonly used verbs and how to form comparative and superlative adjectives.
- Solve such grammatical problems as whether to use an adverb or adjective form, how to ensure straightforward subject–verb and pronoun–antecedent agreement, and which preposition to use in simple contexts.
- Recognize and use the appropriate word in frequently confused pairs such as *there* and *their*, *past* and *passed*, and *led* and *lead*.
- Use idiomatically appropriate prepositions, especially in combination with verbs (e.g., *long for*, *appeal to*).
- Ensure that a verb agrees with its subject when there is some text between the two.
- Ensure that a pronoun agrees with its antecedent when the two occur in separate clauses or sentences.
- Identify the correct past and past participle forms of irregular and infrequently used verbs, and form present–perfect verbs by using *have* rather than *of*.
- Correctly use reflexive pronouns, the possessive pronouns *its* and *your*, and the relative pronouns *who* and *whom*.
- Ensure that a verb agrees with its subject in unusual situations (e.g., when the subject–verb order is inverted or when the subject is an indefinite pronoun).
- Provide idiomatically and contextually appropriate prepositions following verbs in situations involving sophisticated language or ideas.
- Ensure that a verb agrees with its subject when a phrase or clause between the two suggests a different number for the verb.

E6 Conventions of Punctuation

- Delete commas that create basic sense problems (e.g., between verb and direct object).
- Provide appropriate punctuation in straightforward situations (e.g., items in a series).
- Delete commas that disturb the sentence flow (e.g., between modifier and modified element).
- Use commas to set off simple parenthetical phrases.
- Delete unnecessary commas when an incorrect reading of the sentence suggests a pause that should be punctuated (e.g., between verb and direct object clause).
- Use punctuation to set off complex parenthetical phrases.
- Recognize and delete unnecessary commas based on a careful reading of a complicated sentence (e.g., between the elements of a compound subject or compound verb joined by *and*).
- Use apostrophes to indicate simple possessive nouns.
- Recognize inappropriate uses of colons and semicolons.
- Use commas to set off a nonessential/nonrestrictive appositive or clause.

- Deal with multiple punctuation problems (e.g., compound sentences containing unnecessary commas and phrases that may or may not be parenthetical).
- Use an apostrophe to show possession, especially with irregular plural nouns.
- Use a semicolon to indicate a relationship between closely related independent clauses.
- Use a colon to introduce an example or an elaboration.

Math

M1 Basic Operations and Applications

- Perform one-operation computation with whole numbers and decimals.
- Solve problems in one or two steps using whole numbers.
- Perform common conversions (e.g., inches to feet or hours to minutes).
- Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent.
- Solve some routine two-step arithmetic problems.
- Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average.
- Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour).
- Solve word problems containing several rates, proportions, or percentages.
- Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings).

M2 Probability, Statistics, and Data Analysis

- Calculate the average of a list of positive whole numbers.
- Perform a single computation using information from a table or chart.
- Calculate the average of a list of numbers.
- Calculate the average, given the number of data values and the sum of the data values.
- Read tables and graphs.
- Perform computations on data from tables and graphs.
- Use the relationship between the probability of an event and the probability of its complement.
- Calculate the missing data value, given the average and all data values but one.
- Translate from one representation of data to another (e.g., a bar graph to a circle graph).
- Determine the probability of a simple event.
- Exhibit knowledge of simple counting techniques.*
- Calculate the average, given the frequency counts of all the data values.
- Manipulate data from tables and graphs.
- Compute straightforward probabilities for common situations.
- Use Venn diagrams in counting.*
- Calculate or use a weighted average.
- Interpret and use information from figures, tables, and graphs.

- Apply counting techniques.
- Compute a probability when the event and/or sample space is not given or obvious.
- Distinguish between mean, median, and mode for a list of numbers.
- Analyze and draw conclusions based on information from figures, tables, and graphs.
- Exhibit knowledge of conditional and joint probability.

M3 Numbers: Concepts and Properties

- Recognize equivalent fractions and fractions in lowest terms.
- Recognize one-digit factors of a number.
- Identify a digit's place value.
- Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor.
- Find and use the least common multiple.
- Order fractions.
- Work with numerical factors.
- Work with scientific notation.
- Work with squares and square roots of numbers.
- Work problems involving positive integer exponents.*
- Work with cubes and cube roots of numbers.*
- Determine when an expression is undefined.*
- Exhibit some knowledge of the complex numbers.†
- Apply number properties involving prime factorization.
- Apply number properties involving even and odd numbers and factors and multiples.
- Apply number properties involving positive and negative numbers.
- Apply rules of exponents.
- Multiply two complex numbers.†
- Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers.
- Exhibit knowledge of logarithms and geometric sequences.
- Apply properties of complex numbers.

M4 Expressions, Equations, and Inequalities

- Exhibit knowledge of basic expressions (e.g., identify an expression for a total as $b + g$).
- Solve equations in the form $x + a = b$, where a and b are whole numbers or decimals.
- Substitute whole numbers for unknown quantities to evaluate expressions.
- Solve one-step equations having integer or decimal answers.
- Combine like terms (e.g., $2x + 5x$).
- Evaluate algebraic expressions by substituting integers for unknown quantities.
- Add and subtract simple algebraic expressions.
- Solve routine first-degree equations.
- Perform straightforward word-to-symbol translations.
- Multiply two binomials.*
- Solve real-world problems using first-degree equations.

- Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions).
- Identify solutions to simple quadratic equations.
- Add, subtract, and multiply polynomials.*
- Factor simple quadratics (e.g., the difference of squares and perfect square trinomials).*
- Solve first-degree inequalities that do not require reversing the inequality sign.*
- Manipulate expressions and equations.
- Write expressions, equations, and inequalities for common algebra settings.
- Solve linear inequalities that require reversing the inequality sign.
- Solve absolute value equations.
- Solve quadratic equations.
- Find solutions to systems of linear equations.
- Write expressions that require planning and/or manipulating to accurately model a situation.
- Write equations and inequalities that require planning, manipulating, and/or solving.
- Solve simple absolute value inequalities.

M5 Graphical Representations

- Identify the location of a point with a positive coordinate on the number line.
- Locate points on the number line and in the first quadrant.
- Locate points in the coordinate plane.
- Comprehend the concept of length on the number line.*
- Exhibit knowledge of slope.*
- Identify the graph of a linear inequality on the number line.*
- Determine the slope of a line from points or equations.*
- Match linear graphs with their equations.*
- Find the midpoint of a line segment.*
- Interpret and use information from graphs in the coordinate plane.
- Match number line graphs with solution sets of linear inequalities.
- Use the distance formula.
- Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point.
- Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle).†
- Match number line graphs with solution sets of simple quadratic inequalities.
- Identify characteristics of graphs based on a set of conditions or on a general equation such as y = ax2 + c.
- Solve problems integrating multiple algebraic and/or geometric concepts.
- Analyze and draw conclusions based on information from graphs in the coordinate plane.

M6 Properties of Plane Figures

- Exhibit some knowledge of the angles associated with parallel lines.

- Find the measure of an angle using properties of parallel lines.
- Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°).
- Use several angle properties to find an unknown angle measure.
- Recognize Pythagorean triples.*
- Use properties of isosceles triangles.*
- Apply properties of 30°-60°-90°, 45°-45°-90°, similar, and congruent triangles.
- Use the Pythagorean theorem.
- Draw conclusions based on a set of conditions.
- Solve multistep geometry problems that involve integrating concepts, planning, visualization, and/or making connections with other content areas.
- Use relationships among angles, arcs, and distances in a circle.

M7 Measurement

- Estimate or calculate the length of a line segment based on other lengths given on a geometric figure.
- Compute the perimeter of polygons when all side lengths are given.
- Compute the area of rectangles when whole number dimensions are given.
- Compute the area and perimeter of triangles and rectangles in simple problems.
- Use geometric formulas when all necessary information is given.
- Compute the area of triangles and rectangles when one or more additional simple steps are required.
- Compute the area and circumference of circles after identifying necessary information.
- Compute the perimeter of simple composite geometric figures with unknown side lengths.*
- Use relationships involving area, perimeter, and volume of geometric figures to compute another measure.
- Use scale factors to determine the magnitude of a size change.
- Compute the area of composite geometric figures when planning or visualization is required.

M8 Functions

- Evaluate quadratic functions, expressed in function notation, at integer values.
- Evaluate polynomial functions, expressed in function notation, at integer values.†
- Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths.†
- Evaluate composite functions at integer values.†
- Apply basic trigonometric ratios to solve right-triangle problems.†
- Write an expression for the composite of two simple functions.†
- Use trigonometric concepts and basic identities to solve problems.†
- Exhibit knowledge of unit circle trigonometry.†
- Match graphs of basic trigonometric functions with their equations.

Notes

- Students who score in the 1–12 range are most likely beginning to develop the knowledge and skills assessed in the other ranges.
- Standards followed by an asterisk (*) apply to the PLAN and ACT Mathematics tests only.
- Standards followed by a dagger (†) apply to the ACT Mathematics test only.

Reading

R1 Main Ideas and Author's Approach

- Recognize a clear intent of an author or narrator in uncomplicated literary narratives.
- Identify a clear main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Infer the main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in uncomplicated passages.
- Identify a clear main idea or purpose of any paragraph or paragraphs in uncomplicated passages.
- Infer the main idea or purpose of straightforward paragraphs in more challenging passages.
- Summarize basic events and ideas in more challenging passages.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in more challenging passages.
- Infer the main idea or purpose of more challenging passages or their paragraphs.
- Summarize events and ideas in virtually any passage.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in virtually any passage.
- Identify clear main ideas or purposes of complex passages or their paragraphs.

R2 Supporting Details

- Locate basic facts (e.g., names, dates, events) clearly stated in a passage.
- Locate simple details at the sentence and paragraph level in uncomplicated passages.
- Recognize a clear function of a part of an uncomplicated passage.
- Locate important details in uncomplicated passages.
- Make simple inferences about how details are used in passages.
- Locate important details in more challenging passages.
- Locate and interpret minor or subtly stated details in uncomplicated passages.
- Discern which details, though they may appear in different sections throughout a passage, support important points in more challenging passages.
- Locate and interpret minor or subtly stated details in more challenging passages.
- Use details from different sections of some complex informational passages to support a specific point or argument.
- Locate and interpret details in complex passages.
- Understand the function of a part of a passage when the function is subtle or complex.

R3 Sequential, Comparative, and Cause–Effect Relationships

- Determine when (e.g., first, last, before, after) or if an event occurred in uncomplicated passages.
- Recognize clear cause–effect relationships described within a single sentence in a passage.

- Identify relationships between main characters in uncomplicated literary narratives.
- Recognize clear cause–effect relationships within a single paragraph in uncomplicated literary narratives.
- Order simple sequences of events in uncomplicated literary narratives.
- Identify clear relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear cause–effect relationships in uncomplicated passages.
- Order sequences of events in uncomplicated passages.
- Understand relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear relationships between characters, ideas, and so forth in more challenging literary narratives.
- Understand implied or subtly stated cause–effect relationships in uncomplicated passages.
- Identify clear cause–effect relationships in more challenging passages.
- Order sequences of events in more challenging passages.
- Understand the dynamics between people, ideas, and so forth in more challenging passages.
- Understand implied or subtly stated cause–effect relationships in more challenging passages.
- Order sequences of events in complex passages.
- Understand the subtleties in relationships between people, ideas, and so forth in virtually any passage.
- Understand implied, subtle, or complex cause–effect relationships in virtually any passage.

R4 Meaning of Words

- Understand the implication of a familiar word or phrase and of simple descriptive language.
- Use context to understand basic figurative language.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in uncomplicated passages.
- Use context to determine the appropriate meaning of virtually any word, phrase, or statement in uncomplicated passages.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in more challenging passages.
- Determine the appropriate meaning of words, phrases, or statements from figurative or somewhat technical contexts.
- Determine, even when the language is richly figurative and the vocabulary is difficult, the appropriate meaning of context-dependent words, phrases, or statements in virtually any passage.

R5 Generalizations and Conclusions

- Draw simple generalizations and conclusions about the main characters in uncomplicated literary narratives.
- Draw simple generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw simple generalizations and conclusions using details that support the main points of more challenging passages.
- Draw subtle generalizations and conclusions about characters, ideas, and so forth in uncomplicated literary narratives.
- Draw generalizations and conclusions about people, ideas, and so forth in more challenging passages.
- Use information from one or more sections of a more challenging passage to draw generalizations and conclusions about people, ideas, and so forth.
- Draw complex or subtle generalizations and conclusions about people, ideas, and so forth, often by synthesizing information from different portions of the passage.
- Understand and generalize about portions of a complex literary narrative.

Science

S1 Interpretation of Data

- Select a single piece of data (numerical or non-numerical) from a simple data presentation (e.g., a table or graph with two or three variables, a food web diagram).
- Identify basic features of a table, graph, or diagram (e.g., headings, units of measurement, axis labels).
- Select two or more pieces of data from a simple data presentation.
- Understand basic scientific terminology.
- Find basic information in a brief body of text.
- Determine how the value of one variable changes as the value of another variable changes in a simple data presentation.
- Select data from a complex data presentation (e.g., a table or graph with more than three variables, a phase diagram).
- Compare or combine data from a simple data presentation (e.g., order or sum data from a table).
- Translate information into a table, graph, or diagram.
- Compare or combine data from two or more simple data presentations (e.g., categorize data from a table using a scale from another table).
- Compare or combine data from a complex data presentation.
- Interpolate between data points in a table or graph.
- Determine how the value of one variable changes as the value of another variable changes in a complex data presentation.
- Identify and/or use a simple (e.g., linear) mathematical relationship between data.
- Analyze given information when presented with new, simple information.

- Compare or combine data from a simple data presentation with data from a complex data presentation.
- Identify and/or use a complex (e.g., nonlinear) mathematical relationship between data.
- Extrapolate from data points in a table or graph.
- Compare or combine data from two or more complex data presentations.
- Analyze given information when presented with new, complex information.

S2 Scientific Investigation

- Understand the methods and tools used in a simple experiment.
- Understand the methods and tools used in a moderately complex experiment.
- Understand a simple experimental design.
- Identify a control in an experiment.
- Identify similarities and differences between experiments.
- Understand the methods and tools used in a complex experiment.
- Understand a complex experimental design.
- Predict the results of an additional trial or measurement in an experiment.
- Determine the experimental conditions that would produce specified results.
- Determine the hypothesis for an experiment.
- Identify an alternate method for testing a hypothesis.
- Understand precision and accuracy issues.
- Predict how modifying the design or methods of an experiment will affect results.
- Identify an additional trial or experiment that could be performed to enhance or evaluate experimental results.

S3 Evaluation of Models, Inferences, and Experimental Results

- Select a simple hypothesis, prediction, or conclusion that is supported by a data presentation or a model.
- Identify key issues or assumptions in a model.
- Select a simple hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a simple hypothesis or conclusion and why.
- Identify strengths and weaknesses in one or more models.
- Identify similarities and differences between models.
- Determine which model(s) is/are supported or weakened by new information.
- Select a data presentation or a model that supports or contradicts a hypothesis, prediction, or conclusion.
- Select a complex hypothesis, prediction, or conclusion that is supported by a data presentation or model.
- Determine whether new information supports or weakens a model and why.
- Use new information to make a prediction based on a model.
- Select a complex hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a complex hypothesis or conclusion and why.

Writing

W1 Expressing Judgments

- Show a little understanding of the persuasive purpose of the task, but neglect to take or to maintain a position on the issue in the prompt.
- Show limited recognition of the complexity of the issue in the prompt.
- Show a basic understanding of the persuasive purpose of the task by taking a position on the issue in the prompt but may not maintain that position.
- Show a little recognition of the complexity of the issue in the prompt by acknowledging, but only briefly describing, a counterargument to the writer's position.
- Show understanding of the persuasive purpose of the task by taking a position on the issue in the prompt.
- Show some recognition of the complexity of the issue in the prompt by doing the following:
    - Acknowledging counterarguments to the writer's position
    - Providing some response to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a broad context for discussion.
- Show recognition of the complexity of the issue in the prompt by doing the following:
    - Partially evaluating implications and/or complications of the issue
    - Posing and partially responding to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a critical context for discussion.
- Show understanding of the complexity of the issue in the prompt by doing the following:
    - Examining different perspectives
    - Evaluating implications or complications of the issue
    - Posing and fully discussing counterarguments to the writer's position

W2 Focusing on the Topic

- Maintain a focus on the general topic in the prompt through most of the essay.
- Maintain a focus on the general topic in the prompt throughout the essay.
- Maintain a focus on the general topic in the prompt throughout the essay, and attempt a focus on the specific issue in the prompt.
- Present a thesis that establishes focus on the topic.
- Maintain a focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a thesis that establishes a focus on the writer's position on the issue.
- Maintain a clear focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a critical thesis that clearly establishes the focus on the writer's position on the issue.

W3 Developing a Position

- Offer a little development, with one or two ideas; if examples are given, they are general and may not be clearly relevant; resort often to merely repeating ideas.
- Show little or no movement between general and specific ideas and examples.
- Offer limited development of ideas using a few general examples; resort sometimes to merely repeating ideas.
- Show little movement between general and specific ideas and examples.
- Develop ideas by using some specific reasons, details, and examples.
- Show some movement between general and specific ideas and examples.
- Develop most ideas fully, using some specific and relevant reasons, details, and examples.
- Show clear movement between general and specific ideas and examples.
- Develop several ideas fully, using specific and relevant reasons, details, and examples.
- Show effective movement between general and specific ideas and examples.

W4 Organizing Ideas

- Provide a discernible organization with some logical grouping of ideas in parts of the essay.
- Use a few simple and obvious transitions.
- Present a discernible, though minimally developed, introduction and conclusion.
- Provide a simple organization with logical grouping of ideas in parts of the essay.
- Use some simple and obvious transitional words, though they may at times be inappropriate or misleading.
- Present a discernible, though underdeveloped, introduction and conclusion.
- Provide an adequate but simple organization with logical grouping of ideas in parts of the essay but with little evidence of logical progression of ideas.
- Use some simple and obvious, but appropriate, transitional words and phrases.
- Present a discernible introduction and conclusion with a little development.
- Provide unity and coherence throughout the essay, sometimes with a logical progression of ideas.
- Use relevant, though at times simple and obvious, transitional words and phrases to convey logical relationships between ideas.
- Present a somewhat developed introduction and conclusion.
- Provide unity and coherence throughout the essay, often with a logical progression of ideas.
- Use relevant transitional words, phrases, and sentences to convey logical relationships between ideas.
- Present a well-developed introduction and conclusion.

W5 Using Language

- Show limited control of language by doing the following:
    - Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes significantly impede understanding

- Using simple vocabulary
- Using simple sentence structure
- Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes impede understanding
- Using simple but appropriate vocabulary
- Using a little sentence variety, though most sentences are simple in structure
- Correctly employing many of the conventions of standard English grammar, usage, and mechanics but with some distracting errors that may occasionally impede understanding
- Using appropriate vocabulary
- Using some varied kinds of sentence structures to vary pace
- Correctly employing most conventions of standard English grammar, usage, and mechanics with a few distracting errors but none that impede understanding
- Using some precise and varied vocabulary
- Using several kinds of sentence structures to vary pace and to support meaning
- Correctly employing most conventions of standard English grammar, usage, and mechanics with just a few, if any, errors
- Using precise and varied vocabulary
- Using a variety of sentence structures to vary pace and to support meaning

Appendix D: Pathway Content Standards

Consortium for Entrepreneurship Education (CEE)

CEE1 Entrepreneurial Processes: Understands concepts and processes associated with successful entrepreneurial performance (Discovery, Concept Development, Resourcing, Actualization, and Harvesting)

CEE2 Entrepreneurial Traits/Behaviors: Understands the personal traits/behaviors associated with successful entrepreneurial performance (Leadership, Personal Assessment, and Personal Management)

CEE3 Business Foundations: Understands fundamental business concepts that affect business decision making (Business Concepts, Business Activities)

CEE4 Communications and Interpersonal Skills: Understands concepts, strategies, and systems needed to interact effectively with others (Fundamentals of Communication, Staff Communications, Ethics in Communication, Group Working Relationships, and Dealing with Conflict)

CEE5 Digital Skills: Understands concepts and procedures needed for basic computer operations (Computer Basics and Computer Applications)

CEE6 Economics: Understands the economic principles and concepts fundamental to entrepreneurship/small-business ownership (Basic Concepts, Cost-Profit Relationships, Economic Indicators/Trends, Economic Systems, and International Concepts)

CEE7 Financial Literacy: Understands personal money-management concepts, procedures, and strategies (Money Basics, Financial Services, and Personal Money Management)

CEE8 Professional Development: Understands concepts and strategies needed for career exploration, development, and growth (Career Planning and Job-Seeking Skills)

CEE9 Financial Management: Understands the financial concepts and tools used in making business decisions (Accounting, Finance, and Money Management)

CEE10 Human Resource Management: Understands the concepts, systems, and strategies needed to acquire, motivate, develop, and terminate staff (Organizing, Staffing, Training/Development, Morale/Motivation, and Assessment)

CEE11 Information Management: Understands the concepts, systems, and tools needed to access, process, maintain, evaluate, and disseminate information for business decision-making (Record keeping, Technology, Information Acquisition)

CEE12 Marketing Management: Understands the concepts, processes, and systems needed to determine and satisfy customer needs/wants/expectations, meet business goals/objectives, and create new product/service ideas (Product/Service Creation, Marketing-information Management, Promotion, Pricing, and Selling)

CEE13 Operations Management: Understands the processes and systems implemented to facilitate daily business operations (Business Systems, Channel Management, Purchasing/Procurement, and Daily Operations)

CEE14 Risk Management: Understands the concepts, strategies, and systems that businesses implement and enforce to minimize loss (Business Risks, and Legal Considerations)

CEE15 Strategic Management: Understands the processes, strategies, and systems needed to guide the overall business organization (Planning and Controlling)

National Foundation of Teaching Entrepreneurship (NFTE)

NFTE1 Goal Setting: Measureable Goals, Thinking Skills: Problem Solving Process, Negotiating Skills

NFTE2 Viewing yourself as an Entrepreneur, Entrepreneurial Skills and Attitudes, Self-Confidence: Learning Self-Improvement, Recognizing Strengths: Reflecting on Interests and Talents, Understanding Cultural Differences, Responsible and Ethical Behavior, Networking: Finding a Mentor

NFTE3 Reading and Writing for Information and Understanding, Presenting Information Clearly, Understanding Vocabulary, Following Directions, Analyzing Information, Mathematical Reasoning, Number and Numeration, and Mathematical Modeling

NFTE4 Writing, Listening, and Speaking for Social Interaction, Critical Listening Strategies, Listening and Writing for Information and Analysis, Writing and Speaking to Persuade, Using Nonverbal Communication Skills

NFTE5 Understanding New Technologies and Trends, Multimedia Presentations, Using Text Features and Online Research , Using Graphics in Presentations, Online Research and Devising Spreadsheets

NFTE6 Determining Price per Unit to Compare Prices, Devising Formulas, Calculating Currency Exchange Rates

NFTE7 Mathematical Operations, Problem Solving, Rounding Numbers, Statistics, Interpreting Graphs and Charts: Using Diagrams to Develop Strategies, Number and Numeration: Understanding Percentage, Rounding Numbers, Solving Real World Problems, Displaying Data in Charts and Graphs

NFTE8 Job-Seeking Skills, Interviewing Skills, Sales Interviews

NFTE9 Understanding Spreadsheet Formulas, Numeration and Operations, Using Mental Math

NFTE10 Understanding Diversity, Dealing with Criticism, Using Open-Ended Questions, Networking and Communication: Finding Contacts, Listening, Interviewing, Understanding Cultural Differences

NFTE11 Using Internet Resources, Online Research, Locating Data Online, Using a Spell-Checker, Numeration and Operations, Calculating Percentage Change, Technology Etiquette, Cell Phones, Voice Mail, Email

NFTE12 Understanding Market Research, Understanding Customer Needs

NFTE13 Performing Operations Using Formulas, Math Formulas and Operations, Simple Interest, Rounding Numbers and Proportional Reasoning, Measurement and Reasoning, Understanding Length and Area, Understanding Percentages of Purchases Interest Charges, Income Tax Rates

NFTE14 Reading for Critical Analysis, Practicing Risk-Taking, Estimation and Approximation, Solving Problems That Do Not Require Exact Answers, Probability: Comparing Data and Uncertainty

NFTE15 Supporting Arguments with Details and Evidence, Interpreting Graphs and Charts, Using Diagrams to Develop Strategies, Mathematical Reasoning and Data Analysis

National Business Education Association (NBEA)

NBEA1 Understanding the Role of the Entrepreneur in Business, Opportunity Recognition and Pursuit, Problem Identification and Solutions

NBEA2 Characteristics of an Entrepreneur

NBEA3 Establishing a Vision, Forms of Business Organizations, Forms of Business Ownership, Government Regulations of Business Ownership, Business Ethics, Developing a Business Plan

NBEA4 The Economic Way of Thinking, Characteristics of a Market Economy, The Function of Price, The Role of Profit and Risk, The Role of Government, Trends in the Global Marketplace

NBEA5 Determining Cash Needs of a Business, Identifying Sources and Types of Funding, Interpreting Financial Statements

NBEA6 Keeping Business Records, Identifying Types of Business Records, Establishing and Using Business Records, Interpreting Business Records

NBEA7 Establishing a Vision, Hiring Employees, Building Teams, Monitoring Achievement, Cultural Differences and their Effects on Business

NBEA8 Identifying the Market, Reaching the Market, Keeping/Increasing the Market, Trends in the Global Marketplace, Import/Export Opportunities

NBEA9 Managing Risks

Appendix E: National Educational Technology Standards for Students

T1 Creativity and Innovation
T2 Communication and Collaboration
T3 Research and Information Fluency
T4 Critical Thinking, Problem Solving, and Decision Making
T5 Digital Citizenship
T6 Technology Operations and Concepts

T1 Creativity and Innovation

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students do the following:

a. Apply existing knowledge to generate new ideas, products, or processes.
b. Create original works as a means of personal or group expression.
c. Use models and simulations to explore complex systems and issues.
d. Identify trends and forecast possibilities.

T2 Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students do the following:

a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
c. Develop cultural understanding and global awareness by engaging with learners of other cultures.
d. Contribute to project teams to produce original works or solve problems.

T3 Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information. Students do the following:

a. Plan strategies to guide inquiry.
b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
d. Process data and report results.

T4 Critical Thinking, Problem Solving, and Decision Making

Students use critical-thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students do the following:

a. Identify and define authentic problems and significant questions for investigation.

b. Plan and manage activities to develop a solution or complete a project.
c. Collect and analyze data to identify solutions and/or make informed decisions.
d. Use multiple processes and diverse perspectives to explore alternative solutions.

T5 Digital Citizenship

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students do the following:

a. Advocate and practice safe, legal, and responsible use of information and technology.
b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.
c. Demonstrate personal responsibility for lifelong learning.
d. Exhibit leadership for digital citizenship.

T6 Technology Operations and Concepts

Students demonstrate a sound understanding of technology concepts, systems, and operations. Students do the following:

a. Understand and use technology systems.
b. Select and use applications effectively and productively.
c. Troubleshoot systems and applications.
d. Transfer current knowledge to learning of new technologies.

FRAMEWORKS FOR
CAREER-TECHNICAL PROGRAMS
REVISED IN
2011

SECONDARY
EXECUTIVE SUMMARY
2011

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Foreword

Secondary career-technical education programs in Mississippi are faced with many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, Mississippi Code of 1972, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, ch. 487, §14; Laws, 1991, ch. 423, §1; Laws, 1992, ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act III, 1998; and No Child Left Behind Act of 2001).

Each secondary career-technical course consists of a series of instructional units which focus on a common theme. All units have been written using a common format which includes the following components:

- Unit Number and Title
- Suggested Time on Task - An estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75-80 percent of the time in the course.
- Competencies and Suggested Objectives
  - A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies.
  - The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.
- Suggested Teaching Strategies - This section of each unit indicates strategies that can be used to enable students to master each competency. Emphasis has been placed on strategies which reflect active learning methodologies. Teachers should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.
- Suggested Assessment Strategies - This section indicates strategies that can be used to measure student mastery. Examples of suggested strategies could include rubrics, class participation, reflection, and journaling. Again, teachers should feel free to modify or enhance these suggested assessment strategies based on local needs and resources.
- Integrated Academic Topics, Workplace Skills, Technology Standards, and Occupational Standards - This section identifies related academic topics as required in the Subject Area Assessment Program (SATP) in Algebra I, Biology I, English II, and U. S. History from 1877, which are integrated into the content of the unit. It also identifies the 21st Century Skills, which were developed by the Partnership for 21st Century Skills, a group of business and education organizations concerned about the gap between the knowledge and skills learned in school and those needed in communities and the workplace. A portion of the 21st Century Skills addresses learning skills needed in the 21st century, including information and communication skills, thinking and problem-solving skills, and interpersonal and self-

directional skills. The need for these types of skills have been recognized for some time and the 21st Century Skills are adapted in part from the 1991 report from the U.S. Secretary of Labor's Commission on Achieving Necessary Skills (SCANS). Another important aspect of learning and working in the 21st century involves technology skills, and the International Society for Technology in Education, developers of the National Education Technology Standards (NETS), were strategic partners in the Partnership for 21st Century Skills.

- References - A list of suggested references is provided for each unit. The list includes some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested and the list may be modified or enhanced based on needs and abilities of students and on available resources.

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Horticulture

Horticulture Executive Summary

Pathway Description

The secondary pathway in Horticulture prepares individuals for entry level employment or continuing education in a wide variety of fields in the horticulture industry. Students enrolled in the pathway participate in a variety of instructional activities including lectures, discussions, laboratory experiences at the school, and work-based learning activities in the field such as field trips and shadowing experiences. Students also receive supplementary instruction and reinforcement of learning through activities in youth organizations. Topics covered in the two-year program include plant structure and growth; plant propagation; pest management; floristry; greenhouse crops and management; olericulture; plantscaping; landscape design, installation, and management; and turfgrass management. Student competencies and suggested objectives in the curriculum framework have been correlated to the knowledge and skill statements listed in Career Cluster Resources for Agriculture, Food, and Natural Resources, as published by the National Association of State Directors of Career and Technical Education.

Industry Certification

No national industry-recognized certifications are known to exist at this time in the field of horticulture. Competencies and suggested performance indicators in the horticulture courses have been correlated, however, to the National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards that have been reviewed and endorsed at the national level by the National Council on Agricultural Education.

Articulation

The following articulation plan is in place for the Horticulture Pathway.

High School Program	Community College Programs	Community College Course
Horticulture (Program CIP: 01.0601 – Applied Horticulture/Horticultural Operations, General)	Horticulture Technology (Program CIP: 01.0601 – Horticulture Service Operations and Management) (Program CIP: 01.0605 – Landscaping) (Program CIP: 01.0607 – Turf Management)	HLT 1411 - Leadership MGT HLT 1213 - Applied Principles of Plan Propagation

Assessment

Students will be assessed using the Horticulture MS-CPAS2 test. The MS-CPAS2 blueprint can be found at http://info.rcu.msstate.edu/services/curriculum.asp. If there are questions regarding assessment of this program, please contact the agriculture instructional design

specialist at the Research and Curriculum Unit at 662.325.2510.

Student Prerequisites

In order for students to experience success in the Horticulture program, the following prerequisites are recommended:

1. C or Higher in Pre-Algebra
   or
2. TABE Math Computation and TABE Math Applied Score (eighth grade or higher)
   or
3. Instructor Approval

Applied Academic Credit

Content of the Horticulture course has been aligned to the 2010 Mississippi Science Curriculum Framework. Students who complete Horticulture will receive two electives and two science credits or four elective credits that will count toward high school science graduation requirements.

Licensure Requirements

The 995 licensure endorsement is needed to teach the Horticulture pathway. The requirements for the 995 licensure endorsement are listed below:

1. Hold a valid Mississippi Educator License with endorsement #301 – Vocational Agriculture Education Programs or #302 – Agriculture.
2. Possess a baccalaureate degree in an agricultural subject area.
3. Enroll immediately in the Vocational Instructor Preparation (VIP) program or the College and Career Readiness Education Program (CCREP).
4. Complete the individualized Professional Development Plan (PDP) requirements of the VIP or CCREP prior to the expiration date of the 3-year vocational license.
5. Successfully complete an MDE-approved computer literacy certification exam.
6. Successfully complete a certification for an online learning workshop, module, or course that is approved by MDE.

Note: If the applicant meets all requirements listed above, that applicant will be issued a 995 endorsement—a 5-year license. If the applicant does not meet **all** requirements, the applicant will be issued a 3-year endorsement (license), and all requirements stated above must be satisfied prior to the ending date of that license.

Professional Learning

If you have specific questions about the content of each training session provided, please contact the Research and Curriculum Unit at 662.325.2510, and ask for the Professional Learning Specialist.

Course Outlines

Program CIP Code: 01.0601
This curriculum framework is divided into four one-Carnegie-unit courses as outlined below. The first two courses are comprised of units from Horticulture Year 1. The last two courses are comprised of units from Horticulture Year 2.

Option 1 – Four One-Carnegie-Unit Courses

Course Description: Introduction to Horticulture teaches students the about horticulture orientation and leadership development. Students are also introduced to basic plant and soil science (Plant Structure and Growth). This course also focuses on horticulture structures.

Course Description: Horticulture Plant Processes focuses on plant propagation, principles of pest management greenhouse crops and olericulture production.

Course Description: Horticulture Nursery is a comprehensive course that reviews leadership, careers, and safety. It also introduces students to nursery and landscape plant identification horticulture marketing and business procedures container and field crop production.

Course Description: Horticulture Landscape and Turf grass covers the concepts of landscape design, installation, construction, and maintenance. Students will also learn skills and knowledge associated with turfgrass installation and maintenance, pomology production, basic principles of floristry.

Introduction to Horticulture (Course Code: 991402)

Unit		Title	Hours
1		Horticulture Orientation and Leadership Development	17.5
2		Basic Plant and Soil Science (Plant Structure and Growth)	67.5
3		Horticulture Structures	20.0
			105

Horticulture Plant Processes (Course Code: 991403)

Unit		Title	Hours
4		Plant Propagation	33.0
5		Principles of Pest Management	28.0
6		Greenhouse Crops and Olericulture Production	44.0
			105

Horticulture Nursery (Course Code: 991404)

Unit		Title	Hours
7		Leadership, Careers, and Safety	25.0
8		Nursery and Landscape Plant Identification	25.0
9		Horticulture Marketing and Business Procedures	27.5
10		Container and Field Crop Production	27.5
			105

Horticulture Landscape and Turf grass (Course Code: 991405)

Unit		Title	Hours
11		Landscape Design, Installation, Construction, and Maintenance	67.5
12		Turfgrass Installation and Maintenance	15.0
13		Pomology Production	10.0
14		Basic Principles of Floristry	22.5
			115

Program CIP Code: 01.0601

This curriculum framework is divided into four one-Carnegie-unit courses as outlined below. The first two courses are comprised of units from Horticulture Year 1. The last two courses are comprised of units from Horticulture Year 2.

Horticulture I (Two Carnegie Unit) - Course Code: 991400

Unit		Title	Hours
1		Horticulture Orientation and Leadership Development	17.5
2		Basic Plant and Soil Science (Plant Structure and Growth)	67.5
3		Horticulture Structures	20.0
4		Plant Propagation	33.0
5		Principles of Pest Management	28.0
6		Greenhouse Crops and Olericulture Production	44.0
			210

Horticulture II (Two Carnegie Unit) - Course Code: 991401

Unit		Title	Hours
7		Leadership, Careers, and Safety	25.0
8		Nursery and Landscape Plant Identification	25.0
9		Horticulture Marketing and Business Procedures	27.5
10		Container and Field Crop Production	27.5
11		Landscape Design, Installation, Construction, and Maintenance	67.5
12		Turfgrass Installation and Maintenance	15.0
13		Pomology Production	10.0
14		Basic Principles of Floristry	22.5
			220

Horticulture Competencies and Objectives

Unit 1: Horticulture Orientation and Leadership Development

1. Identify school and program policies and procedures related to the horticulture program. (DOK 1)
   a. Describe local program and vocational/career technical center policies and procedures including dress code, attendance, academic requirements, discipline, and the school technology acceptable use policy and horticulture regulations. (DOK 1)
   b. Describe basic employee responsibilities and how to communicate effectively in on-the-job situations. Identify and apply the practices that affect employer and employee decision making as it relates to identifying and applying appropriate algebraic formulas to personal finance situations, linear programming to business decisions, and algebraic formulas to personal and business investments. (DOK 2)
2. Demonstrate basic and fundamental safety practices related to horticulture enterprises. (DOK 1)
   a. Identify hazards that may be found in horticulture operations, laboratory and activities such as poisons and other chemicals, sunburn, ladders and scaffolds, electrical shock, fire, poisonous insects and snakes, equipment and tool hazards, spills and slipping. (DOK 1)
   b. Identify and demonstrate the use of personal protection devices including eye protection, hearing protection, foot protection, respiratory protection, clothing, and body protection, general safety equipment in horticulture operations including fire extinguishers, eyewash and shower stations, first-aid kits. (DOK 1)
3. Develop life and career skills for success in the 21st century. (DOK 3)
   a. Identify, describe, and apply essential life and career skills. (DOK 3)
   b. Apply the concepts of team building and team member participation. (DOK 3)
   c. Demonstrate basic parliamentary procedures. (DOK 3)
4. Explore the role of the FFA in promoting leadership, personal development, and human relations skills. (DOK 1)
   a. Explore the history and nature of the FFA in promoting and developing leadership, personal development, and human relations skills. (DOK 3)
   b. Identify career-related values and ethics promoted through the FFA. (DOK 1)
   c. Identify benefits of FFA membership. (DOK 1)
   d. Select FFA activities that promote personal development and leadership skills. (DOK 3)
5. Examine the concept of leadership. (DOK 3)
   a. Explain the role of effective leadership. (DOK 3)
   b. Have students self-evaluate their personal leadership traits and develop a plan for improvement. (DOK 2)
6. Describe the role of work ethics and values in establishing and building a successful career. (DOK 3)
   a. Define and describe universally accepted work ethics and values as applied to horticulture careers. (DOK 1)

b. Practice work ethics and values in the horticulture classroom and lab. (DOK 2)

Unit 2: Basic Plant and Soil Science (Plant Structure and Growth)

1. Explore plant structure and their functions**.** (DOK2)
   a. Draw a diagram of a flowering plant, and label and describe the major parts (roots, stems, leaves, and flowers) and functions as related to plant growth (cell division, cell elongation, and cell differentiation. (DOK 1)
   b. Describe the process of respiration, photosynthesis, and transpiration. (DOK 1)
   c. Describe the relationship of environmental and cultural factors to plant growth (water, light, temperature, soil, climatic zones) (DOK 2)
2. Apply systems of plant classification. (DOK 2)
   a. Interpret the scientific classification of plants. (DOK 1)
   b. Discuss variety and variety selection of various plants. (DOK 2)
   c. Classify plants according to life cycle. (DOK 1)
3. Describe and apply principles of plant growth media**.** (DOK 2)
   a. Identify and compare the components of natural soil, and soil-less mix; List and explain the characteristics each one imparts to the root medium. (DOK 2)
   b. Prepare a growing media to specifications, or identify the components and proportions in a commercially prepared root medium and discuss/explain the advantages of a commercial root medium over media containing natural soil. (DOK 2)
   c. Identify macronutrients and micronutrients and their effects on plant growth. (DOK 2)
   d. Describe the effect of excesses and deficiencies. (DOK 2)
   e. Demonstrate the proper procedure for taking a soil sample. (DOK 1)
   f. Predict the effect various pH levels will have on plant nutrition and growth. (DOK 2)
   g. Analyze a soil sample for nutrient deficiencies by using the scientific method. (DOK 2)
   h. Calculate fertilizer application rates to meet nutritional requirements for a specific crop. (DOK 2)
   i. Select fertilizer application methods for different plant enterprises. (DOK 1)

Unit 3: Horticulture Structures

1. Describe the characteristics and features of different types of greenhouses. (DOK 3)
   a. Identify and compare the greenhouse structures and coverings and auxiliary (Shade house, hot beds, cold frame) types: Quonset, ridge and furrow, even span, and shade houses. (DOK 2)
   b. Describe the environmental controls including humidistat, thermostat, cooling, watering, and heating. (DOK 2)
   c. Describe the importance of light in plant growth. (DOK 1)
   d. Discuss water, fertigation, and chemigation management in growing plants. (DOK 2)

e. Identify and describe factors to consider in establishing a floor plan for a greenhouse including sanitation, benching, flooring, potting facilities, chemical and dry storage and traffic patterns. (DOK 2)

Unit 4: Plant Propagation

1. Distinguish between sexual and asexual reproduction. (DOK 2)
   a. Describe sexual reproduction in plants. (DOK 1)
   b. Describe the conditions needed for good seed germination. (DOK 1)
   c. Plan and conduct a seed germination test. (DOK 2)
   d. Interpret information found on a seed tag. (DOK 1)
   e. Describe, discuss, or demonstrate how to propagate plants from scarified or stratified seeds. (DOK 2)
   f. Identify and describe asexual reproduction methods. (DOK 2)
   g. Explore asexual plant reproduction techniques using grafting, budding, cuttings (root, stem and leaf), layering, separation and division, and tissue culture methods. (DOK 2)
   h. Identify common tools and chemicals used in asexual reproduction and demonstrate their safe use and care. (DOK 1)

Unit 5: Principles of Pest Management

1. Assess the effects of pests on plant production. (DOK 2)
   a. Identify types of plant pests (insects, wildlife, diseases, and weeds), and describe how each type of pest affects production, the control and management practices for plant pests and concepts related to integrated pest management.. (DOK 3)
   b. Design an integrated pest management plan for a designated horticulture crop. (DOK 2)
2. Identify, describe, and apply pesticide safety procedures**.** (DOK1)
   a. Interpret safety and first aid precautions and formulations on pesticide labels (Insecticide, herbicides, ,rodenticide, fungicide, miticide, molluscicide and Nematocides). (DOK 1)
   b. Identify beneficial insects, and discuss how they benefit plants. (DOK 1)
   c. Discuss the relationship between biological, chemical, cultural, and mechanical control methods. (DOK 2)
   d. Discuss and apply general precautions for working with pesticides in relation to the requirements for pesticide applicator's certification/licensure. (DOK 1)

Unit 6: Greenhouse Crops and Olericulture Production

1. Describe and apply principles of greenhouse crop production**.** (DOK 1)
   a. Identify different types of greenhouse crops (bedding plants, vegetables, flowering plants, foliage plants, etc.) and common species of each type, to include cultural considerations for greenhouse crops including fertilizer, water, growing medium, pest control, temperature, natural and chemical growth control and stimulation, and light control for common crops. (DOK 1)

   b. Produce a greenhouse crop following accepted commercial practices. (ongoing throughout the year) (DOK 3)
2. Describe and apply principles of Olericulture production**.** (DOK 2)
   a. Describe characteristics of common vegetables grown for commercial production including cultural requirements, direct seeding versus transplanting, plant growth style, and growing season; and distinguish between warm season and cool season crops. (DOK 1)
   b. Identify and demonstrate the use of common tools and equipment used in gardening including tillers, spreaders, sprayers, watering devices, rakes, hoes, and shovels. (DOK 1)
   c. Identify and describe factors to consider in preparing a seedbed including soil class and texture, use of soil amendments, and characteristics of a properly prepared seedbed. (DOK 2)
   d. Develop a plan for an intensive culture garden including crop and variety selection, location and spacing of different crops, scheduling of crops, crop rotation, and harvesting and marketing of crops. (DOK 3)
   e. Identify common garden pests including insects, diseases, and weeds, and methods of control. (DOK 1)
   f. Discuss new and emerging technologies, trends, and issues concerning the production and marketing of vegetables in Mississippi. Identify and discuss the roles of agencies and organizations that regulate the production and marketing of vegetables. (DOK 1)

Unit 7: Leadership, Careers, and Safety (Review and Reinforcement-Ongoing)

1. Review program policies, procedures, and safety rules**.** (DOK 1)
   a. Review program operation policies and procedures, including general safety procedures. (DOK 1)
2. Practice leadership skills. (DOK 2)
   a. Identify and discuss fundamental parliamentary procedures for participating in a public meeting and public speaking. (DOK 1)
   b. Select FFA activities that promote personal development and leadership skills. (DOK 1)
3. Complete school-to-careers activities related to horticulture. (DOK 1)
   a. Identify employment and career opportunities in the horticulture industry. (DOK 1)
   b. Investigate educational opportunities related to horticulture at the postsecondary level. (DOK 2)
   c. Describe national standards and certification/licensing procedures, trade organizations, associations, and unions as related to horticulture.(DOK 1)

Unit 8: Nursery and Landscape Plant Identification

1. Identify and describe the use of major plants associated with nursery and landscape operations. (DOK 1)
   a. Identify and describe the use of major nursery plants including trees, shrubs, ground covers, vines, and ornamental grasses. To include the use of major foliage plants used

in nursery and landscape operations .Identify and describe the use of major flowering plants including annuals, biennials, and perennials. (DOK 1)

Unit 9: Horticulture Marketing and Business Procedures

1. Describe and apply marketing and business practices associated with horticulture operations**.** (DOK 1)
   a. Maintain an inventory of plants and supplies for the horticulture program. (on-going throughout the year) (DOK 3)
   b. Develop an annual calendar of activities/enterprises for a horticulture business to include ordering materials/supplies for an enterprise. (DOK 2)
   c. Describe factors to consider in pricing products of an enterprise and complete a sales transaction including providing customer service. (DOK 1)
   d. Describe factors to consider in marketing and advertising products.(DOK1)

Unit 10: Container and Field Crop Production

1. Describe and apply principles of container and field crop production. (DOK 2)
   a. Describe advantages and disadvantages of container crop production and filed crop production. (DOK 2)
   b. Identify and demonstrate the safe use of tools and equipment for container and field crop production. (DOK 1)
   c. Produce container and field grown plants. (DOK 3)
   d. Describe automation and plug production in the nursery industry. (DOK 1)

Unit 11: Landscape Design, Installation, Construction, and Maintenance

1. Describe and apply principles of landscape design**.** (DOK 1)
   a. Describe careers in the landscape design field.(DOK 1)
   b. Identify and demonstrate the use of tools and equipment for landscape design including computer-assisted landscape design hardware and software. (DOK 1)
   c. Identify and demonstrate the methods of lettering and symbols used in landscape design plans.(DOK 2)
   d. Describe principles of design associated with landscaping including simplicity, balance, proportion.. (DOK 2)
   e. Prepare site analysis/needs assessment for a given site. (DOK 3)
   f. Prepare a simple landscape plan to scale for a given site to include plant selection and location.(DOK 2)
2. Describe and apply basic principles of landscape installation and construction. (DOK 1)
   a. Discuss the essential elements of a landscape installation contract (to include warranty and an estimate. (DOK 2)
   b. Develop a contract and pricing estimate for the landscape plan.(DOK 2)
   c. Describe and discuss procedures for preparing a planting site, installing plants, and providing post-transplant care according to a landscape plan. (DOK 2)
   d. Describe licensing requirements for landscape installation. (DOK 1)

   e. Discuss installation and maintenance of a landscape irrigation system. (DOK 1)
3. Describe and apply principles of landscape maintenance. (DOK 1)
   a. Identify and demonstrate the safe use of equipment and hand tools for landscape maintenance. (DOK 1)
   b. Identify and discuss the proper procedures for pruning trees and shrubs. (DOK 1)
   c. Determine and discuss a cost estimate fertilizer needs, pest control and maintenance needs of trees, shrubs, and beds. (DOK 2)

Unit 12: Turfgrass Installation and Maintenance

1. Describe and apply principles of turfgrass installation**.** (DOK 1)
   a. Describe factors to consider in selecting a turfgrass for a specific area.(Identify varieties of turfgrass and describe their characteristics.) (DOK 2)
   b. Describe installation practices for different turfgrasses including site preparation and initial care. (DOK 1)
2. Describe and apply principles of turfgrass maintenance. (DOK 1)
   a. Identify and demonstrate the safe use and maintenance of equipment and tools used for turfgrass maintenance including mowers, dethatchers, aerators, and other equipment. (DOK 1)
   b. Use of Mower, Sprayers or spreaders for a specific grass. (DOK 3)
   c. Identify and describe common pests of turfgrass including insects, diseases, and weeds and common irrigation methods for turfgrass (DOK 1)
   d. Perform repair/renovation practices including aeration and dethatching. (DOK 2)
   e. Develop a plan/cost estimate for a turfgrass management program. (DOK 2)

Unit 13: Pomology Production

1. Describe and apply principles of fruit and berry production**.** (DOK 1)
   a. Identify, discuss and prepare a planting and marketing plan of common fruits and berries produced in Mississippi. (DOK 1)
   b. Provide or explain/describe how to provide cultural care for fruit or berry plants commonly grown in Mississippi, to include pruning, fertilizing, pest control, and harvesting. (DOK 2)
   c. Identify, discuss, and describe marketing of fruits and vegetables. As it relates to local, state, national, and international organizations that impact fruit and berry production. (DOK 2)

Unit 14: Principles of Floristry

1. Describe and apply principles of floristry. (DOK 1)
   a. Demonstrate the procedures for receiving and storing (including rotation of inventory) of floral materials. (DOK 1)
   b. Apply basic design principles including balance, transition, rhythm, focal point, proportion, scale. (DOK 2)
   c. Receive and process orders for floral products. (DOK 1)

d. Create an advanced floral design product such as a hogarth curve, fan, right or left triangle, diagonal. (DOK 3)
e. Identify and demonstrate the safe and proper use of tools and supplies used in floristry including shears, tape, foam, floral wire, to include plant materials used in floristry including potted, flower, and foliage materials. (DOK 1)

Horticulture Competency Profile
Program CIP: 01.0601

Unit 1: Horticulture Orientation and Leadership Development

_____ 1. Identify school and program policies and procedures related to the horticulture program. (DOK 1)
_____ 2. Demonstrate basic and fundamental safety practices related to horticulture enterprises. (DOK 1)
_____ 3. Develop life and career skills for success in the 21st century. (DOK 3)
_____ 4. Explore the role of the FFA in promoting leadership, personal development, and human relations skills. (DOK 1)
_____ 5. Examine the concept of leadership. (DOK 3)
_____ 6. Describe the role of work ethics and values in establishing and building a successful career. (DOK 3)

Unit 2: Basic Plant and Soil Science (Plant Structure and Growth)

_____ 1. Explore plant structure and their functions**.** (DOK2)
_____ 2. Apply systems of plant classification. (DOK 2)
_____ 3. Describe and apply principles of plant growth media**.** (DOK 2)

Unit 3: Horticulture Structures

_____ 1. Describe the characteristics and features of different types of greenhouses. (DOK 3)

Unit 4: Plant Propagation

_____ 1. Distinguish between sexual and asexual reproduction. (DOK 2)

Unit 5: Principles of Pest Management

_____ 1. Assess the effects of pests on plant production. (DOK 2)
_____ 2. Identify, describe, and apply pesticide safety procedures**.** (DOK1)

Unit 6: Greenhouse Crops and Olericulture Production

_____ 1. Describe and apply principles of greenhouse crop production**.** (DOK 1)
_____ 2. Describe and apply principles of Olericulture production**.** (DOK 2)

Unit 7: Leadership, Careers, and Safety (Review and Reinforcement-Ongoing)

_____ 1. Review program policies, procedures, and safety rules**.** (DOK 1)
_____ 2. Practice leadership skills. (DOK 2)
_____ 3. Complete school-to-careers activities related to horticulture. (DOK 1)

Unit 8: Nursery and Landscape Plant Identification

_____ 1. Identify and describe the use of major plants associated with nursery and landscape operations. (DOK 1)

Unit 9: Horticulture Marketing and Business Procedures

_____ 1. Describe and apply marketing and business practices associated with horticulture operations**.** (DOK 1)

Unit 10: Container and Field Crop Production

_____ 1. Describe and apply principles of container and field crop production. (DOK 2)

Unit 11: Landscape Design, Installation, Construction, and Maintenance

_____ 1. Describe and apply principles of landscape design**.** (DOK 1)

_____ 2. Describe and apply basic principles of landscape installation and construction. (DOK 1)

_____ 3. Describe and apply principles of landscape maintenance. (DOK 1)

Unit 12: Turfgrass Installation and Maintenance

_____ 1. Describe and apply principles of turfgrass installation**.** (DOK 1)

_____ 2. Describe and apply principles of turfgrass maintenance. (DOK 1)

Unit 13: Pomology Production

_____ 1. Describe and apply principles of fruit and berry production**.** (DOK 1)

Unit 14: Principles of Floristry

_____ 1. Describe and apply principles of floristry. (DOK 1)

Appendix A: 21st Century Skills Standards

CSS1-21st Century Themes

CS1 Global Awareness

7. Using 21st century skills to understand and address global issues
8. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
9. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business and Entrepreneurial Literacy

7. Knowing how to make appropriate personal economic choices
8. Understanding the role of the economy in society
9. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

7. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
8. Exercising the rights and obligations of citizenship at local, state, national, and global levels
9. Understanding the local and global implications of civic decisions

CS4 Health Literacy

11. Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health
12. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
13. Using available information to make appropriate health-related decisions
14. Establishing and monitoring personal and family health goals
15. Understanding national and international public health and safety issues

CS5 Environmental Literacy

9. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems
10. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.)
11. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions
12. Take individual and collective action towards addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues)

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

7. Think Creatively
8. Work Creatively with Others
9. Implement Innovations

CS7 Critical Thinking and Problem Solving

9. Reason Effectively
10. Use Systems Thinking
11. Make Judgments and Decisions
12. Solve Problems

CS8 Communication and Collaboration

5. Communicate Clearly
6. Collaborate with Others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy

5. Access and Evaluate Information
6. Use and Manage Information

CS10 Media Literacy

5. Analyze Media
6. Create Media Products

CS11 ICT Literacy

3. Apply Technology Effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

5. Adapt to change
6. Be Flexible

CS13 Initiative and Self-Direction

7. Manage Goals and Time
8. Work Independently
9. Be Self-directed Learners

CS14 Social and Cross-Cultural Skills

5. Interact Effectively with others
6. Work Effectively in Diverse Teams

CS15 Productivity and Accountability

5. Manage Projects
6. Produce Results

CS16 Leadership and Responsibility

5. Guide and Lead Others
6. Be Responsible to Others

Appendix B: MS Academic Standards

MISSISSIPPI SCIENCE FRAMEWORK COMPETENCIES

Marine and Aquatic Science

AQ 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
AQ 2	Develop an understanding of physical and chemical properties of water and aquatic environments.
AQ 3	Apply an understanding of the diverse organisms found in aquatic environments.
AQ 4	Draw conclusions about the relationships between human activity and aquatic organisms.

3. <u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>

a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
   - Safety rules and symbols
   - Proper use and care of the compound light microscope, slides, chemicals, etc.
   - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers

b. Formulate questions that can be answered through research and experimental design. (DOK 3)

c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)

d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)

e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)

f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)

g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. <u>Develop an understanding of physical and chemical properties of water and aquatic environments.</u>

o. Analyze the physical and chemical properties of water, and justify why it is essential to living organisms. (DOK 1)

p. Explain the causes and characteristics of tides. (DOK 1)

q. Research, create diagrams, and summarize principles related to waves and current characteristics and formation. (DOK 2)

r. Compare and contrast the physical and chemical parameters of dissolved O2, pH, temperature, salinity, and results obtained through analysis of different water column depths/zones. (DOK 2)
s. Investigate the causes and effects of erosion and discuss conclusions. (DOK 2)
t. Describe and differentiate among the major geologic features of specific aquatic environments. (DOK 1)
   - Plate tectonics
   - Rise, slope, elevation, and depth
   - Formation of dunes, reefs, barrier/volcanic islands, and coastal/flood plains
   - Watershed formation as it relates to bodies of freshwater
u. Compare and contrast the unique abiotic and biotic characteristics of selected aquatic ecosystems. (DOK 2)
   - Barrier island, coral reef, tidal pool, and ocean
   - River, stream, lake, pond, and swamp
   - Bay, sound, estuary, and marsh

3. <u>Apply an understanding of the diverse organisms found in aquatic environments.</u>

m. Analyze and explain the diversity and interactions among aquatic life. (DOK 3)
   - Adaptations of representative organisms for their aquatic environments
   - Relationship of organisms in food chains/webs within aquatic environments
n. Research, calculate, and interpret population data. (DOK 2)
o. Research and compare reproductive processes in aquatic organisms. (DOK 2)
p. Differentiate among characteristics of planktonic, nektonic, and benthic organisms. (DOK 1)
q. Explore the taxonomy of aquatic organisms, and use dichotomous keys to differentiate among the organisms. (DOK 2)
r. Research and explain the symbiotic relationships in aquatic ecosystems. (DOK 3)

4. <u>Draw conclusions about the relationships between human activity and aquatic organisms.</u>

s. Describe the impact of natural and human activity on aquatic ecosystems, and evaluate the effectiveness of various solutions to environmental problems. (DOK 3)
   - Sources of pollution in aquatic environments and methods to reduce the effects of the pollution
   - Effectiveness of a variety of methods of environmental management and stewardship
   - Effects of urbanization on aquatic ecosystems and the effects of continued expansion
t. Research and cite evidence of the effects of natural phenomena such as hurricanes, floods, or drought on aquatic habitats and organisms. (DOK 3)
u. Discuss the advantages and disadvantages involved in applications of modern technology in aquatic science. (DOK 2)
   - Careers related to aquatic science
   - Modern technology within aquatic science (e.g., mariculture and aquaculture)
   - Contributions of aquatic technology to industry and government

Biology I

BIOI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BIOI 2	Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
BIOI 3	Investigate and evaluate the interaction between living organisms and their environment.
BIOI 4	Analyze and explain the structures and function of the levels of biological organization.
BIOI 5	Demonstrate an understanding of the molecular basis of heredity.
BIOI 6	Demonstrate an understanding of principles that explain the diversity of life and biological evolution.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
   c. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
      - Safety rules and symbols
      - Proper use and care of the compound light microscope, slides, chemicals, etc.
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers

   v. Formulate questions that can be answered through research and experimental design. (DOK 3)

   w. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 2)

   x. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)

   y. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)

   z. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)

   aa. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. **Describe the biochemical basis of life, and explain how energy flows within and between the living systems.**
   o. Explain and compare with the use of examples the types of bond formation (e.g., covalent, ionic, hydrogen, etc.) between or among atoms. (DOK 2)
      - Subatomic particles and arrangement in atoms
      - Importance of ions in biological processes

   p. Develop a logical argument defending water as an essential component of living systems (e.g., unique bonding and properties including polarity, high specific heat, surface tension, hydrogen bonding, adhesion, cohesion, and expansion upon freezing). (DOK 2)

q. Classify solutions as acidic, basic, or neutral, and relate the significance of the pH scale to an organism's survival (e.g., consequences of having different concentrations of hydrogen and hydroxide ions). (DOK 2)
r. Compare and contrast the structure, properties, and principle functions of carbohydrates, lipids, proteins, and nucleic acids in living organisms. (DOK 2)
   - Basic chemical composition of each group
   - Building components of each group (e.g., amino acids, monosaccharides, nucleotides, etc.)
   - Basic functions (e.g., energy, storage, cellular, heredity) of each group
s. Examine the life processes to conclude the role enzymes play in regulating biochemical reactions. (DOK 2)
   - Enzyme structure
   - Enzyme function, including enzyme-substrate specificity and factors that affect enzyme function (pH and temperature)
t. Describe the role of adenosine triphosphate (ATP) in making energy available to cells. (DOK 1)
   - ATP structure
   - ATP function
u. Analyze and explain the biochemical process of photosynthesis and cellular respiration, and draw conclusions about the roles of the reactant and products in each. (DOK 3)
   - Photosynthesis and respiration (reactants and products)
   - Light-dependent reactions and light independent reactions in photosynthesis, including requirements and products of each
   - Aerobic and anaerobic processes in cellular respiration, including products each and energy differences

3. <u>Investigate and evaluate the interaction between living organisms and their environment.</u>

g. Compare and contrast the characteristics of the world's major biomes (e.g., deserts, tundra, taiga, grassland, temperate forest, tropical rainforest). (DOK 2)
   - Plant and animal species
   - Climate (temperature and rainfall)
   - Adaptations of organisms
h. Provide examples to justify the interdependence among environmental elements. (DOK 2)
   - Biotic and abiotic factors in an ecosystem (e.g., water, carbon, oxygen, mold, leaves)
   - Energy flow in ecosystems (e.g., energy pyramids and photosynthetic organisms to herbivores, carnivores, and decomposers)
   - Roles of beneficial bacteria
   - Interrelationships of organisms (e.g., cooperation, predation, parasitism, commensalism, symbiosis, and mutualism)

i. Examine and evaluate the significance of natural events and human activities on major ecosystems (e.g., succession, population growth, technology, loss of genetic diversity, consumption of resources). (DOK 2)

4. <u>Analyze and explain the structures and function of the levels of biological organization.</u>

i. Differentiate among plant and animal cells and eukaryotic and prokaryotic cells. (DOK 2)
   - Functions of all major cell organelles and structures (e.g., nucleus, mitochondrion, rough ER, smooth ER, ribosomes, Golgi bodies, vesicles, lysosomes, vacuoles, microtubules, microfiliaments, chloroplast, cytoskeleton, centrioles, nucleolus, chromosomes, nuclear membrane, cell wall, cell membrane [active and passive transport], cytosol)
   - Components of mobility (e.g., cilia, flagella, pseudopodia)

j. Differentiate between types of cellular reproduction. (DOK 1)
   - Main events in the cell cycle and cell mitosis (including differences in plant and animal cell divisions)
   - Binary fission (e.g., budding, vegetative propagation, etc.)
   - Significance of meiosis in sexual reproduction
   - Significance of crossing over

k. Describe and differentiate among the organizational levels of organisms (e.g., cells, tissues, organs, systems, types of tissues.) (DOK 1)

l. Explain and describe how plant structures (vascular and nonvascular) and cellular functions are related to the survival of plants (e.g., movement of materials, plant reproduction). (DOK 1)

5. <u>Demonstrate an understanding of the molecular basis of heredity.</u>

i. Analyze and explain the molecular basis of heredity and the inheritance of traits to successive generations by using the Central Dogma of Molecular Biology. (DOK 3)
   - Structures of DNA and RNA
   - Processes of replication, transcription, and translation
   - Messenger RNA codon charts

j. Utilize Mendel's laws to evaluate the results of monohybrid Punnett squares involving complete dominance, incomplete dominance, codominance, sex linked, and multiple alleles (including outcome percentage of both genotypes and phenotypes). (DOK 2)

k. Examine inheritance patterns using current technology (e.g., pedigrees, karyotypes, gel electrophoresis). (DOK 2)

l. Discuss the characteristics and implications of both chromosomal and gene mutations. (DOK 2)
   - Significance of nondisjunction, deletion, substitutions, translocation, frame shift mutation in animals
   - Occurrence and significance of genetic disorders such as sickle cell anemia, Tay-Sachs disorder, cystic fibrosis, hemophilia, Down syndrome, color blindness

6. <u>Demonstrate an understanding of principles that explain the diversity of life and biological evolution.</u>

k. Draw conclusions about how organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their evolutionary relationships. (DOK 2)
   - Characteristics of the six kingdoms
   - Major levels in the hierarchy of taxa (e.g., kingdom, phylum/division, class, order, family, genus, and species)
   - Body plans (symmetry)
   - Methods of sexual reproduction (e.g., conjugation, fertilization, pollination)
   - Methods of asexual reproduction (e.g., budding, binary fission, regeneration, spore formation)

l. Critique data (e.g., comparative anatomy, Biogeography, molecular biology, fossil record, etc.) used by scientists (e.g., Redi, Needham, Spallanzani, Pasteur) to develop an understanding of evolutionary processes and patterns. (DOK 3)

m. Research and summarize the contributions of scientists (including Darwin, Malthus, Wallace, Lamarck, and Lyell) whose work led to the development of the theory of evolution. (DOK 2)

n. Analyze and explain the roles of natural selection, including the mechanisms of speciation (e.g., mutations, adaptations, geographic isolation) and applications of speciation (e.g., pesticide and antibiotic resistance). (DOK 3)

o. Differentiate among chemical evolution, organic evolution, and the evolutionary steps along the way to aerobic heterotrophs and photosynthetic autotrophs. (DOK 2)

Biology II

BIOII 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BIOII 2	Describe and contrast the structures, functions, and chemical processes of the cell.
BIOII 3	Investigate and discuss the molecular basis of heredity.
BIOII 4	Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.
BIOII 5	Develop an understanding of organism classification.

1. <u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>

o. Use current technologies such as CD-ROM, DVD, Internet, and on-line data search to explore current research related to a specific topic. (DOK 3)

p. Clarify research questions and design laboratory investigations. (DOK 3)

q. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)

r. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)

s. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)

t. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)

u. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. <u>Describe and contrast the structures, functions, and chemical processes of the cell.</u>

i. Relate the structure and function of a selectively permeable membrane to its role in diffusion and osmosis. (DOK 2)

j. Summarize how cell regulation controls and coordinates cell growth and division. (DOK 2)

k. Analyze and describe the function of enzymes in biochemical reactions. (DOK 2)
- The impact of enzymatic reactions on biochemical processes
- Factors that affect enzyme function (e.g., pH, concentration, temperature, etc.)

l. Differentiate between photosynthesis and cellular respiration. (DOK 2)
- Cellular sites and major pathways of anaerobic and aerobic respiration (with reactants, products, and ATP per monosaccharide)
- Cellular respiration with respect to the sites at which they take place, the reactions involved, and the energy input and output in each stage (e.g., glycolysis, Krebs cycle, electron transport chain)
- Pigments, absorption, reflection of light, and light-dependent and light-independent reactions of photosynthesis
- Oxidation and reduction reactions

3. <u>Investigate and discuss the molecular basis of heredity.</u>

k. Explain how the process of meiosis clarifies the mechanism underlying Mendel's conclusions about segregation and independent assortment on a molecular level. (DOK 1)

l. Research and explain how major discoveries led to the determination of DNA structure. (DOK 2)

m. Relate gene expression (e.g., replication, transcription, translation) to protein structure and function. (DOK 2)
- Translation of a messenger RNA strand into a protein
- Processing by organelles so that the protein is appropriately packaged, labeled, and eventually exported by the cell
- Messenger RNA codon charts to determine the effects of different types of mutations on amino acid sequence and protein structure (e.g., sickle cell anemia resulting from base substitution mutation)
- Gene expression regulated in organisms so that specific proteins are synthesized only when they are needed by the cell (e.g., allowing cell specialization)

n. Assess the potential implications of DNA technology with respect to its impact on society. (DOK 3)
- Modern DNA technologies (e.g., polymerase chain reaction (PCR), gene splicing, gel electrophoresis, transformation, recombinant DNA) in agriculture, medicine, and forensics

o. Develop a logical argument defending or refuting bioethical issues arising from applications of genetic technology (e.g., the human genome project, cloning, gene therapy, stem cell research). (DOK 3)

4. **<u>Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.</u>**
   s. Explain the history of life on earth, and infer how geological changes provide opportunities and constraints for biological evolution. (DOK 2)
      - Main periods of the geologic timetable of earth's history
        - Roles of catastrophic and gradualistic processes in shaping planet Earth
   t. Provide support for the argument based upon evidence from anatomy, embryology, biochemistry, and paleontology that organisms descended with modification from common ancestry. (DOK 2)
   u. Identify and provide supporting evidence for the evolutionary relationships among various organisms using phylogenetic trees and cladograms. (DOK 2)
   v. Formulate a scientific explanation based on fossil records of ancient life-forms, and describe how new species could originate as a result of geological isolation and reproductive isolation. (DOK 2)
   w. Compare and contrast the basic types of selection (e.g., disruptive, stabilizing, directional, etc.). (DOK 2)
   x. Cite examples to justify behaviors that have evolved through natural selection (e.g., migration, parental care, use of tools, etc.). (DOK 1)
   y. Research and explain the contributions of 19th century scientists (e.g., Malthus, Wallace, Lyell, and Darwin) on the formulation of ideas about evolution. (DOK 2)
   z. Develop a logical argument describing ways in which the influences of 20th century science have impacted the development of ideas about evolution (e.g., synthetic theory of evolution, molecular biology). (DOK 3)
   aa. Analyze changes in an ecosystem resulting from natural causes (succession), changes in climate, human activity (pollution and recycling), or introduction of nonnative species. (DOK 2)
5. **<u>Develop an understanding of organism classification.</u>**
   e. Classify organisms according to traditional Linnaean classification characteristics (e.g., cell structure, biochemistry, anatomy, fossil record, methods of reproduction) and the cladistic approach. (DOK 2)
   f. Categorize organisms according to the characteristics that distinguish them as Bacteria, Archaea, or Eucarya. (DOK 1)
      - Bacteria, fungi, and protists
      - Characteristics of invertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to phyla (e.g., Porifera, Cnidarians, Nematoda, Annelida, Platyhelmenthes, and Arthropoda) and classes (e.g., Insecta, Crustacea, Arachnida, Mollusca, Echinodermata)
      - Characteristics of vertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to classes (e.g., Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, Mammalia)
      - Nomenclature of various types of plants (e.g., Bryophyta, Tracheophyta, Gymnospermae, Angiospermae, Monocotyledonae, Dicotyledonae, vascular plants, nonvascular plants)

Botany

BO 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BO 2	Distinguish among the characteristics of botanical organization, structure, and function.
BO 3	Demonstrate an understanding of plant reproduction.
BO 4	Draw conclusions about the factors that affect the adaptation and survival of plants.
BO 5	Relate an understanding of plant genetics to its uses in modern living.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
    o. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
        - Safety rules and symbols
        - Proper use and care of the compound light microscope, slides, chemicals, etc.
        - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers

    p. Formulate questions that can be answered through research and experimental design. (DOK 3)

    q. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)

    r. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)

    s. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)

    t. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)

    u. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. **Distinguish among the characteristics of botanical organization, structure, and function.**
    k. Relate plant cell structures to their functions (e.g., major organelles, cell wall components, photosynthetic chemical reactions, plant pigments, plant tissues, roots, stems, leaves, flowers). (DOK 1)

    l. Differentiate the characteristics found in various plant divisions. (DOK 2)
        - Differences and similarities of nonvascular plants
        - Characteristics of seed-bearing and non-seed bearing vascular plants relative to taxonomy
        - Major vegetative structures and their modifications in angiosperms and gymnosperms

    m. Compare and contrast leaf modifications of gymnosperms and angiosperms (e.g., needles, overlapping scales, simple leaves, compound leaves, evergreen trees, and deciduous trees). (DOK 2)

n. Apply the modern classification scheme utilized in naming plants to identify plant specimens. (DOK 2)
   - Classification scheme used in botany
   - Classification of native Mississippi plants

o. Use inquiry to investigate and discuss the physical and chemical processes of plants. (DOK 3)
   - Relationships among photosynthesis, cellular respiration, and translocation
   - Importance of soil type and soil profiles to plant survival
   - Mechanism of water movement in plants
   - Effects of environmental conditions for plant survival
   - Tropic responses of a plant organ to a given stimulus

3. <u>Demonstrate an understanding of plant reproduction.</u>

m. Compare and contrast reproductive structures (e.g., cones, flowers). (DOK 2)

n. Differentiate among the vegetative organs of monocots, herbaceous dicots, and woody dicots. (DOK 1)

o. Differentiate between the structures and processes of sexual and asexual reproduction in plants. (DOK 1)
   - Reproductive structures, their modifications, and the mechanisms involved in plant reproduction
   - Functions of flower parts, seeds, cones
   - Spore production in bryophytes and ferns

p. Explain and provide examples of the concept of alternation of generations and its examples. (DOK 2)

q. Categorize types of fruits and methods of seed distribution in plants. (DOK 1)

r. Research and compare various methods of plant propagation. (DOK 2)

4. <u>Draw conclusions about the factors that affect the adaptation and survival of plants.</u>

i. List and assess several adaptations of plants to survive in a given biome. (DOK 2)

j. Design and conduct an experiment to determine the effects of environmental factors on photosynthesis. (DOK 3)

k. Explain how natural selection and the evolutionary consequences (e.g., adaptation or extinction) support scientific explanations for similarities of ancient life-forms in the fossil record and molecular similarities present in living organisms. (DOK 2)

l. Research factors that might influence or alter plant stability, and propose actions that may reduce the negative impacts of human activity. (DOK 2)

5. <u>Relate an understanding of plant genetics to its uses in modern living.</u>

i. Research, prepare, and present a position relating to issues surrounding the current botanical trends involving biotechnology. (DOK 3)

j. Apply an understanding of the principles of plant genetics to analyze monohybrid and dihybrid crosses, and predict the potential effects the crosses might have on agronomy and agriculture. (DOK 3)

k. Discuss the effects of genetic engineering of plants on society. (DOK 2)

l. Describe the chemical compounds extracted from plants, their economical importance, and the impact on humans. (DOK 3)
   - Plant extracts, their function, and origin

- Impact of the timber industry on local and national economy

Chemistry I

CHI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
CHI 2	Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.
CHI 3	Develop an understanding of the periodic table.
CHI 4.	Analyze the relationship between microscopic and macroscopic models of matter.
CHI 5	Compare factors associated with acid/base and oxidation/reduction reactions.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
   o. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
   p. Clarify research questions and design laboratory investigations. (DOK 3)
   q. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
   r. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
   s. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
   t. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
   u. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)
2. **Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.**
   o. Describe and classify matter based on physical and chemical properties and interactions between molecules or atoms. (DOK 1)
      - Physical properties (e.g., melting points, densities, boiling points) of a variety of substances
      - Substances and mixtures
      - Three states of matter in terms of internal energy, molecular motion, and the phase transitions between them
   p. Research and explain crucial contributions and critical experiments of Dalton, Thomson, Rutherford, Bohr, de Broglie, and Schrődinger, and describe how each discovery contributed to the current model of atomic and nuclear structure. (DOK 2)
   q. Develop a model of atomic and nuclear structure based on theory and knowledge of fundamental particles. (DOK 2)
      - Properties and interactions of the three fundamental particles of the atom

- Laws of conservation of mass, constant composition, definite proportions, and multiple proportions

r. Write appropriate equations for nuclear decay reactions, describe how the nucleus changes during these reactions, and compare the resulting radiation with regard to penetrating ability. (DOK 1)
   - Three major types of radioactive decay (e.g., alpha, beta, gamma) and the properties of the emissions (e.g., composition, mass, charge, penetrating power)
   - The concept of half-life for a radioactive isotope (e.g., carbon-14 dating) based on the principle that the decay of any individual atom is a random process

s. Compare the properties of compounds according to their type of bonding. (DOK 1)
   - Covalent, ionic, and metallic bonding
   - Polar and nonpolar covalent bonding
   - Valence electrons and bonding atoms

t. Compare different types of intermolecular forces, and explain the relationship between intermolecular forces, boiling points, and vapor pressure when comparing differences in properties of pure substances. (DOK 1)

u. Develop a three-dimensional model of molecular structure. (DOK 2)
   - Lewis dot structures for simple molecules and ionic compounds
   - Valence shell electron pair repulsion theory (VSEPR)

3. <u>Develop an understanding of the periodic table.</u>

i. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)

j. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
   - Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
   - Average atomic mass calculations
   - Chemical characteristics of each region
   - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius)

k. Classify chemical reactions by type. (DOK 2)
   - Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
   - Products (given reactants) or reactants (given products) for each reaction type
   - Solubility rules for precipitation reactions and the activity series for single and double displacement reactions

l. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)
   - Difference between chemical reactions and chemical equations
   - Formulas and calculations of the molecular (molar) masses
   - Empirical formula given the percent composition of elements

- Molecular formula given the empirical formula and molar mass

4. <u>Analyze the relationship between microscopic and macroscopic models of matter.</u>

i. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)

j. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
   - Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
   - Average atomic mass calculations
   - Chemical characteristics of each region
   - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius)

k. Classify chemical reactions by type. (DOK 2)
   - Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
   - Products (given reactants) or reactants (given products) for each reaction type
   - Solubility rules for precipitation reactions and the activity series for single and double displacement reactions

l. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)
   - Difference between chemical reactions and chemical equations
   - Formulas and calculations of the molecular (molar) masses
   - Empirical formula given the percent composition of elements
   - Molecular formula given the empirical formula and molar mass

5. <u>Compare factors associated with acid/base and oxidation/reduction reactions.</u>

g. Analyze and explain acid/base reactions. (DOK 2)
   - Properties of acids and bases, including how they affect indicators and the relative pH of the solution
   - Formation of acidic and basic solutions
   - Definition of pH in terms of the hydronium ion concentration and the hydroxide ion concentration
   - The pH or pOH from the hydrogen ion or hydroxide ion concentrations of solution
   - How a buffer works and examples of buffer solutions

h. Classify species in aqueous solutions according to the Arrhenius and Bronsted-Lowry definitions respectively, and predict products for aqueous neutralization reactions. (DOK 2)

i. Analyze a reduction/oxidation reaction (REDOX) to assign oxidation numbers (states) to reaction species, and identify the species oxidized and reduced, the oxidizing agent, and reducing agent. (DOK 2)

Organic Chemistry

ORGC 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
ORGC 2 Demonstrate an understanding of the properties, structure, and function of organic compounds.
ORGC 3 Discuss the versatility of polymers and the diverse application of organic chemicals.

1. **<u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>**
   o. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
      - Safety rules and symbols
      - Proper use and care of the compound light microscope, slides, chemicals, etc.
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
   p. Formulate questions that can be answered through research and experimental design. (DOK 3)
   q. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
   r. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
   s. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
   t. Recognize and analyze alternative explanations for experimental results, and make predictions based on observations and prior knowledge. (DOK 3)
   u. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **<u>Demonstrate an understanding of the properties, structure, and function of organic compounds.</u>**
   m. Apply International Union of Pure and Applied Chemistry (IUPAC) nomenclature, and differentiate the structure of aliphatic, aromatic, and cyclic hydrocarbon compounds. (DOK 1)
      - Structures of hydrocarbon compounds
      - Isomerism in hydrocarbon compounds
   n. Relate structure to physical and chemical properties of hydrocarbon. (DOK 1)
   o. Apply principles of geometry and hybridization to organic molecules. (DOK 2)
      - Lewis structures for organic molecules
      - Bond angles
      - Hybridization (as it applies to organic molecules)
   p. Write, complete, and classify common reactions for aliphatic, aromatic, and cyclic hydrocarbons. (DOK 1)
   q. Construct, solve, and explain equations representing combustion reactions, substitution reactions, dehydrogenation reactions, and addition reactions. (DOK 2)

r. Classify functional groups (e.g., alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines, amides, and nitrides) by their structure and properties. (DOK 2)
   - Structural formulas from functional group names and vice versa
   - Chemical and physical properties of compounds containing functional groups
   - Equations representing the transformation of one functional group into another

3. <u>Discuss the versatility of polymers and the diverse application of organic chemicals.</u>

g. Describe and classify the synthesis, properties, and uses of polymers. (DOK 2)
   - Common polymers
   - Synthesis of polymers from monomers by addition or condensation
   - Condensations of plastics according to their commercial types
   - Elasticity and other polymer properties

h. Develop a logical argument supporting the use of organic chemicals and their application in industry, drug manufacture, and biological chemistry. (DOK 1)
   - Common uses of polymers and organic compounds in medicine, drugs, and personal care products
   - Compounds that have the property to dye materials
   - Petrochemical production
   - Biologically active compounds in terms of functional group substrate interaction

i. Research and summarize the diversity, applications, and economics of industrial chemicals (solvents, coatings, surfactants, etc.). (DOK 3)

Earth and Space Science

E1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
E2	Develop an understanding of the history and evolution of the universe and earth.
E3	Discuss factors that are used to explain the geological history of earth.
E4	Demonstrate an understanding of earth systems relating to weather and climate.
E5	Apply an understanding of ecological factors to explain relationships between earth systems.

1. <u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>

o. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
   - Safety rules and symbols
   - Proper use and care of the compound light microscope, slides, chemicals, etc.
   - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers.

p. Formulate questions that can be answered through research and experimental design. (DOK 3)

q. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)

r. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
s. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
t. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
u. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. <u>Develop an understanding of the history and evolution of the universe and earth.</u>

i. Summarize the origin and evolution of the universe. (DOK 2)
   - Big bang theory
   - Microwave background radiation
   - The Hubble constant
   - Evidence of the existence of dark matter and dark energy in the universe and the history of the universe

j. Differentiate methods used to measure space distances, including astronomical unit, light-year, stellar parallax, Cepheid variables, and the red shift. (DOK 1)
k. Interpret how gravitational attraction played a role in the formation of the planetary bodies and how the fusion of hydrogen and other processes in "ordinary" stars and supernovae lead to the formation of all other elements. (DOK 2)
l. Summarize the early evolution of the earth, including the formation of Earth's solid layers (e.g., core, mantle, and crust), the distribution of major elements, the origin of internal heat sources, and the initiation of plate tectonics. (DOK 2)
   - How the decay of radioactive isotopes is used to determine the age of rocks, earth, and the solar system
   - How Earth acquired its initial oceans and atmosphere

3. <u>Discuss factors which are used to explain the geological history of earth.</u>

q. Develop an understanding of how plate tectonics create certain geological features, materials, and hazards. (DOK 1)
   - Plate tectonic boundaries (e.g., divergent, convergent, and transform)
   - Modern and ancient geological features to each kind of plate tectonic boundary
   - Production of particular groups of igneous and metamorphic rocks and mineral resources
   - Sedimentary basins created and destroyed through time

r. Compare and contrast types of mineral deposits/groups (e.g., oxides, carbonates, halides, sulfides, sulfates, silicates, phosphates). (DOK 2)
s. Categorize minerals and rocks by determining their physical and/or chemical characteristics. (DOK 2)
t. Justify the causes of certain geological hazards (e.g., earthquakes, volcanoes, tsunamis) to their effects on specific plate tectonic locations. (DOK 2)
u. Interpret and explain how rock relationships and fossils are used to reconstruct the geologic history of the earth. (DOK 2)

v. Apply principles of relative age (e.g., superposition, original horizontality, crosscutting relations, and original lateral continuity) to support an opinion related to earth's geological history. (DOK 3)
   - Types of unconformity (e.g., disconformity, angular unconformity, nonconformity)
   - Geological timetable

w. Apply the principle of uniformitarianism to relate sedimentary rock associations and their fossils to the environments in which the rocks were deposited. (DOK 2)

x. Compare and contrast the relative and absolute dating methods (e.g., the principle of fossil succession, radiometric dating, and paleomagnetism) for determining the age of the earth. (DOK 1)

4. <u>Demonstrate an understanding of earth systems relating to weather and climate.</u>

k. Explain the interaction of earth systems that affect weather and climate. (DOK 1)
   - Latitudinal variations in solar heating
   - The effects of Coriolis forces on ocean currents, cyclones, anticyclones, ocean currents, topography, and air masses (e.g., warm fronts, cold fronts, stationary fronts, and occluded fronts).

l. Interpret the patterns in temperature and precipitation that produce the climate regions on earth, and relate them to the hazards associated with extreme weather events and climate change (e.g., hurricanes, tornadoes, El Niño/La Niña, global warming). (DOK 2)

m. Justify how changes in global climate and variation in earth/sun relationships contribute to natural and anthropogenic (human-caused) modification of atmospheric composition. (DOK 2)

n. Summarize how past and present actions of ice, wind, and water contributed to the types and distributions of erosional and depositional features in landscapes. (DOK 1)

o. Research and explain how external forces affect earth's topography. (DOK 2)
   - How surface water and groundwater act as the major agents of physical and chemical weathering
   - How soil results from weathering and biological processes
   - Processes and hazards associated with both sudden and gradual mass wasting

5. <u>Apply an understanding of ecological factors to explain relationships between earth systems.</u>

i. Draw conclusions about how life on earth shapes earth systems and responds to the interaction of earth systems (lithosphere, hydrosphere, atmosphere, and biosphere). (DOK 3)
   - Nature and distribution of life on earth, including humans, to the chemistry and availability of water
   - Distribution of biomes (e.g., terrestrial, freshwater, and marine) to climate regions through time
   - Geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) that interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming and channeling of rivers)

j. Interpret the record of shared ancestry (fossils), evolution, and extinction as related to natural selection. (DOK 2)

k. Identify the cause and effect relationships of the evolutionary innovations that most profoundly shaped earth systems. (DOK 1)
   - Photosynthesis and the atmosphere
   - Multicellular animals and marine environments
   - Land plants and terrestrial environments

l. Cite evidence about how dramatic changes in earth's atmosphere influenced the evolution of life. (DOK 1)

Environmental Science

ES 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.

ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.

ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

o. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
   - Safety rules and symbols
   - Proper use and care of the compound light microscope, slides, chemicals, etc.
   - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers

p. Formulate questions that can be answered through research and experimental design. (DOK 3)

q. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)

r. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)

s. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)

t. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)

u. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK3)

2. Develop an understanding of the relationship of ecological factors that affect an ecosystem.

o. Compare ways in which the three layers of the biosphere change over time and their influence on an ecosystem's ability to support life. (DOK 2)

p. Explain the flow of matter and energy in ecosystems. (DOK 2)
   - Interactions between biotic and abiotic factors
   - Indigenous plants and animals and their roles in various ecosystems

- Biogeochemical cycles within the environment

q. Predict the impact of the introduction, removal, and reintroduction of an organism on an ecosystem. (DOK 3)

r. Develop a logical argument explaining the relationships and changes within an ecosystem. (DOK 2)
   - How a species adapts to its niche
   - Process of primary and secondary succession and its effects on a population
   - How changes in the environment might affect organisms

s. Explain the causes and effects of changes in population dynamics (e.g., natural selection, exponential growth, predator/prey relationships) to carrying capacity and limiting factors. (DOK 2)

t. Research and explain how habitat destruction leads to the loss of biodiversity. (DOK 2)

u. Compare and contrast the major biomes of the world's ecosystems, including location, climate, adaptations and diversity. (DOK 1)

3. <u>Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.</u>

g. Summarize the effects of human activities on resources in the local environments. (DOK 2)
   - Sources, uses, quality, and conservation of water
   - Renewable and nonrenewable resources
   - Effects of pollution (e.g., water, noise, air, etc.) on the ecosystem

h. Research and evaluate the impacts of human activity and technology on the lithosphere, hydrosphere, and atmosphere, and develop a logical argument to support how communities restore ecosystems. (DOK 3)

i. Research and evaluate the use of renewable and nonrenewable resources, and critique efforts to conserve natural resources and reduce global warming in the United States including (but not limited) to Mississippi. (DOK 3)

<u>Genetics</u>

G 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
G 2	Analyze the structure and function of the cell and cellular organelles.
G 3	Apply the principles of heredity to demonstrate genetic understandings.

1. <u>Use critical thinking and scientific problem solving in designing and performing biological research and experimentation. (L, P, E)</u>

o. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)

p. Clarify research questions and design laboratory investigations. (DOK 3)

q. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)

r. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for pie, bar, and line graphs) to draw conclusions and make inferences. (DOK 3)
s. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
t. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
u. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. <u>Review the structure and function of the cell as it applies to genetics. (L)</u>

o. Cite evidence to illustrate how the structure and function of cells are involved in the maintenance of life. (DOK 2)
p. Describe how organic components are integral to biochemical processes. (DOK 2)
q. Differentiate among the processes by which plants and animals reproduce. (DOK 1)
   - Cell cycle and mitosis
   - Meiosis, spermatogenesis, and oogenesis
r. Explain the significance of the discovery of nucleic acids. (DOK 1)
s. Analyze and explain the structure and function of DNA and RNA in replication, transcription, translation and DNA repair. (DOK 2)
t. Cite examples to compare the consequences of the different types of mutations. (DOK 1)
u. Draw conclusions about the importance and potential impacts of the process of gene transfer used in biotechnology. (DOK 3)

3. <u>Analyze the structure and function of DNA and RNA molecules. (L, P)</u>

o. Cite evidence that supports the significance of Mendel's concept of "particulate inheritance" to explain the understanding of heredity. (DOK 1)
p. Apply classical genetics principles to solve basic genetic problems. (DOK 2)
   - Genes and alleles, dominance, recessiveness, the laws of segregation, and independent assortment
   - Inheritance of autosomal and sex-linked traits
   - Inheritance of traits influenced by multiple alleles and traits with polygenetic inheritance
   - Chromosomal theory of inheritance
q. Apply population genetic concepts to summarize variability of multicellular organisms. (DOK 2)
   - Genetic variability
   - Hardy-Weinberg formula
   - Migration and genetic drift
   - Natural selection in humans
r. Distinguish and explain the applications of various tools and techniques used in DNA manipulation. (DOK 1)
   - Steps in genetic engineering experiments
   - Use of restriction enzymes
   - Role of vectors in genetic research
   - Use of transformation techniques

s. Research and present a justifiable explanation the practical uses of biotechnology (e.g., chromosome mapping, karyotyping, and pedigrees). (DOK 2)
t. Develop and present a scientifically-based logical argument for or against moral and ethical issues related to genetic engineering. (DOK 3)
u. Research genomics (human and other organisms), and predict benefits and medical advances that may result from the use of genome projects. (DOK 2)

Geology

GE1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
GE2	Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.

1. **<u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>**
   o. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
      - Safety rules and symbols
      - Proper use and care of the compound light microscope, slides, chemicals, etc.
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
   p. Formulate questions that can be answered through research and experimental design. (DOK 3)
   q. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
   r. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
   s. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
   t. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
   u. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **<u>Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.</u>**
   w. Differentiate the components of the earth's atmosphere and lithosphere. (DOK 1)
   x. Research and summarize explanations of how earth acquired its initial atmosphere and oceans. (DOK 2)
   y. Compare the causes and effects of internal and external components that shape earth's topography. (DOK 2)
      - Physical weathering (e.g., atmospheric, glacial, etc.)
      - Chemical weathering agents (e.g., acid precipitation, carbon dioxide, oxygen, water, etc.)

z. Develop an understanding of how plate tectonics create certain geologic features, materials, and hazards. (DOK 2)
   - Types of crustal movements and the resulting landforms (e.g., seafloor spreading, paleomagnetic measurements, and orogenesis)
   - Processes that create earthquakes and volcanoes
   - Asthenosphere

aa. Summarize the theories of plate development and continental drift, and describe the causes and effects involved in each. (DOK 2)

bb. Develop a logical argument to explain how geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming, and channeling of rivers). (DOK 2)

cc. Interpret how the earth's geological time scale relates to geological history, landforms, and life-forms. (DOK 2)

dd. Research and describe different techniques for determining relative and absolute age of the earth (e.g., index of fossil layers, superposition, radiometric dating, etc.). (DOK 1)

ee. Summarize the geological activity of the New Madrid fault line, and compare and contrast it to geological activity in other parts of the world. (DOK 2)

ff. Identify and differentiate the major geological features in Mississippi (e.g., Delta, Coastal Areas, etc.). (DOK 1)

gg. Evaluate an emergency preparedness plan for natural disasters associated with crustal movement. (DOK 3)

Physical Science

PS 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
PS 2 Describe and explain how forces affect motion.
PS 3 Demonstrate an understanding of general properties and characteristics of waves.
PS 4 Develop an understanding of the atom.
PS 5 Investigate and apply principles of physical and chemical changes in matter.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

o. Use appropriate laboratory safety symbols and procedures to design and conduct a scientific investigation. (DOK 2)
   - Safety symbols and safety rules in all laboratory activities
   - Proper use and care of the compound light microscope
   - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers

p. Identify questions that can be answered through scientific investigations. (DOK 3)

q. Identify and apply components of scientific methods in classroom investigations. (DOK 3)
   - Predicting, gathering data, drawing conclusions

- Recording outcomes and organizing data from a variety of sources (e.g., scientific articles, magazines, student experiments, etc.)
- Critically analyzing current investigations/problems using periodicals and scientific scenarios

r. Interpret and generate graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)

s. Analyze procedures and data to draw conclusions about the validity of research. (DOK 3)

t. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)

u. Communicate effectively to present and explain scientific results, using appropriate terminology and graphics. (DOK 3)

2. <u>Describe and explain how forces affect motion.</u>

k. Demonstrate and explain the basic principles of Newton's three laws of motion including calculations of acceleration, force, and momentum. (DOK 2)
- Inertia and distance-time graphs to determine average speed
- Net force (accounting for gravity, friction, and air resistance) and the resulting motion of objects
- Effects of the gravitational force on objects on Earth and effects on planetary and lunar motion
- Simple harmonic motion (oscillation)

l. Explain the connection between force, work, and energy. (DOK 2)
- Force exerted over a distance (results in work done)
- Force-distance graph (to determine work)
- Network on an object that contributes to change in kinetic energy (work-to-energy theorem)

m. Describe (with supporting details and diagrams) how the kinetic energy of an object can be converted into potential energy (the energy of position) and how energy is transferred or transformed (conservation of energy). (DOK 2)

n. Draw and assess conclusions about charges and electric current. (DOK 2)
- Static/current electricity and direct current/alternating current
- Elements in an electric circuit that are in series or parallel
- Conductors and insulators
- Relationship between current flowing through a resistor and voltage flowing across a resistor

o. Cite evidence and explain the application of electric currents and magnetic fields as they relate to their use in everyday living (e.g., the application of fields in motors and generators and the concept of electric current using Ohm's law). (DOK 2)

3. <u>Demonstrate an understanding of general properties and characteristics of waves.</u>

i. Differentiate among transverse, longitudinal, and surface waves as they propagate through a medium (e.g., string, air, water, steel beam). (DOK 1)

j. Compare properties of waves (e.g., superposition, interference, refraction, reflection, diffraction, Doppler effect), and explain the connection among the quantities (e.g., wavelength, frequency, period, amplitude, and velocity). (DOK 2)

k. Classify the electromagnetic spectrum's regions according to frequency and/or wavelength, and draw conclusions about their impact on life. (DOK 2)
   - The emission of light by electrons when moving from higher to lower levels
   - Energy (photons as quanta of light)
   - Additive and subtractive properties of colors
   - Relationship of visible light to the color spectrum

l. Explain how sound intensity is measured and its relationship to the decibel scale. (DOK 1)

4. <u>Develop an understanding of the atom.</u>

i. Cite evidence to summarize the atomic theory. (DOK 1)
   - Models for atoms
   - Hund's rule and Aufbau process to specify the electron configuration of elements
   - Building blocks of matter (e.g., proton, neutron, and electron) and elementary particles (e.g., positron, mesons, neutrinos, etc.)
   - Atomic orbitals (s, p, d, f) and their basic shapes

j. Explain the difference between chemical and physical changes, and demonstrate how these changes can be used to separate mixtures and compounds into their components. (DOK 2)

k. Research the history of the periodic table of the elements, and summarize the contributions that led to the atomic theory. (DOK 2)
   - Contributions of scientists (e.g., John Dalton, J.J. Thomson, Ernest Rutherford, Newton, Einstein, Neils, Bohr, Louis de Broglie, Erwin Schrödinger, etc.)
   - Technology (e.g., X-rays, cathode-ray tubes, spectroscopes)
   - Experiments (e.g., gold-foil, cathode-ray, etc.)

l. Utilize the periodic table to predict and explain patterns and draw conclusions about the structure, properties, and organization of matter. (DOK 2)
   - Atomic composition and valence electron configuration (e.g., atomic number, mass number of protons, neutrons, electrons, isotopes, and ions)
   - Periodic trends using the periodic table (e.g., valence, reactivity, atomic radius)
   - Average atomic mass from isotopic abundance
   - Solids, liquids, and gases
   - Periodic properties of elements (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius) and how they relate to position in the periodic table

5. <u>Investigate and apply principles of physical and chemical changes in matter.</u>

g. Write chemical formulas for compounds comprising monatomic and polyatomic ions. (DOK 1)

h. Balance chemical equations. (DOK 2)

i. Classify types of chemical reactions (e, g., composition, decomposition, single displacement, double displacement, combustion, acid/base reactions). (DOK 2)

Physics I

PHYI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
PHYI 2	Develop an understanding of concepts related to forces and motion.
PHYI 3	Develop an understanding of concepts related to work and energy.
PHYI 4	Discuss the characteristics and properties of light and sound.
PHYI 5	Apply an understanding of magnetism, electric fields, and electricity.
PHYI 6	Analyze and explain concepts of nuclear physics.

1. **Investigate and apply principles of physical and chemical changes in matter.**
   o. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
   p. Clarify research questions, and design laboratory investigations. (DOK 3)
   q. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
   r. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
   s. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
   t. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
   u. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)
2. **Develop an understanding of concepts related to forces and motion.**
   i. Use inquiry to investigate and develop an understanding of the kinematics and dynamics of physical bodies. (DOK 3)
      - Vector and scalar quantities
      - Vector problems (solved mathematically and graphically)
      - Vector techniques and free-body diagrams to determine the net force on a body when several forces are acting on it
      - Relations among mass, inertia, and weight
   j. Analyze, describe, and solve problems by creating and utilizing graphs of one-dimensional motion (e.g., position, distance, displacement, time, speed, velocity, acceleration, the special case of free fall). (DOK 2)
   k. Analyze real-world applications to draw conclusions about Newton's three laws of motion. (DOK 2)
   l. Apply the effects of the universal gravitation law to graph and interpret the force between two masses, acceleration due to gravity, and planetary motion. (DOK 2)
      - Situations where g is constant (falling bodies)
      - Concept of centripetal acceleration undergoing uniform circular motion
      - Kepler's third law
      - Oscillatory motion and the mechanics of waves

3. **<u>Develop an understanding of concepts related to work and energy.</u>**
   k. Explain and apply the conservation of energy and momentum. (DOK 2)
      - Concept of work and applications
      - Concept of kinetic energy, using the elementary work-energy theorem
      - Concept of conservation of energy with simple examples
      - Concepts of energy, work, and power (qualitatively and quantitatively)
      - Principles of impulse in inelastic and elastic collisions
   l. Analyze real-world applications to draw conclusions about mechanical potential energy (the energy of configuration). (DOK 3)
   m. Apply the principles of impulse, and compare conservation of momentum and conservation of kinetic energy in perfectly inelastic and elastic collisions. (DOK 1)
   n. Investigate and summarize the principles of thermodynamics. (DOK 2)
      - How heat energy is transferred from higher temperature to lower temperature until equilibrium is reached
      - Temperature and thermal energy as related to molecular motion and states of matter
      - Problems involving specific heat and heat capacity
      - First and second laws of thermodynamics as related to heat engines, refrigerators, and thermal efficiency
   o. Develop the kinetic theory of ideal gases and explain the concept of Carnot efficiency. (DOK 2)
4. **<u>Discuss the characteristics and properties of light and sound.</u>**
   k. Describe and model the characteristics and properties of mechanical waves. (DOK 2)
      - Simple harmonic motion
      - Relationships among wave characteristics such as velocity, period, frequency, amplitude, phase, and wavelength
      - Energy of a wave in terms of amplitude and frequency.
      - Standing waves and waves in specific media (e.g., stretched string, water surface, air, etc.)
   l. Differentiate and explain the Doppler effect as it relates to a moving source and to a moving observer. (DOK 1)
   m. Explain the laws of reflection and refraction, and apply Snell's law to describe the relationship between the angles of incidence and refraction. (DOK 2)
   n. Use ray tracing and the thin lens equation to solve real-world problems involving object distance from lenses. (DOK 2)
   o. Investigate and draw conclusions about the characteristics and properties of electromagnetic waves. (DOK 2)
5. **<u>Apply an understanding of magnetism, electric fields, and electricity.</u>**
   g. Analyze and explain the relationship between electricity and magnetism. (DOK 2)
      - Characteristics of static charge and how a static charge is generated
      - Electric field, electric potential, current, voltage, and resistance as related to Ohm's law
      - Magnetic poles, magnetic flux and field, Ampère's law and Faraday's law
      - Coulomb's law

h. Use schematic diagrams to analyze the current flow in series and parallel electric circuits, given the component resistances and the imposed electric potential. (DOK 2)
i. Analyze and explain the relationship between magnetic fields and electrical current by induction, generators, and electric motors. (DOK 2)

6. <u>Analyze and explain concepts of nuclear physics.</u>

e. Analyze and explain the principles of nuclear physics. (DOK 1)
   - The mass number and atomic number of the nucleus of an isotope of a given chemical element
   - The conservation of mass and the conservation of charge
   - Nuclear decay

f. Defend the wave-particle duality model of light, using observational evidence. (DOK 3)
   - Quantum energy and emission spectra
   - Photoelectric and Compton effects

Spatial Information Science

SP 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.

SP 2 Develop an understanding of geographic information systems.

1. <u>Demonstrate the basic concepts of global positioning systems (GPS). (E)</u>

o. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
p. Clarify research questions, and design laboratory investigations. (DOK 3)
q. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
r. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences). (DOK 3)
s. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
t. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
u. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBLs, etc.). (DOK 3)

2. <u>Demonstrate the basic concepts of remote sensing. (E, P)</u>

m. Describe the characteristics of the electromagnetic spectrum.
n. Using images and graphs, interpret the absorption/reflection spectrum.
o. Distinguish between passive vs. active sensor systems.
p. Analyze the effects of changes in spatial, temporal, and spectral resolution.
q. Analyze the effects on images due to changes in scale.
r. Identify the types of sensor platforms.

Zoology

ZO 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
ZO 2 Develop an understanding of levels of organization and animal classification.
ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.
ZO 4 Demonstrate an understanding of the principles of animal genetic diversity and evolution.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
   o. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
      - Safety rules and symbols
      - Proper use and care of the compound light microscope, slides, chemicals, etc.
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
   p. Formulate questions that can be answered through research and experimental design. (DOK 3)
   q. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
   r. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
   s. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
   t. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
   u. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Develop an understanding of levels of organization and animal classification.**
   i. Explain how organisms are classified, and identify characteristics of major groups. (DOK 1)
      - Levels of organization of structures in animals (e.g., cells, tissues, organs, and systems)
      - Characteristics used to classify organisms (e.g., cell structure, biochemistry, anatomy, fossil record, and methods of reproduction)
   j. Identify and describe characteristics of the major phyla. (DOK 1)
      - Symmetry and body plan
      - Germ layers and embryonic development
      - Organ systems (e.g., digestive, circulatory, excretory, and reproductive)
      - Locomotion and coordination
   k. Distinguish viruses from bacteria and protists, and give examples. (DOK 1)
   l. Differentiate among the characteristics of bacteria, archaea, and eucarya. (DOK 1)
      - Phylogenic sequencing of the major phyla

- Invertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following phyla: Porifera, Cnidarians, Nematoda, Annelida, Platyhelmenthes, Arthropoda, Insecta, Crustacea, Arachnida, Mollusca [Bivalvia and Gastropoda], and Echinodermata)
- Vertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following classes: Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, and Mammalia

3. <u>Differentiate among animal life cycles, behaviors, adaptations, and relationships.</u>

k. Describe life cycles, alternation of generations, and metamorphosis of various animals, and evaluate the advantages and disadvantages of asexual and sexual reproduction. (DOK 1)

l. Describe and explain concepts of animal behavior, and differentiate between learned and innate behavior. (DOK 1)
   - Division of labor within a group of animals
   - Communication within animals groups
   - Degree of parental care given in animal groups

m. Evaluate the unique protective adaptations of animals as they relate to survival. (DOK 2)

n. Compare and contrast ecological relationships, and make predictions about the survival of populations under given circumstances. (DOK 3)
   - Terrestrial and aquatic ecosystems
   - Herbivores, carnivores, omnivores, decomposers and other feeding relationships
   - Symbiotic relationships such as mutualism, commensalisms, and parasitism

o. Contrast food chains and food webs. (DOK 2)

4. <u>Demonstrate an understanding of the principles of animal genetic diversity and evolution.</u>

e. Categorize and explain sources of genetic variation on the cellular level (e.g., mutations, crossing over, and nondisjunction) and the population level (e.g., nonrandom mating, migration, etc.). (DOK 2)
   - Relationship between natural selection and evolution
   - Mutations, crossing over, nondisjunction
   - Nonrandom mating, migration, etc.
   - Effects of genetic drift on evolution

f. Develop a logical argument defending or refuting issues related to genetic engineering of animals. (DOK 3)

Appendix C: ACT College Readiness Standards

English

E1 Topic Development in Terms of Purpose and Focus

- Identify the basic purpose or role of a specified phrase or sentence.
- Delete a clause or sentence because it is obviously irrelevant to the essay.
- Identify the central idea or main topic of a straightforward piece of writing.
- Determine relevancy when presented with a variety of sentence-level details.
- Identify the focus of a simple essay, applying that knowledge to add a sentence that sharpens that focus or to determine if an essay has met a specified goal.
- Delete material primarily because it disturbs the flow and development of the paragraph.
- Add a sentence to accomplish a fairly straightforward purpose such as illustrating a given statement.
- Apply an awareness of the focus and purpose of a fairly involved essay to determine the rhetorical effect and suitability of an existing phrase or sentence or to determine the need to delete plausible but irrelevant material.
- Add a sentence to accomplish a subtle rhetorical purpose such as to emphasize, to add supporting detail, or to express meaning through connotation.
- Determine whether a complex essay has accomplished a specific purpose.
- Add a phrase or sentence to accomplish a complex purpose, often expressed in terms of the main focus of the essay.

E2 Organization, Unity, and Coherence

- Use conjunctive adverbs or phrases to show time relationship in simple narrative essays (e.g., *then, this time*, etc.).
- Select the most logical place to add a sentence in a paragraph.
- Use conjunctive adverbs or phrases to express straightforward logical relationships (e.g., *first, afterward, in response*).
- Decide the most logical place to add a sentence in an essay.
- Add a sentence that introduces a simple paragraph.
- Determine the need for conjunctive adverbs or phrases to create subtle logical connections between sentences (e.g., *therefore, however, in addition*).
- Rearrange the sentences in a fairly uncomplicated paragraph for the sake of logic.
- Add a sentence to introduce or conclude the essay or to provide a transition between paragraphs when the essay is fairly straightforward.
- Make sophisticated distinctions concerning the logical use of conjunctive adverbs or phrases, particularly when signaling a shift between paragraphs.
- Rearrange sentences to improve the logic and coherence of a complex paragraph.
- Add a sentence to introduce or conclude a fairly complex paragraph.
- Consider the need for introductory sentences or transitions, basing decisions on a thorough understanding of both the logic and rhetorical effect of the paragraph and essay.

E3 Word Choice in Terms of Style, Tone, Clarity, and Economy

- Revise sentences to correct awkward and confusing arrangements of sentence elements.
- Revise vague nouns and pronouns that create obvious logic problems.
- Delete obviously synonymous and wordy material in a sentence.
- Revise expressions that deviate from the style of an essay.
- Delete redundant material when information is repeated in different parts of speech (e.g., *alarmingly startled*).
- Use the word or phrase most consistent with the style and tone of a fairly straightforward essay.
- Determine the clearest and most logical conjunction to link clauses.
- Revise a phrase that is redundant in terms of the meaning and logic of the entire sentence.
- Identify and correct ambiguous pronoun references.
- Use the word or phrase most appropriate in terms of the content of the sentence and tone of the essay.
- Correct redundant material that involves sophisticated vocabulary and sounds acceptable as conversational English (e.g., *an aesthetic viewpoint* versus *the outlook of an aesthetic viewpoint*).
- Correct vague and wordy or clumsy and confusing writing containing sophisticated language.
- Delete redundant material that involves subtle concepts or that is redundant in terms of the paragraph as a whole.

E4 Sentence Structure and Formation

- Use conjunctions or punctuation to join simple clauses.
- Revise shifts in verb tense between simple clauses in a sentence or between simple adjoining sentences.
- Determine the need for punctuation and conjunctions to avoid awkward sounding sentence fragments and fused sentences.
- Decide the appropriate verb tense and voice by considering the meaning of the entire sentence.
- Recognize and correct marked disturbances of sentence flow and structure (e.g., participial phrase fragments, missing or incorrect relative pronouns, dangling or misplaced modifiers).
- Revise to avoid faulty placement of phrases and faulty coordination and subordination of clauses in sentences with subtle structural problems.
- Maintain consistent verb tense and pronoun person on the basis of the preceding clause or sentence.
- Use sentence-combining techniques, effectively avoiding problematic comma splices, run-on sentences, and sentence fragments, especially in sentences containing compound subjects or verbs.
- Maintain a consistent and logical use of verb tense and pronoun person on the basis of information in the paragraph or essay as a whole.

- Work comfortably with long sentences and complex clausal relationships within sentences, avoiding weak conjunctions between independent clauses and maintaining parallel structure between clauses.

E5 Conventions of Usage

- Solve such basic grammatical problems as how to form the past and past participle of irregular but commonly used verbs and how to form comparative and superlative adjectives.
- Solve such grammatical problems as whether to use an adverb or adjective form, how to ensure straightforward subject–verb and pronoun–antecedent agreement, and which preposition to use in simple contexts.
- Recognize and use the appropriate word in frequently confused pairs such as *there* and *their*, *past* and *passed*, and *led* and *lead*.
- Use idiomatically appropriate prepositions, especially in combination with verbs (e.g., *long for, appeal to*).
- Ensure that a verb agrees with its subject when there is some text between the two.
- Ensure that a pronoun agrees with its antecedent when the two occur in separate clauses or sentences.
- Identify the correct past and past participle forms of irregular and infrequently used verbs, and form present–perfect verbs by using *have* rather than *of*.
- Correctly use reflexive pronouns, the possessive pronouns *its* and *your*, and the relative pronouns *who* and *whom*.
- Ensure that a verb agrees with its subject in unusual situations (e.g., when the subject–verb order is inverted or when the subject is an indefinite pronoun).
- Provide idiomatically and contextually appropriate prepositions following verbs in situations involving sophisticated language or ideas.
- Ensure that a verb agrees with its subject when a phrase or clause between the two suggests a different number for the verb.

E6 Conventions of Punctuation

- Delete commas that create basic sense problems (e.g., between verb and direct object).
- Provide appropriate punctuation in straightforward situations (e.g., items in a series).
- Delete commas that disturb the sentence flow (e.g., between modifier and modified element).
- Use commas to set off simple parenthetical phrases.
- Delete unnecessary commas when an incorrect reading of the sentence suggests a pause that should be punctuated (e.g., between verb and direct object clause).
- Use punctuation to set off complex parenthetical phrases.
- Recognize and delete unnecessary commas based on a careful reading of a complicated sentence (e.g., between the elements of a compound subject or compound verb joined by *and*).
- Use apostrophes to indicate simple possessive nouns.
- Recognize inappropriate uses of colons and semicolons.

- Use commas to set off a nonessential/nonrestrictive appositive or clause.
- Deal with multiple punctuation problems (e.g., compound sentences containing unnecessary commas and phrases that may or may not be parenthetical).
- Use an apostrophe to show possession, especially with irregular plural nouns.
- Use a semicolon to indicate a relationship between closely related independent clauses.
- Use a colon to introduce an example or an elaboration.

Math

M1 Basic Operations and Applications

- Perform one-operation computation with whole numbers and decimals.
- Solve problems in one or two steps using whole numbers.
- Perform common conversions (e.g., inches to feet or hours to minutes).
- Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent.
- Solve some routine two-step arithmetic problems.
- Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average.
- Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour).
- Solve word problems containing several rates, proportions, or percentages.
- Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings).

M2 Probability, Statistics, and Data Analysis

- Calculate the average of a list of positive whole numbers.
- Perform a single computation using information from a table or chart.
- Calculate the average of a list of numbers.
- Calculate the average, given the number of data values and the sum of the data values.
- Read tables and graphs.
- Perform computations on data from tables and graphs.
- Use the relationship between the probability of an event and the probability of its complement.
- Calculate the missing data value, given the average and all data values but one.
- Translate from one representation of data to another (e.g., a bar graph to a circle graph).
- Determine the probability of a simple event.
- Exhibit knowledge of simple counting techniques.*
- Calculate the average, given the frequency counts of all the data values.
- Manipulate data from tables and graphs.
- Compute straightforward probabilities for common situations.
- Use Venn diagrams in counting.*
- Calculate or use a weighted average.

- Interpret and use information from figures, tables, and graphs.
- Apply counting techniques.
- Compute a probability when the event and/or sample space is not given or obvious.
- Distinguish between mean, median, and mode for a list of numbers.
- Analyze and draw conclusions based on information from figures, tables, and graphs.
- Exhibit knowledge of conditional and joint probability.

M3 Numbers: Concepts and Properties

- Recognize equivalent fractions and fractions in lowest terms.
- Recognize one-digit factors of a number.
- Identify a digit's place value.
- Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor.
- Find and use the least common multiple.
- Order fractions.
- Work with numerical factors.
- Work with scientific notation.
- Work with squares and square roots of numbers.
- Work problems involving positive integer exponents.*
- Work with cubes and cube roots of numbers.*
- Determine when an expression is undefined.*
- Exhibit some knowledge of the complex numbers.†
- Apply number properties involving prime factorization.
- Apply number properties involving even and odd numbers and factors and multiples.
- Apply number properties involving positive and negative numbers.
- Apply rules of exponents.
- Multiply two complex numbers.†
- Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers.
- Exhibit knowledge of logarithms and geometric sequences.
- Apply properties of complex numbers.

M4 Expressions, Equations, and Inequalities

- Exhibit knowledge of basic expressions (e.g., identify an expression for a total as $b + g$).
- Solve equations in the form $x + a = b$, where a and b are whole numbers or decimals.
- Substitute whole numbers for unknown quantities to evaluate expressions.
- Solve one-step equations having integer or decimal answers.
- Combine like terms (e.g., $2x + 5x$).
- Evaluate algebraic expressions by substituting integers for unknown quantities.
- Add and subtract simple algebraic expressions.
- Solve routine first-degree equations.
- Perform straightforward word-to-symbol translations.
- Multiply two binomials.*

- Solve real-world problems using first-degree equations.
- Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions).
- Identify solutions to simple quadratic equations.
- Add, subtract, and multiply polynomials.*
- Factor simple quadratics (e.g., the difference of squares and perfect square trinomials).*
- Solve first-degree inequalities that do not require reversing the inequality sign.*
- Manipulate expressions and equations.
- Write expressions, equations, and inequalities for common algebra settings.
- Solve linear inequalities that require reversing the inequality sign.
- Solve absolute value equations.
- Solve quadratic equations.
- Find solutions to systems of linear equations.
- Write expressions that require planning and/or manipulating to accurately model a situation.
- Write equations and inequalities that require planning, manipulating, and/or solving.
- Solve simple absolute value inequalities.

M5 Graphical Representations

- Identify the location of a point with a positive coordinate on the number line.
- Locate points on the number line and in the first quadrant.
- Locate points in the coordinate plane.
- Comprehend the concept of length on the number line.*
- Exhibit knowledge of slope.*
- Identify the graph of a linear inequality on the number line.*
- Determine the slope of a line from points or equations.*
- Match linear graphs with their equations.*
- Find the midpoint of a line segment.*
- Interpret and use information from graphs in the coordinate plane.
- Match number line graphs with solution sets of linear inequalities.
- Use the distance formula.
- Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point.
- Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle).†
- Match number line graphs with solution sets of simple quadratic inequalities.
- Identify characteristics of graphs based on a set of conditions or on a general equation such as y = ax2 + c.
- Solve problems integrating multiple algebraic and/or geometric concepts.
- Analyze and draw conclusions based on information from graphs in the coordinate plane.

M6 Properties of Plane Figures

- Exhibit some knowledge of the angles associated with parallel lines.
- Find the measure of an angle using properties of parallel lines.
- Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°).
- Use several angle properties to find an unknown angle measure.
- Recognize Pythagorean triples.*
- Use properties of isosceles triangles.*
- Apply properties of 30°-60°-90°, 45°-45°-90°, similar, and congruent triangles.
- Use the Pythagorean theorem.
- Draw conclusions based on a set of conditions.
- Solve multistep geometry problems that involve integrating concepts, planning, visualization, and/or making connections with other content areas.
- Use relationships among angles, arcs, and distances in a circle.

M7Measurement

- Estimate or calculate the length of a line segment based on other lengths given on a geometric figure.
- Compute the perimeter of polygons when all side lengths are given.
- Compute the area of rectangles when whole number dimensions are given.
- Compute the area and perimeter of triangles and rectangles in simple problems.
- Use geometric formulas when all necessary information is given.
- Compute the area of triangles and rectangles when one or more additional simple steps are required.
- Compute the area and circumference of circles after identifying necessary information.
- Compute the perimeter of simple composite geometric figures with unknown side lengths.*
- Use relationships involving area, perimeter, and volume of geometric figures to compute another measure.
- Use scale factors to determine the magnitude of a size change.
- Compute the area of composite geometric figures when planning or visualization is required.

M8Functions

- Evaluate quadratic functions, expressed in function notation, at integer values.
- Evaluate polynomial functions, expressed in function notation, at integer values.†
- Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths.†
- Evaluate composite functions at integer values.†
- Apply basic trigonometric ratios to solve right-triangle problems.†
- Write an expression for the composite of two simple functions.†
- Use trigonometric concepts and basic identities to solve problems.†
- Exhibit knowledge of unit circle trigonometry.†
- Match graphs of basic trigonometric functions with their equations.

Notes

- Students who score in the 1–12 range are most likely beginning to develop the knowledge and skills assessed in the other ranges.
- Standards followed by an asterisk (*) apply to the PLAN and ACT Mathematics tests only.
- Standards followed by a dagger (†) apply to the ACT Mathematics test only.

Reading

R1 Main Ideas and Author's Approach

- Recognize a clear intent of an author or narrator in uncomplicated literary narratives.
- Identify a clear main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Infer the main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in uncomplicated passages.
- Identify a clear main idea or purpose of any paragraph or paragraphs in uncomplicated passages.
- Infer the main idea or purpose of straightforward paragraphs in more challenging passages.
- Summarize basic events and ideas in more challenging passages.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in more challenging passages.
- Infer the main idea or purpose of more challenging passages or their paragraphs.
- Summarize events and ideas in virtually any passage.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in virtually any passage.
- Identify clear main ideas or purposes of complex passages or their paragraphs.

R2 Supporting Details

- Locate basic facts (e.g., names, dates, events) clearly stated in a passage.
- Locate simple details at the sentence and paragraph level in uncomplicated passages.
- Recognize a clear function of a part of an uncomplicated passage.
- Locate important details in uncomplicated passages.
- Make simple inferences about how details are used in passages.
- Locate important details in more challenging passages.
- Locate and interpret minor or subtly stated details in uncomplicated passages.
- Discern which details, though they may appear in different sections throughout a passage, support important points in more challenging passages.
- Locate and interpret minor or subtly stated details in more challenging passages.
- Use details from different sections of some complex informational passages to support a specific point or argument.

- Locate and interpret details in complex passages.
- Understand the function of a part of a passage when the function is subtle or complex.

R3 Sequential, Comparative, and Cause–Effect Relationships

- Determine when (e.g., first, last, before, after) or if an event occurred in uncomplicated passages.
- Recognize clear cause–effect relationships described within a single sentence in a passage.
- Identify relationships between main characters in uncomplicated literary narratives.
- Recognize clear cause–effect relationships within a single paragraph in uncomplicated literary narratives.
- Order simple sequences of events in uncomplicated literary narratives.
- Identify clear relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear cause–effect relationships in uncomplicated passages.
- Order sequences of events in uncomplicated passages.
- Understand relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear relationships between characters, ideas, and so forth in more challenging literary narratives.
- Understand implied or subtly stated cause–effect relationships in uncomplicated passages.
- Identify clear cause–effect relationships in more challenging passages.
- Order sequences of events in more challenging passages.
- Understand the dynamics between people, ideas, and so forth in more challenging passages.
- Understand implied or subtly stated cause–effect relationships in more challenging passages.
- Order sequences of events in complex passages.
- Understand the subtleties in relationships between people, ideas, and so forth in virtually any passage.
- Understand implied, subtle, or complex cause–effect relationships in virtually any passage.

R4 Meaning of Words

- Understand the implication of a familiar word or phrase and of simple descriptive language.
- Use context to understand basic figurative language.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in uncomplicated passages.
- Use context to determine the appropriate meaning of virtually any word, phrase, or statement in uncomplicated passages.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in more challenging passages.

- Determine the appropriate meaning of words, phrases, or statements from figurative or somewhat technical contexts.
- Determine, even when the language is richly figurative and the vocabulary is difficult, the appropriate meaning of context-dependent words, phrases, or statements in virtually any passage.

R5 Generalizations and Conclusions

- Draw simple generalizations and conclusions about the main characters in uncomplicated literary narratives.
- Draw simple generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw simple generalizations and conclusions using details that support the main points of more challenging passages.
- Draw subtle generalizations and conclusions about characters, ideas, and so forth in uncomplicated literary narratives.
- Draw generalizations and conclusions about people, ideas, and so forth in more challenging passages.
- Use information from one or more sections of a more challenging passage to draw generalizations and conclusions about people, ideas, and so forth.
- Draw complex or subtle generalizations and conclusions about people, ideas, and so forth, often by synthesizing information from different portions of the passage.
- Understand and generalize about portions of a complex literary narrative.

Science

S1 Interpretation of Data

- Select a single piece of data (numerical or non-numerical) from a simple data presentation (e.g., a table or graph with two or three variables, a food web diagram).
- Identify basic features of a table, graph, or diagram (e.g., headings, units of measurement, axis labels).
- Select two or more pieces of data from a simple data presentation.
- Understand basic scientific terminology.
- Find basic information in a brief body of text.
- Determine how the value of one variable changes as the value of another variable changes in a simple data presentation.
- Select data from a complex data presentation (e.g., a table or graph with more than three variables, a phase diagram).
- Compare or combine data from a simple data presentation (e.g., order or sum data from a table).
- Translate information into a table, graph, or diagram.
- Compare or combine data from two or more simple data presentations (e.g., categorize data from a table using a scale from another table).

- Compare or combine data from a complex data presentation.
- Interpolate between data points in a table or graph.
- Determine how the value of one variable changes as the value of another variable changes in a complex data presentation.
- Identify and/or use a simple (e.g., linear) mathematical relationship between data.
- Analyze given information when presented with new, simple information.
- Compare or combine data from a simple data presentation with data from a complex data presentation.
- Identify and/or use a complex (e.g., nonlinear) mathematical relationship between data.
- Extrapolate from data points in a table or graph.
- Compare or combine data from two or more complex data presentations.
- Analyze given information when presented with new, complex information.

S2 Scientific Investigation

- Understand the methods and tools used in a simple experiment.
- Understand the methods and tools used in a moderately complex experiment.
- Understand a simple experimental design.
- Identify a control in an experiment.
- Identify similarities and differences between experiments.
- Understand the methods and tools used in a complex experiment.
- Understand a complex experimental design.
- Predict the results of an additional trial or measurement in an experiment.
- Determine the experimental conditions that would produce specified results.
- Determine the hypothesis for an experiment.
- Identify an alternate method for testing a hypothesis.
- Understand precision and accuracy issues.
- Predict how modifying the design or methods of an experiment will affect results.
- Identify an additional trial or experiment that could be performed to enhance or evaluate experimental results.

S3 Evaluation of Models, Inferences, and Experimental Results

- Select a simple hypothesis, prediction, or conclusion that is supported by a data presentation or a model.
- Identify key issues or assumptions in a model.
- Select a simple hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a simple hypothesis or conclusion and why.
- Identify strengths and weaknesses in one or more models.
- Identify similarities and differences between models.
- Determine which model(s) is/are supported or weakened by new information.
- Select a data presentation or a model that supports or contradicts a hypothesis, prediction, or conclusion.

- Select a complex hypothesis, prediction, or conclusion that is supported by a data presentation or model.
- Determine whether new information supports or weakens a model and why.
- Use new information to make a prediction based on a model.
- Select a complex hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a complex hypothesis or conclusion and why.

Writing

W1 Expressing Judgments

- Show a little understanding of the persuasive purpose of the task, but neglect to take or to maintain a position on the issue in the prompt.
- Show limited recognition of the complexity of the issue in the prompt.
- Show a basic understanding of the persuasive purpose of the task by taking a position on the issue in the prompt but may not maintain that position.
- Show a little recognition of the complexity of the issue in the prompt by acknowledging, but only briefly describing, a counterargument to the writer's position.
- Show understanding of the persuasive purpose of the task by taking a position on the issue in the prompt.
- Show some recognition of the complexity of the issue in the prompt by doing the following:
    - Acknowledging counterarguments to the writer's position
    - Providing some response to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a broad context for discussion.
- Show recognition of the complexity of the issue in the prompt by doing the following:
    - Partially evaluating implications and/or complications of the issue
    - Posing and partially responding to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a critical context for discussion.
- Show understanding of the complexity of the issue in the prompt by doing the following:
    - Examining different perspectives
    - Evaluating implications or complications of the issue
    - Posing and fully discussing counterarguments to the writer's position

W2 Focusing on the Topic

- Maintain a focus on the general topic in the prompt through most of the essay.
- Maintain a focus on the general topic in the prompt throughout the essay.
- Maintain a focus on the general topic in the prompt throughout the essay, and attempt a focus on the specific issue in the prompt.
- Present a thesis that establishes focus on the topic.
- Maintain a focus on discussion of the specific topic and issue in the prompt throughout the essay.

- Present a thesis that establishes a focus on the writer's position on the issue.
- Maintain a clear focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a critical thesis that clearly establishes the focus on the writer's position on the issue.

W3 Developing a Position

- Offer a little development, with one or two ideas; if examples are given, they are general and may not be clearly relevant; resort often to merely repeating ideas.
- Show little or no movement between general and specific ideas and examples.
- Offer limited development of ideas using a few general examples; resort sometimes to merely repeating ideas.
- Show little movement between general and specific ideas and examples.
- Develop ideas by using some specific reasons, details, and examples.
- Show some movement between general and specific ideas and examples.
- Develop most ideas fully, using some specific and relevant reasons, details, and examples.
- Show clear movement between general and specific ideas and examples.
- Develop several ideas fully, using specific and relevant reasons, details, and examples.
- Show effective movement between general and specific ideas and examples.

W4 Organizing Ideas

- Provide a discernible organization with some logical grouping of ideas in parts of the essay.
- Use a few simple and obvious transitions.
- Present a discernible, though minimally developed, introduction and conclusion.
- Provide a simple organization with logical grouping of ideas in parts of the essay.
- Use some simple and obvious transitional words, though they may at times be inappropriate or misleading.
- Present a discernible, though underdeveloped, introduction and conclusion.
- Provide an adequate but simple organization with logical grouping of ideas in parts of the essay but with little evidence of logical progression of ideas.
- Use some simple and obvious, but appropriate, transitional words and phrases.
- Present a discernible introduction and conclusion with a little development.
- Provide unity and coherence throughout the essay, sometimes with a logical progression of ideas.
- Use relevant, though at times simple and obvious, transitional words and phrases to convey logical relationships between ideas.
- Present a somewhat developed introduction and conclusion.
- Provide unity and coherence throughout the essay, often with a logical progression of ideas.
- Use relevant transitional words, phrases, and sentences to convey logical relationships between ideas.

- Present a well-developed introduction and conclusion.

W5 Using Language

- Show limited control of language by doing the following:
    - Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes significantly impede understanding
    - Using simple vocabulary
    - Using simple sentence structure
    - Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes impede understanding
    - Using simple but appropriate vocabulary
    - Using a little sentence variety, though most sentences are simple in structure
    - Correctly employing many of the conventions of standard English grammar, usage, and mechanics but with some distracting errors that may occasionally impede understanding
    - Using appropriate vocabulary
    - Using some varied kinds of sentence structures to vary pace
    - Correctly employing most conventions of standard English grammar, usage, and mechanics with a few distracting errors but none that impede understanding
    - Using some precise and varied vocabulary
    - Using several kinds of sentence structures to vary pace and to support meaning
    - Correctly employing most conventions of standard English grammar, usage, and mechanics with just a few, if any, errors
    - Using precise and varied vocabulary
    - Using a variety of kinds of sentence structures to vary pace and to support meaning

Appendix D: Pathway Content Standards[2]

AGRICULTURE, FOOD, AND NATURAL RESOURCES (AFNR) PATHWAY CONTENT STANDARDs AND PERFORMANCE ELEMENTS

The AFNR Pathway Content Standards and Performance Elements are adapted from *National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards.* Reprinted with permission from the National Council for Agricultural Education, 1410 King Street, Suite 400, Alexandria, VA 22314. (800) 772-0939. Copyright © 2011. A complete copy of the National Standards can be downloaded from the Team Ag Ed Learning Center at https://aged.learn.com.

AGRIBUSINESS SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of agribusiness systems.

ABS.01. Utilize economic principles to establish and manage an AFNR enterprise.
- ABS.01.01. Apply principles of capitalism in the business environment.
- ABS.01.02. Apply principles of entrepreneurship in businesses.

ABS.02. Utilize appropriate management planning principles in AFNR business enterprises.
- ABS.02.01. Compose and analyze a business plan for an enterprise.
- ABS.02.02. Read, interpret, evaluate, and write a mission statement to guide business goals, objectives, and resource allocation.
- ABS.02.03. Apply appropriate management skills to organize a business.
- ABS.02.04. Recruit, train, and retain appropriate and productive human resources for business.

ABS.03. Utilize record keeping to accomplish AFNR business objectives while complying with laws and regulations.
- ABS.03.01. Prepare and maintain all files needed to accomplish effective record keeping.
- ABS.03.02 Implement appropriate inventory management practices.

ABS.04. Apply generally accepted accounting principles and skills to manage cash budgets, credit budgets, and credit for AFNR businesses.
- ABS.04.01. Use accounting fundamentals to accomplish dependable bookkeeping and fiscal management.

[2]*National Agriculture, Food and Natural Resources (AFNR) (2011) Standards. Reprinted with permission from the National Council for Agricultural Education,* Retrieved April 3, 2011, from https://aged.learn.com.

ABS.05. Assess accomplishment of goals and objectives by an AFNR business.

ABS.05.01. Maintain and interpret financial information (income statements, balance sheets, inventory, purchase orders, accounts receivable, and cash-flow analyses) for businesses.

ABS.06. Use industry-accepted marketing practices to accomplish AFNR business objectives.

ABS.06.01. Conduct appropriate market and marketing research.

ABS.06.02. Develop a marketing plan.

ABS.06.03. Develop strategies for marketing plan implementation.

ABS.06.04. Develop specific tactics to market AFNR products and services.

ABS.07. Create a production system plan.

ABS.07.01. Prepare a step-by-step production plan that identifies needed resources.

ABS.07.02. Develop a production and operational plan.

ABS.07.03. Utilize appropriate techniques to determine the most likely strengths, weaknesses, and inconsistencies in a business plan, and relate these to risk management strategies.

ABS.07.04. Manage risk and uncertainty.

ANIMAL SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and practices to the production and management of animals.

AS.01. Examine the components, historical development, global implications, and future trends of the animal systems industry.

AS.01.01. Evaluate the development and implications of animal origin, domestication, and distribution.

AS.02. Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics.

AS.02.01. Classify animals according to hierarchical taxonomy and agricultural use.

AS.02.02. Apply principles of comparative anatomy and physiology to uses within various animal systems.

AS.02.03. Select animals for specific purposes and maximum performance based on anatomy and physiology.

AS.03. Provide for the proper health care of animals.

AS.03.01. Prescribe and implement a prevention and treatment program for animal diseases, parasites, and other disorders.

AS.03.02. Provide for the biosecurity of agricultural animals and production facilities.

AS.04. Apply principles of animal nutrition to ensure the proper growth, development, reproduction, and economic production of animals.

AS.04.01. Formulate feed rations to provide for the nutritional needs of animals.

AS.04.02. Prescribe and administer animal feed additives and growth promotants in animal production.

AS.05. Evaluate and select animals based on scientific principles of animal production.

AS.05.01. Evaluate the male and female reproductive systems in selecting animals.

AS.05.02. Evaluate animals for breeding readiness and soundness.

AS.05.03. Apply scientific principles in the selection and breeding of animals.

AS.06. Prepare and implement animal handling procedures for the safety of animals, producers and consumers of animal products.

AS.06.01. Demonstrate safe animal handling and management techniques.

AS.06.02. Implement procedures to ensure that animal products are safe.

AS.07. Select animal facilities and equipment that provide for the safe and efficient production, housing, and handling of animals.

AS.07.01. Design animal housing, equipment, and handling facilities for the major systems of animal production.

AS.07.02. Comply with government regulations and safety standards for facilities used in animal production.

AS.08. Analyze environmental factors associated with animal production.

AS.08.01. Reduce the effects of animal production on the environment.

AS.08.02. Evaluate the effects of environmental conditions on animals.

BIOTECHNOLOGY

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to biotechnology in agriculture.

BS.01. Recognize the historical, social, cultural, and potential applications of biotechnology.

BS.01.01. Distinguish major innovators, historical developments, and potential applications of biotechnology in agriculture.

BS.01.02. Determine regulatory issues, and identify agencies associated with biotechnology.

BS.01.03. Analyze the ethical, legal, social, and cultural issues relating to biotechnology.

BS.02 Demonstrate laboratory skills as applied to biotechnology.

BS.02.01. Maintain and interpret biotechnology laboratory records.

BS.02.02. Operate biotechnology laboratory equipment according to standard procedures.

BS.02.03. Demonstrate proper laboratory procedures using biological materials.
BS.02.04. Safely manage biological materials, chemicals, and wastes used in the laboratory.
BS.02.05. Perform microbiology, molecular biology, enzymology, and immunology procedures.

BS.03. Demonstrate the application of biotechnology to Agriculture, Food, and Natural Resources (AFNR).

BS.03.01. Evaluate the application of genetic engineering to improve products of AFNR systems.
BS.03.02. Perform biotechnology processes used in AFNR systems.
BS.03.03. Use biotechnology to monitor and evaluate procedures performed in AFNR systems.

ENVIRONMENTAL SERVICE SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of environmental service systems.

ESS.01. Use analytical procedures to plan and evaluate environmental service systems.

ESS.01.01. Analyze and interpret samples.

ESS.02. Assess the impact of policies and regulations on environmental service systems.

ESS.02.01. Interpret laws affecting environmental service systems.

ESS.03. Apply scientific principles to environmental service systems.

ESS.03.01. Apply meteorology principles to environmental service systems.
ESS.03.02. Apply soil science principles to environmental service systems.
ESS.03.03. Apply hydrology principles to environmental service systems.
ESS.03.04. Apply best management techniques associated with the properties, classifications, and functions of wetlands.
ESS.03.05. Apply chemistry principles to environmental service systems.
ESS.03.06. Apply microbiology principles to environmental service systems.

ESS.04. Operate environmental service systems to manage a facility environment.

ESS.04.01. Use pollution control measures to maintain a safe facility environment.
ESS.04.02. Manage safe disposal of all categories of solid waste.
ESS.04.03. Apply the principles of public drinking water treatment operations to ensure safe water at a facility.
ESS.04.04. Apply principles of wastewater treatment to manage wastewater disposal in keeping with rules and regulations.
ESS.04.05. Manage hazardous materials to assure a safe facility and to comply with applicable regulations.

ESS.05. Examine the relationships between energy sources and environmental service systems.

ESS.05.01. Compare and contrast the impact of conventional and alternative energy sources on the environment.

ESS.06. Use tools, equipment, machinery, and technology to accomplish tasks in environmental service systems.

ESS.06.01. Use technological and mathematical tools to map land, facilities, and infrastructure.

ESS.06.02. Maintain tools, equipment, and machinery in safe working order for tasks in environmental service systems.

FOOD PRODUCTS AND PROCESSING SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles, practices, and techniques in the processing, storage, and development of food products.

FPP.01. Examine components of the food industry and historical development of food products and processing.

FPP.01.01. Evaluate the significance and implications of changes and trends in the food products and processing industry.

FPP.01.02. Work effectively with industry organizations, groups, and regulatory agencies affecting the food products and processing industry.

FPP.02. Apply safety principles, recommended equipment, and facility management techniques to the food products and processing industry.

FPP.02.01. Manage operational procedures, and create equipment and facility maintenance plans.

FPP.02.02. Implement Hazard Analysis and Critical Control Point (HACCP) procedures to establish operating parameters.

FPP.02.03. Apply safety and sanitation procedures in the handling, processing, and storing of food products.

FPP.02.04. Demonstrate worker safety procedures with food product and processing equipment and facilities.

FPP.03. Apply principles of science to the food products and processing industry.

FPP.03.01. Apply principles of science to food processing to provide a safe, wholesome, and nutritious food supply.

FPP.04. Select and process food products for storage, distribution, and consumption.

FPP.04.01. Utilize harvesting, selection, and inspection techniques to obtain quality food products for processing.

FPP.04.02. Evaluate, grade, and classify processed food products.

FPP.04.03. Process, preserve, package, and present food and food products for sale and distribution.

NATURAL RESOURCE SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of natural resources.

NRS.01. Explain interrelationships between natural resources and humans necessary to conduct management activities in natural environments.

NRS.01.01. Apply knowledge of natural resource components to the management of natural resource systems.

NRS01.02. Classify natural resources.

NRS.02. Apply scientific principles to natural resource management activities.

NRS.02.01. Develop a safety plan for work with natural resources.

NRS.02.02. Demonstrate cartographic skills to aid in developing, implementing, and evaluating natural resource management plans.

NRS.02.03. Measure and survey natural resource status to obtain planning data.

NRS.02.04. Demonstrate natural resource enhancement techniques.

NRS.02.05. Interpret laws related to natural resource management and protection.

NRS.02.06. Apply ecological concepts and principles to natural resource systems.

NRS.03. Apply knowledge of natural resources to production and processing industries.

NRS.03.01. Produce, harvest, process, and use natural resource products.

NRS.04. Demonstrate techniques used to protect natural resources.

NRS.04.01. Manage fires in natural resource systems.

NRS.04.02. Diagnose plant and wildlife diseases, and follow protocol to prevent their spread.

NRS.04.03. Manage insect infestations of natural resources.

NRS.05. Use effective methods and venues to communicate natural resource processes to the public.

NRS.05.01. Communicate natural resource information to the public.

PLANT SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the production and management of plants.

PS.01. Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.

PS.01.01. Classify agricultural plants according to taxonomy systems.

PS.01.02. Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.

PS.01.03. Apply knowledge of plant physiology and energy conversion to plant systems.

PS.02. Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

PS.02.01. Determine the influence of environmental factors on plant growth.

PS.02.02. Prepare growing media for use in plant systems.

PS.02.03. Develop and implement a fertilization plan for specific plants or crops.

PS.03. Propagate, culture, and harvest plants.

PS.03.01 Demonstrate plant propagation techniques.

PS.03.02. Develop and implement a plant management plan for crop production.

PS.03.03. Develop and implement a plan for integrated pest management.

PS.03.04. Apply principles and practices of sustainable agriculture to plant production.

PS.03.05 Harvest, handle, and store crops.

PS.04. Employ elements of design to enhance an environment.

PS.04.01. Create designs using plants.

POWER, STRUCTURAL AND TECHNICAL SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of power, structural, and technical systems.

PST.01. Use physical science principles and engineering applications with power, structural, and technical systems to solve problems and improve performance.

PST.01.01. Select energy sources in power generation appropriate to the situation.

PST.01.02. Apply physical science laws and principles to identify, classify, and use lubricants.

PST.01.03. Identify and use hand and power tools and equipment for service, construction, and fabrication.

PST.02. Design, operate, and maintain mechanical equipment, structures, biological systems, land treatment, power, and technology.

PST.02.01. Perform service routines to maintain power units and equipment.

PST.02.02. Operate, service, and diagnose the condition of power units and equipment.

PST.03. Service and repair mechanical equipment and power systems.

PST.03.01. Troubleshoot and repair internal combustion engines.

PST.03.02. Utilize manufacturers' guidelines to service and repair the power transmission systems of equipment.

PST.03.03. Service and repair hydraulic and pneumatic systems.

PST.03.04. Troubleshoot and service electrical systems.

PST.03.05. Service vehicle heating and air-conditioning systems.

PST.03.06. Service and repair steering, suspension, traction, and vehicle performance systems.

PST.04. Plan, build and maintain agricultural structures.

PST.04.01. Create sketches and plans of agricultural structures.

PST.04.02. Apply structural plans, specifications, and building codes.

PST.04.03. Examine structural requirements for materials and procedures, and estimate construction cost.

PST.04.05. Follow architectural and mechanical plans to construct and/or repair equipment, buildings, and facilities.

PST.05. Apply technology principles in the use of agricultural technical systems.

PST.05.01. Use instruments and meters to test and monitor electrical and electronic processes.

PST.05.02. Prepare and/or use electrical drawings to design, install, and troubleshoot control systems.

PST.05.03. Use geospatial technologies in agricultural applications.

Appendix E: National Educational Technology Standards for Students

T1 Creativity and Innovation
T2 Communication and Collaboration
T3 Research and Information Fluency
T4 Critical Thinking, Problem Solving, and Decision Making
T5 Digital Citizenship
T6 Technology Operations and Concepts

T1 Creativity and Innovation

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students do the following:

a. Apply existing knowledge to generate new ideas, products, or processes.
b. Create original works as a means of personal or group expression.
c. Use models and simulations to explore complex systems and issues.
d. Identify trends and forecast possibilities.

T2 Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students do the following:

a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
c. Develop cultural understanding and global awareness by engaging with learners of other cultures.
d. Contribute to project teams to produce original works or solve problems.

T3 Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information. Students do the following:

a. Plan strategies to guide inquiry.
b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
d. Process data and report results.

T4 Critical Thinking, Problem Solving, and Decision Making

Students use critical-thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students do the following:

a. Identify and define authentic problems and significant questions for investigation.

b. Plan and manage activities to develop a solution or complete a project.
c. Collect and analyze data to identify solutions and/or make informed decisions.
d. Use multiple processes and diverse perspectives to explore alternative solutions.

T5 Digital Citizenship

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students do the following:

a. Advocate and practice safe, legal, and responsible use of information and technology.
b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.
c. Demonstrate personal responsibility for lifelong learning.
d. Exhibit leadership for digital citizenship.

T6 Technology Operations and Concepts

Students demonstrate a sound understanding of technology concepts, systems, and operations. Students do the following:

a. Understand and use technology systems.
b. Select and use applications effectively and productively.
c. Troubleshoot systems and applications.
d. Transfer current knowledge to learning of new technologies.

FRAMEWORKS FOR

CAREER-TECHNICAL PROGRAMS

REVISED IN

2011

SECONDARY

EXECUTIVE SUMMARY

2011

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Foreword

Secondary career-technical education programs in Mississippi are faced with many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, Mississippi Code of 1972, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, ch. 487, §14; Laws, 1991, ch. 423, §1; Laws, 1992, ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act III, 1998; and No Child Left Behind Act of 2001).

Each secondary vocational-technical course consists of a series of instructional units which focus on a common theme. All units have been written using a common format which includes the following components:

- Unit Number and Title
- Suggested Time on Task - An estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75-80 percent of the time in the course.
- Competencies and Suggested Objectives
  - A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies.
  - The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.
- Suggested Teaching Strategies - This section of each unit indicates strategies that can be used to enable students to master each competency. Emphasis has been placed on strategies which reflect active learning methodologies. Teachers should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.
- Suggested Assessment Strategies - This section indicates strategies that can be used to measure student mastery. Examples of suggested strategies could include rubrics, class participation, reflection, and journaling. Again, teachers should feel free to modify or enhance these suggested assessment strategies based on local needs and resources.
- Integrated Academic Topics, Workplace Skills, Technology Standards, and Occupational Standards - This section identifies related academic topics as required in the Subject Area Assessment Program (SATP) in Algebra I, Biology I, English II, and U. S. History from 1877, which are integrated into the content of the unit. It also identifies the 21st Century

Skills, which were developed by the Partnership for 21st Century Skills, a group of business and education organizations concerned about the gap between the knowledge and skills learned in school and those needed in communities and the workplace. A portion of the 21st Century Skills addresses learning skills needed in the 21st century, including information and communication skills, thinking and problem-solving skills, and interpersonal and self-directional skills. The need for these types of skills have been recognized for some time. The 21st Century Skills are adapted in part from the 1991 report from the U.S. Secretary of Labor's Commission on Achieving Necessary Skills (SCANS). Another important aspect of learning and working in the 21st century involves technology skills. The International Society for Technology in Education, developers of the National Education Technology Standards (NETS), were strategic partners in the Partnership for 21st Century Skills.

- References - A list of suggested references is provided for each unit. The list includes some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested and the list may be modified or enhanced based on needs and abilities of students and on available resources.

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Science, Technology, Engineering, and Mathematics (STEM) Applications

STEM Applications Executive Summary

Course Description

STEM Applications is a course that introduces students to concepts and careers in the areas of science, technology, engineering and mathematics. It is an innovative instructional program that prepares students to engage in future academic and vocational courses of study in high school, community college, and institutions of higher learning. During the course, the students will become aware of current topics in several sciences, emerging technology, computer aided design, robotics, and financial literacy. This course is intended to provide an overview of the topics covered in the growing STEM field and to give students the opportunity to investigate careers in this area. Students will develop academic and technical skills, 21st Century Skills, and human relations competencies that accompany technical skills for job success and lifelong learning.

Licensure Requirements

The 983 licensure endorsement is needed to teach the STEM Applications course. The requirements for the 983 licensure endorsement are listed below:

1. Applicant must have earned a 4-year education degree (bachelor's degree) or higher from an accredited institution of higher education.
2. Applicant must hold a current and valid Mississippi 5-year teaching license.
3. Applicant must successfully complete an MDE-approved computer literacy certification exam.
4. Applicant must successfully complete certification for an online learning workshop, module, or course that is approved by the MDE.
5. Applicant must successfully complete a STEM Applications certification workshop, module, or course that is approved by the MDE.

Note: If an applicant meets all requirements listed above, that applicant will be issued a 983 endorsement to be added to his/her 5-year license.

Professional Learning

The professional learning itinerary for the middle school or individual pathways can be found at http://info.rcu.msstate.edu. If you have specific questions about the content of each training session provided, please contact the Research and Curriculum Unit at 662.325.2510, and ask for the Professional Learning Specialist.

Course Outline

Unit Number	Unit Name	Hours
1	Orientation and Ethics	5
2	Technology Literacy	5
3	The Design Process	5
4	Emerging Technologies (ongoing)	5
5	Computer Aided Design	25
6	Sustainable Design and Technology	10
7	Power and Energy	25
8	Robotics Simulation	10
9	Financial and Economic Literacy	20
10	Workplace Skills: School to Careers III	10
Total		120

STEM Applications Competencies and Objectives

Unit 1: Orientation and Ethics

1. Identify and explain course expectations, school policies, program policies, and safety procedures related to Science, Technology, Engineering and Mathematics (STEM). (DOK 2)
   a. Identify course expectations, school policies, and program policies related to Science, Technology, Engineering and Mathematics. (DOK 1)
   b. Identify, describe, and demonstrate the importance of safety and the proper use of lab equipment. (DOK 2)
   c. Describe the operating procedures for the equipment utilized in the course. (DOK 2)
   d. Compare and contrast safety issues in the classroom to safety issues in industry. (DOK 2)
2. Recognize the importance of personality development, leadership, and teamwork in relation to the classroom environment, interpersonal skills, and others. (DOK 2)
   a. Discover individual learning styles and their importance in the classroom/workplace. (DOK 1)
   b. Identify potential influences that shape the personality development including personality traits, heredity, and environment. (DOK 2)
   c. Develop effective leadership, decision-making, and communication skills. (DOK 2)
   d. Indentify career interests. (DOK 2)
3. Identify emerging careers in the technology field. (DOK 1)
   a. Research, identify, and describe, emerging careers in the technology field. (DOK 2)
   b. Investigate requirements necessary to work in selected emerging technology fields. (DOK 1)

Unit 2: Technology Literacy

1. Examine the history of technology in order to define current technology. (DOK 3)
   a. Examine the many characteristics of technology. (DOK 2)
   b. Discover the various types of technology. (DOK 2)
   c. Define technology based on its history. (DOK 3)
2. Demonstrate understanding of the evolution of technology. (DOK 3)
   a. Research and report on evolution of technology. (DOK 3)
   b. Discuss effects technology has on society. (DOK 3)

Unit 3: The Design Process

1. Recognize the need for a design process.
   a. Define the design process.
   b. Identify items designed through the design process and those that are not.

2. Examine how the design process is used to create and modify products and inventions.
   a. Follow the design process to modify a product or invention.
   b. Apply concepts of planning, design, building, testing, quality assurance, and customer needs.

Unit 4: Emerging Technologies

1. Evaluate emerging technologies in society.
   a. Identify and evaluate technologies that have been developed within the last three months. (ongoing)
2. Develop a proposal for a new technology.
   a. Design a new technology based on previous research.
   b. Write a proposal to present your product to an industry for purchase.

Unit 5: Computer Aided Design

1. Examine the drafting and design industry.
   a. Examine the history of drafting and design.
   b. Identify drafting and design applications in business and industry.
2. Create 3-D models with CAD software.
   a. Distinguish between the types of drawing views: orthographic, isometric, and perspective.
   b. Demonstrate use of basic drawing commands.
   c. Create 3-D drawings using CAD software.

Unit 6: Sustainable Design and Technology

1. Demonstrate understanding of the concept of sustainable design.
   a. Research and report on the concept of sustainable design.
   b. Discuss ways that sustainable design can reduce waste in society.
2. Design a “green” alternative to an existing product.
   a. Evaluate common products to discover positive/negative effects on the environment.
   b. Using CAD, design an environmentally friendly alternative to a common product.
   c. Develop a class action plan, implement it, and do a service learning project that addresses one of the issues discussed during this unit.

Unit 7: Power and Energy

1. Demonstrate understanding of the power and energy industry.
   a. Discover the many types of power and energy.
   b. Identify terms and concepts related to the power and energy industry.

   c. Research and report on careers in the power and energy industry.

2. Evaluate the effects of power and energy on the environment.
   a. Examine energy flow through the environment.
   b. Identify pollution effects of energy production and usage.
   c. Propose a solution to an energy problem in your geographical area.

Unit 8: Robotics Simulation

1. Demonstrate understanding of robotics in industry.
   a. Examine the use of robots in industry.
   b. Report how robotics has changed and improved productivity in the workplace.
2. Simulate robotics programming.
   a. Research how robots are programmed to perform tasks.
   b. Using robotics simulation software, program a virtual robot to perform tasks.

Unit 9: Financial and Economic Literacy

1. Understand financial literacy and services.
   a. Define financial literacy.
   b. Recognize the role of financial services providers in achieving financial goals.
2. Demonstrate an understanding of the purpose and importance of credit.
   a. Identify sources of credit.
   b. Compare types of credit.
   c. Compute cost of using and extending credit.
3. Recognize the role of major financial decisions in personal financial literacy.
   a. Summarize the use of a budget to make personal economic decisions and plan for the future.
   b. Compare and contrast different incomes in careers depending on supply and demand of skills and education levels.
   c. Research the different roles in the economy such as producers, consumers, savers, workers, and investors.
   d. Examine the tools that can be used to manage financial resources.
   e. Examine consequences of economic choices made by individuals.

Unit 10: Workplace Skills: School to Careers III

1. Demonstrate proper workplace skills.
   a. Describe traits of a quality employee, including integrity, loyalty, responsibility, and so forth.
   b. Prepare a project management methodology, and use it consistently.

2. Provide essential documents and skills required for entering the workforce.
   a. Prepare a resume containing essential information.
   b. Describe and demonstrate the procedures for a job interview.
   c. Prepare and finalize electronic portfolio to include all relevant materials.

Appendix A: 21st Century Skills Standards

CSS1-21st Century Themes

CS1 Global Awareness

10. Using 21st century skills to understand and address global issues
11. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
12. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business and Entrepreneurial Literacy

10. Knowing how to make appropriate personal economic choices
11. Understanding the role of the economy in society
12. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

10. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
11. Exercising the rights and obligations of citizenship at local, state, national, and global levels
12. Understanding the local and global implications of civic decisions

CS4 Health Literacy

16. Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health
17. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
18. Using available information to make appropriate health-related decisions
19. Establishing and monitoring personal and family health goals
20. Understanding national and international public health and safety issues

CS5 Environmental Literacy

13. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems
14. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.)
15. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions
16. Take individual and collective action towards addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues)

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

10. Think creatively
11. Work creatively with others

12. Implement innovations

CS7 Critical Thinking and Problem Solving

13. Reason effectively
14. Use systems thinking
15. Make judgments and decisions
16. Solve problems

CS8 Communication and Collaboration

7. Communicate clearly
8. Collaborate with others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy

7. Access and evaluate information
8. Use and manage information

CS10 Media Literacy

7. Analyze media
8. Create media products

CS11 ICT Literacy

4. Apply technology effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

7. Adapt to change
8. Be flexible

CS13 Initiative and Self-Direction

10. Manage goals and time
11. Work independently
12. Be self-directed learners

CS14 Social and Cross-Cultural Skills

7. Interact effectively with others
8. Work effectively in diverse teams

CS15 Productivity and Accountability

7. Manage projects
8. Produce results

CS16 Leadership and Responsibility

7. Guide and lead others
8. Be responsible to others

Appendix B: ACT College Readiness Standards

English

E1 Topic Development in Terms of Purpose and Focus

- Identify the basic purpose or role of a specified phrase or sentence.
- Delete a clause or sentence because it is obviously irrelevant to the essay.
- Identify the central idea or main topic of a straightforward piece of writing.
- Determine relevancy when presented with a variety of sentence-level details.
- Identify the focus of a simple essay, applying that knowledge to add a sentence that sharpens that focus or to determine if an essay has met a specified goal.
- Delete material primarily because it disturbs the flow and development of the paragraph.
- Add a sentence to accomplish a fairly straightforward purpose such as illustrating a given statement.
- Apply an awareness of the focus and purpose of a fairly involved essay to determine the rhetorical effect and suitability of an existing phrase or sentence or to determine the need to delete plausible but irrelevant material.
- Add a sentence to accomplish a subtle rhetorical purpose such as to emphasize, to add supporting detail, or to express meaning through connotation.
- Determine whether a complex essay has accomplished a specific purpose.
- Add a phrase or sentence to accomplish a complex purpose, often expressed in terms of the main focus of the essay.

E2 Organization, Unity, and Coherence

- Use conjunctive adverbs or phrases to show time relationship in simple narrative essays (e.g., *then, this time*, etc.).
- Select the most logical place to add a sentence in a paragraph.
- Use conjunctive adverbs or phrases to express straightforward logical relationships (e.g., *first, afterward, in response*).
- Decide the most logical place to add a sentence in an essay.
- Add a sentence that introduces a simple paragraph.
- Determine the need for conjunctive adverbs or phrases to create subtle logical connections between sentences (e.g., *therefore, however, in addition*).
- Rearrange the sentences in a fairly uncomplicated paragraph for the sake of logic.
- Add a sentence to introduce or conclude the essay or to provide a transition between paragraphs when the essay is fairly straightforward.
- Make sophisticated distinctions concerning the logical use of conjunctive adverbs or phrases, particularly when signaling a shift between paragraphs.
- Rearrange sentences to improve the logic and coherence of a complex paragraph.
- Add a sentence to introduce or conclude a fairly complex paragraph.
- Consider the need for introductory sentences or transitions, basing decisions on a thorough understanding of both the logic and rhetorical effect of the paragraph and essay.

E3 Word Choice in Terms of Style, Tone, Clarity, and Economy

- Revise sentences to correct awkward and confusing arrangements of sentence elements.
- Revise vague nouns and pronouns that create obvious logic problems.
- Delete obviously synonymous and wordy material in a sentence.
- Revise expressions that deviate from the style of an essay.
- Delete redundant material when information is repeated in different parts of speech (e.g., *alarmingly startled*).
- Use the word or phrase most consistent with the style and tone of a fairly straightforward essay.
- Determine the clearest and most logical conjunction to link clauses.
- Revise a phrase that is redundant in terms of the meaning and logic of the entire sentence.
- Identify and correct ambiguous pronoun references.
- Use the word or phrase most appropriate in terms of the content of the sentence and tone of the essay.
- Correct redundant material that involves sophisticated vocabulary and sounds acceptable as conversational English (e.g., *an aesthetic viewpoint* versus *the outlook of an aesthetic viewpoint*).
- Correct vague and wordy or clumsy and confusing writing containing sophisticated language.
- Delete redundant material that involves subtle concepts or that is redundant in terms of the paragraph as a whole.

E4 Sentence Structure and Formation

- Use conjunctions or punctuation to join simple clauses.
- Revise shifts in verb tense between simple clauses in a sentence or between simple adjoining sentences.
- Determine the need for punctuation and conjunctions to avoid awkward sounding sentence fragments and fused sentences.
- Decide the appropriate verb tense and voice by considering the meaning of the entire sentence.
- Recognize and correct marked disturbances of sentence flow and structure (e.g., participial phrase fragments, missing or incorrect relative pronouns, dangling or misplaced modifiers).
- Revise to avoid faulty placement of phrases and faulty coordination and subordination of clauses in sentences with subtle structural problems.
- Maintain consistent verb tense and pronoun person on the basis of the preceding clause or sentence.
- Use sentence-combining techniques, effectively avoiding problematic comma splices, run-on sentences, and sentence fragments, especially in sentences containing compound subjects or verbs.
- Maintain a consistent and logical use of verb tense and pronoun person on the basis of information in the paragraph or essay as a whole.

- Work comfortably with long sentences and complex clausal relationships within sentences, avoiding weak conjunctions between independent clauses and maintaining parallel structure between clauses.

E5 Conventions of Usage

- Solve such basic grammatical problems as how to form the past and past participle of irregular but commonly used verbs and how to form comparative and superlative adjectives.
- Solve such grammatical problems as whether to use an adverb or adjective form, how to ensure straightforward subject–verb and pronoun–antecedent agreement, and which preposition to use in simple contexts.
- Recognize and use the appropriate word in frequently confused pairs such as *there* and *their*, *past* and *passed*, and *led* and *lead*.
- Use idiomatically appropriate prepositions, especially in combination with verbs (e.g., *long for, appeal to*).
- Ensure that a verb agrees with its subject when there is some text between the two.
- Ensure that a pronoun agrees with its antecedent when the two occur in separate clauses or sentences.
- Identify the correct past and past participle forms of irregular and infrequently used verbs, and form present–perfect verbs by using *have* rather than *of*.
- Correctly use reflexive pronouns, the possessive pronouns *its* and *your*, and the relative pronouns *who* and *whom*.
- Ensure that a verb agrees with its subject in unusual situations (e.g., when the subject–verb order is inverted or when the subject is an indefinite pronoun).
- Provide idiomatically and contextually appropriate prepositions following verbs in situations involving sophisticated language or ideas.
- Ensure that a verb agrees with its subject when a phrase or clause between the two suggests a different number for the verb.

E6 Conventions of Punctuation

- Delete commas that create basic sense problems (e.g., between verb and direct object).
- Provide appropriate punctuation in straightforward situations (e.g., items in a series).
- Delete commas that disturb the sentence flow (e.g., between modifier and modified element).
- Use commas to set off simple parenthetical phrases.
- Delete unnecessary commas when an incorrect reading of the sentence suggests a pause that should be punctuated (e.g., between verb and direct object clause).
- Use punctuation to set off complex parenthetical phrases.
- Recognize and delete unnecessary commas based on a careful reading of a complicated sentence (e.g., between the elements of a compound subject or compound verb joined by *and*).
- Use apostrophes to indicate simple possessive nouns.
- Recognize inappropriate uses of colons and semicolons.

- Use commas to set off a nonessential/nonrestrictive appositive or clause.
- Deal with multiple punctuation problems (e.g., compound sentences containing unnecessary commas and phrases that may or may not be parenthetical).
- Use an apostrophe to show possession, especially with irregular plural nouns.
- Use a semicolon to indicate a relationship between closely related independent clauses.
- Use a colon to introduce an example or an elaboration.

Math

M1 Basic Operations and Applications

- Perform one-operation computation with whole numbers and decimals.
- Solve problems in one or two steps using whole numbers.
- Perform common conversions (e.g., inches to feet or hours to minutes).
- Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent.
- Solve some routine two-step arithmetic problems.
- Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average.
- Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour).
- Solve word problems containing several rates, proportions, or percentages.
- Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings).

M2 Probability, Statistics, and Data Analysis

- Calculate the average of a list of positive whole numbers.
- Perform a single computation using information from a table or chart.
- Calculate the average of a list of numbers.
- Calculate the average, given the number of data values and the sum of the data values.
- Read tables and graphs.
- Perform computations on data from tables and graphs.
- Use the relationship between the probability of an event and the probability of its complement.
- Calculate the missing data value, given the average and all data values but one.
- Translate from one representation of data to another (e.g., a bar graph to a circle graph).
- Determine the probability of a simple event.
- Exhibit knowledge of simple counting techniques.*
- Calculate the average, given the frequency counts of all the data values.
- Manipulate data from tables and graphs.
- Compute straightforward probabilities for common situations.
- Use Venn diagrams in counting.*

- Calculate or use a weighted average.
- Interpret and use information from figures, tables, and graphs.
- Apply counting techniques.
- Compute a probability when the event and/or sample space is not given or obvious.
- Distinguish between mean, median, and mode for a list of numbers.
- Analyze and draw conclusions based on information from figures, tables, and graphs.
- Exhibit knowledge of conditional and joint probability.

M3Numbers: Concepts and Properties

- Recognize equivalent fractions and fractions in lowest terms.
- Recognize one-digit factors of a number.
- Identify a digit's place value.
- Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor.
- Find and use the least common multiple.
- Order fractions.
- Work with numerical factors.
- Work with scientific notation.
- Work with squares and square roots of numbers.
- Work problems involving positive integer exponents.*
- Work with cubes and cube roots of numbers.*
- Determine when an expression is undefined.*
- Exhibit some knowledge of the complex numbers.†
- Apply number properties involving prime factorization.
- Apply number properties involving even and odd numbers and factors and multiples.
- Apply number properties involving positive and negative numbers.
- Apply rules of exponents.
- Multiply two complex numbers.†
- Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers.
- Exhibit knowledge of logarithms and geometric sequences.
- Apply properties of complex numbers.

M4Expressions, Equations, and Inequalities

- Exhibit knowledge of basic expressions (e.g., identify an expression for a total as $b + g$).
- Solve equations in the form $x + a = b$, where a and b are whole numbers or decimals.
- Substitute whole numbers for unknown quantities to evaluate expressions.
- Solve one-step equations having integer or decimal answers.
- Combine like terms (e.g., $2x + 5x$).
- Evaluate algebraic expressions by substituting integers for unknown quantities.
- Add and subtract simple algebraic expressions.
- Solve routine first-degree equations.
- Perform straightforward word-to-symbol translations.

- Multiply two binomials.*
- Solve real-world problems using first-degree equations.
- Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions).
- Identify solutions to simple quadratic equations.
- Add, subtract, and multiply polynomials.*
- Factor simple quadratics (e.g., the difference of squares and perfect square trinomials).*
- Solve first-degree inequalities that do not require reversing the inequality sign.*
- Manipulate expressions and equations.
- Write expressions, equations, and inequalities for common algebra settings.
- Solve linear inequalities that require reversing the inequality sign.
- Solve absolute value equations.
- Solve quadratic equations.
- Find solutions to systems of linear equations.
- Write expressions that require planning and/or manipulating to accurately model a situation.
- Write equations and inequalities that require planning, manipulating, and/or solving.
- Solve simple absolute value inequalities.

M5 Graphical Representations

- Identify the location of a point with a positive coordinate on the number line.
- Locate points on the number line and in the first quadrant.
- Locate points in the coordinate plane.
- Comprehend the concept of length on the number line.*
- Exhibit knowledge of slope.*
- Identify the graph of a linear inequality on the number line.*
- Determine the slope of a line from points or equations.*
- Match linear graphs with their equations.*
- Find the midpoint of a line segment.*
- Interpret and use information from graphs in the coordinate plane.
- Match number line graphs with solution sets of linear inequalities.
- Use the distance formula.
- Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point.
- Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle).†
- Match number line graphs with solution sets of simple quadratic inequalities.
- Identify characteristics of graphs based on a set of conditions or on a general equation such as y = ax2 + c.
- Solve problems integrating multiple algebraic and/or geometric concepts.
- Analyze and draw conclusions based on information from graphs in the coordinate plane.

M6 Properties of Plane Figures

- Exhibit some knowledge of the angles associated with parallel lines.
- Find the measure of an angle using properties of parallel lines.
- Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°).
- Use several angle properties to find an unknown angle measure.
- Recognize Pythagorean triples.*
- Use properties of isosceles triangles.*
- Apply properties of 30°-60°-90°, 45°-45°-90°, similar, and congruent triangles.
- Use the Pythagorean theorem.
- Draw conclusions based on a set of conditions.
- Solve multistep geometry problems that involve integrating concepts, planning, visualization, and/or making connections with other content areas.
- Use relationships among angles, arcs, and distances in a circle.

M7 Measurement

- Estimate or calculate the length of a line segment based on other lengths given on a geometric figure.
- Compute the perimeter of polygons when all side lengths are given.
- Compute the area of rectangles when whole number dimensions are given.
- Compute the area and perimeter of triangles and rectangles in simple problems.
- Use geometric formulas when all necessary information is given.
- Compute the area of triangles and rectangles when one or more additional simple steps are required.
- Compute the area and circumference of circles after identifying necessary information.
- Compute the perimeter of simple composite geometric figures with unknown side lengths.*
- Use relationships involving area, perimeter, and volume of geometric figures to compute another measure.
- Use scale factors to determine the magnitude of a size change.
- Compute the area of composite geometric figures when planning or visualization is required.

M8 Functions

- Evaluate quadratic functions, expressed in function notation, at integer values.
- Evaluate polynomial functions, expressed in function notation, at integer values.†
- Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths.†
- Evaluate composite functions at integer values.†
- Apply basic trigonometric ratios to solve right-triangle problems.†
- Write an expression for the composite of two simple functions.†
- Use trigonometric concepts and basic identities to solve problems.†
- Exhibit knowledge of unit circle trigonometry.†

- Match graphs of basic trigonometric functions with their equations.

Notes

- Students who score in the 1–12 range are most likely beginning to develop the knowledge and skills assessed in the other ranges.
- Standards followed by an asterisk (*) apply to the PLAN and ACT Mathematics tests only.
- Standards followed by a dagger (†) apply to the ACT Mathematics test only.

Reading

R1 Main Ideas and Author's Approach

- Recognize a clear intent of an author or narrator in uncomplicated literary narratives.
- Identify a clear main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Infer the main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in uncomplicated passages.
- Identify a clear main idea or purpose of any paragraph or paragraphs in uncomplicated passages.
- Infer the main idea or purpose of straightforward paragraphs in more challenging passages.
- Summarize basic events and ideas in more challenging passages.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in more challenging passages.
- Infer the main idea or purpose of more challenging passages or their paragraphs.
- Summarize events and ideas in virtually any passage.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in virtually any passage.
- Identify clear main ideas or purposes of complex passages or their paragraphs.

R2 Supporting Details

- Locate basic facts (e.g., names, dates, events) clearly stated in a passage.
- Locate simple details at the sentence and paragraph level in uncomplicated passages.
- Recognize a clear function of a part of an uncomplicated passage.
- Locate important details in uncomplicated passages.
- Make simple inferences about how details are used in passages.
- Locate important details in more challenging passages.
- Locate and interpret minor or subtly stated details in uncomplicated passages.
- Discern which details, though they may appear in different sections throughout a passage, support important points in more challenging passages.
- Locate and interpret minor or subtly stated details in more challenging passages.

- Use details from different sections of some complex informational passages to support a specific point or argument.
- Locate and interpret details in complex passages.
- Understand the function of a part of a passage when the function is subtle or complex.

R3 Sequential, Comparative, and Cause–Effect Relationships

- Determine when (e.g., first, last, before, after) or if an event occurred in uncomplicated passages.
- Recognize clear cause–effect relationships described within a single sentence in a passage.
- Identify relationships between main characters in uncomplicated literary narratives.
- Recognize clear cause–effect relationships within a single paragraph in uncomplicated literary narratives.
- Order simple sequences of events in uncomplicated literary narratives.
- Identify clear relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear cause–effect relationships in uncomplicated passages.
- Order sequences of events in uncomplicated passages.
- Understand relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear relationships between characters, ideas, and so forth in more challenging literary narratives.
- Understand implied or subtly stated cause–effect relationships in uncomplicated passages.
- Identify clear cause–effect relationships in more challenging passages.
- Order sequences of events in more challenging passages.
- Understand the dynamics between people, ideas, and so forth in more challenging passages.
- Understand implied or subtly stated cause–effect relationships in more challenging passages.
- Order sequences of events in complex passages.
- Understand the subtleties in relationships between people, ideas, and so forth in virtually any passage.
- Understand implied, subtle, or complex cause–effect relationships in virtually any passage.

R4 Meaning of Words

- Understand the implication of a familiar word or phrase and of simple descriptive language.
- Use context to understand basic figurative language.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in uncomplicated passages.
- Use context to determine the appropriate meaning of virtually any word, phrase, or statement in uncomplicated passages.

- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in more challenging passages.
- Determine the appropriate meaning of words, phrases, or statements from figurative or somewhat technical contexts.
- Determine, even when the language is richly figurative and the vocabulary is difficult, the appropriate meaning of context-dependent words, phrases, or statements in virtually any passage.

R5 Generalizations and Conclusions

- Draw simple generalizations and conclusions about the main characters in uncomplicated literary narratives.
- Draw simple generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw simple generalizations and conclusions using details that support the main points of more challenging passages.
- Draw subtle generalizations and conclusions about characters, ideas, and so forth in uncomplicated literary narratives.
- Draw generalizations and conclusions about people, ideas, and so forth in more challenging passages.
- Use information from one or more sections of a more challenging passage to draw generalizations and conclusions about people, ideas, and so forth.
- Draw complex or subtle generalizations and conclusions about people, ideas, and so forth, often by synthesizing information from different portions of the passage.
- Understand and generalize about portions of a complex literary narrative.

Science

S1 Interpretation of Data

- Select a single piece of data (numerical or non-numerical) from a simple data presentation (e.g., a table or graph with two or three variables, a food web diagram).
- Identify basic features of a table, graph, or diagram (e.g., headings, units of measurement, axis labels).
- Select two or more pieces of data from a simple data presentation.
- Understand basic scientific terminology.
- Find basic information in a brief body of text.
- Determine how the value of one variable changes as the value of another variable changes in a simple data presentation.
- Select data from a complex data presentation (e.g., a table or graph with more than three variables, a phase diagram).
- Compare or combine data from a simple data presentation (e.g., order or sum data from a table).
- Translate information into a table, graph, or diagram.

- Compare or combine data from two or more simple data presentations (e.g., categorize data from a table using a scale from another table).
- Compare or combine data from a complex data presentation.
- Interpolate between data points in a table or graph.
- Determine how the value of one variable changes as the value of another variable changes in a complex data presentation.
- Identify and/or use a simple (e.g., linear) mathematical relationship between data.
- Analyze given information when presented with new, simple information.
- Compare or combine data from a simple data presentation with data from a complex data presentation.
- Identify and/or use a complex (e.g., nonlinear) mathematical relationship between data.
- Extrapolate from data points in a table or graph.
- Compare or combine data from two or more complex data presentations.
- Analyze given information when presented with new, complex information.

S2 Scientific Investigation

- Understand the methods and tools used in a simple experiment.
- Understand the methods and tools used in a moderately complex experiment.
- Understand a simple experimental design.
- Identify a control in an experiment.
- Identify similarities and differences between experiments.
- Understand the methods and tools used in a complex experiment.
- Understand a complex experimental design.
- Predict the results of an additional trial or measurement in an experiment.
- Determine the experimental conditions that would produce specified results.
- Determine the hypothesis for an experiment.
- Identify an alternate method for testing a hypothesis.
- Understand precision and accuracy issues.
- Predict how modifying the design or methods of an experiment will affect results.
- Identify an additional trial or experiment that could be performed to enhance or evaluate experimental results.

S3 Evaluation of Models, Inferences, and Experimental Results

- Select a simple hypothesis, prediction, or conclusion that is supported by a data presentation or a model.
- Identify key issues or assumptions in a model.
- Select a simple hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a simple hypothesis or conclusion and why.
- Identify strengths and weaknesses in one or more models.
- Identify similarities and differences between models.
- Determine which model(s) is/are supported or weakened by new information.

- Select a data presentation or a model that supports or contradicts a hypothesis, prediction, or conclusion.
- Select a complex hypothesis, prediction, or conclusion that is supported by a data presentation or model.
- Determine whether new information supports or weakens a model and why.
- Use new information to make a prediction based on a model.
- Select a complex hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a complex hypothesis or conclusion and why.

Writing

W1 Expressing Judgments

- Show a little understanding of the persuasive purpose of the task, but neglect to take or to maintain a position on the issue in the prompt.
- Show limited recognition of the complexity of the issue in the prompt.
- Show a basic understanding of the persuasive purpose of the task by taking a position on the issue in the prompt but may not maintain that position.
- Show a little recognition of the complexity of the issue in the prompt by acknowledging, but only briefly describing, a counterargument to the writer's position.
- Show understanding of the persuasive purpose of the task by taking a position on the issue in the prompt.
- Show some recognition of the complexity of the issue in the prompt by doing the following:
    - Acknowledging counterarguments to the writer's position
    - Providing some response to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a broad context for discussion.
- Show recognition of the complexity of the issue in the prompt by doing the following:
    - Partially evaluating implications and/or complications of the issue
    - Posing and partially responding to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a critical context for discussion.
- Show understanding of the complexity of the issue in the prompt by doing the following:
    - Examining different perspectives
    - Evaluating implications or complications of the issue
    - Posing and fully discussing counterarguments to the writer's position

W2 Focusing on the Topic

- Maintain a focus on the general topic in the prompt through most of the essay.
- Maintain a focus on the general topic in the prompt throughout the essay.
- Maintain a focus on the general topic in the prompt throughout the essay, and attempt a focus on the specific issue in the prompt.

- Present a thesis that establishes focus on the topic.
- Maintain a focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a thesis that establishes a focus on the writer's position on the issue.
- Maintain a clear focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a critical thesis that clearly establishes the focus on the writer's position on the issue.

W3 Developing a Position

- Offer a little development, with one or two ideas; if examples are given, they are general and may not be clearly relevant; resort often to merely repeating ideas.
- Show little or no movement between general and specific ideas and examples.
- Offer limited development of ideas using a few general examples; resort sometimes to merely repeating ideas.
- Show little movement between general and specific ideas and examples.
- Develop ideas by using some specific reasons, details, and examples.
- Show some movement between general and specific ideas and examples.
- Develop most ideas fully, using some specific and relevant reasons, details, and examples.
- Show clear movement between general and specific ideas and examples.
- Develop several ideas fully, using specific and relevant reasons, details, and examples.
- Show effective movement between general and specific ideas and examples.

W4 Organizing Ideas

- Provide a discernible organization with some logical grouping of ideas in parts of the essay.
- Use a few simple and obvious transitions.
- Present a discernible, though minimally developed, introduction and conclusion.
- Provide a simple organization with logical grouping of ideas in parts of the essay.
- Use some simple and obvious transitional words, though they may at times be inappropriate or misleading.
- Present a discernible, though underdeveloped, introduction and conclusion.
- Provide an adequate but simple organization with logical grouping of ideas in parts of the essay but with little evidence of logical progression of ideas.
- Use some simple and obvious, but appropriate, transitional words and phrases.
- Present a discernible introduction and conclusion with a little development.
- Provide unity and coherence throughout the essay, sometimes with a logical progression of ideas.
- Use relevant, though at times simple and obvious, transitional words and phrases to convey logical relationships between ideas.
- Present a somewhat developed introduction and conclusion.

- Provide unity and coherence throughout the essay, often with a logical progression of ideas.
- Use relevant transitional words, phrases, and sentences to convey logical relationships between ideas.
- Present a well-developed introduction and conclusion.

W5 Using Language

- Show limited control of language by doing the following:
    - Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes significantly impede understanding
    - Using simple vocabulary
    - Using simple sentence structure
    - Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes impede understanding
    - Using simple but appropriate vocabulary
    - Using a little sentence variety, though most sentences are simple in structure
    - Correctly employing many of the conventions of standard English grammar, usage, and mechanics but with some distracting errors that may occasionally impede understanding
    - Using appropriate vocabulary
    - Using some varied kinds of sentence structures to vary pace
    - Correctly employing most conventions of standard English grammar, usage, and mechanics with a few distracting errors but none that impede understanding
    - Using some precise and varied vocabulary
    - Using several kinds of sentence structures to vary pace and to support meaning
    - Correctly employing most conventions of standard English grammar, usage, and mechanics with just a few, if any, errors
    - Using precise and varied vocabulary
    - Using a variety of kinds of sentence structures to vary pace and to support meaning

Appendix C: National Educational Technology Standards for Students

T1 Creativity and Innovation
T2 Communication and Collaboration
T3 Research and Information Fluency
T4 Critical Thinking, Problem Solving, and Decision Making
T5 Digital Citizenship
T6 Technology Operations and Concepts

T1 Creativity and Innovation

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students do the following:

a. Apply existing knowledge to generate new ideas, products, or processes.
b. Create original works as a means of personal or group expression.
c. Use models and simulations to explore complex systems and issues.
d. Identify trends and forecast possibilities.

T2 Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students do the following:

a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
c. Develop cultural understanding and global awareness by engaging with learners of other cultures.
d. Contribute to project teams to produce original works or solve problems.

T3 Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information. Students do the following:

a. Plan strategies to guide inquiry.
b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
d. Process data and report results.

T4 Critical Thinking, Problem Solving, and Decision Making

Students use critical-thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students do the following:

a. Identify and define authentic problems and significant questions for investigation.

b. Plan and manage activities to develop a solution or complete a project.
c. Collect and analyze data to identify solutions and/or make informed decisions.
d. Use multiple processes and diverse perspectives to explore alternative solutions.

T5 Digital Citizenship

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students do the following:

a. Advocate and practice safe, legal, and responsible use of information and technology.
b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.
c. Demonstrate personal responsibility for lifelong learning.
d. Exhibit leadership for digital citizenship.

T6 Technology Operations and Concepts

Students demonstrate a sound understanding of technology concepts, systems, and operations. Students do the following:

a. Understand and use technology systems.
b. Select and use applications effectively and productively.
c. Troubleshoot systems and applications.
d. Transfer current knowledge to learning of new technologies.