

2005 Mississippi Curriculum Framework

Adult Short-Term Magnetic Resonance Imaging

(Program CIP: 51.0911 – Medical Radiologic Technology)

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American Society of Radiologic Technologists

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Workplace Skills for the 21st Century

Secretary's Commission on Achieving Necessary Skills

ISTE National Educational Technology Standards for Students

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Program Description

This Adult Short-Term program for Magnetic Resonance Imaging (MRI) consists of two courses and is designed to offer radiographers or student radiographers entry-level knowledge, skills, and competencies necessary for the practice of Magnetic Resonance Imaging. This program provides instruction in patient care and safety, imaging procedures, data acquisition and processing, and physics and instrumentation. This program may be taken as partial preparation for credentialing by the American Registry of Radiologic Technologists (ARRT) or be used as continuing education credits for radiographers.

The curriculum was written to follow the ARRT Magnetic Resonance Imaging Clinical Experience Requirements General Guidelines. Standards are based on ARRT Content Specifications for the Examination in Magnetic Resonance Imaging. This program was written to correspond with appropriate sections of the American Society of Radiologic Technologists (ASRT) Magnetic Resonance Curriculum.

Suggested Course Sequence*
Adult Short-Term
Magnetic Resonance Imaging

- 3 sch Magnetic Resonance Imaging (MRI 2113)
- 4 sch Magnetic Resonance Imaging Clinical (MRI 2124)

* Students who lack entry level skills in math, English, science, etc. will be provided related studies.

Magnetic Resonance Imaging Courses

Course Name: Magnetic Resonance Imaging

Course Abbreviation: MRI 2113

Classification: Adult Short-Term

Description: This course provides a basic foundation of Magnetic Resonance Imaging (MRI). The physical and technical principles, imaging sequences, image artifacts, clinical applications, system components, and safety issues will be discussed. Images of sectional anatomy related to MRI will also be explored. (3 sch: 3 hr. lecture)

Prerequisite: Sectional Anatomy (CSA 2113)

Competencies and Suggested Objectives
1. Describe preparation, assessment, and monitoring of the patient for a MRI procedure. <ol style="list-style-type: none"> a. Describe screening and consent procedures. b. Explain patient education. c. Discuss immobilization techniques. d. Summarize assessment and monitoring techniques, to include history, vital signs, and medications.
2. Discuss safety and patient care considerations for MRI exams. <ol style="list-style-type: none"> a. Incorporate safety considerations when working in the MRI department. b. Describe patient care considerations for MRI exams.
3. Describe biological considerations for MRI procedures. <ol style="list-style-type: none"> a. Discuss radio frequency guidelines and effects. b. Discuss static field guidelines and effects. c. Discuss gradient field guidelines and effects.
4. Identify correct acquisition methods and protocols for MRI examination of each of the anatomical regions of the body, to include modifications for pathology, trauma, and special procedures. <ol style="list-style-type: none"> a. Identify correct acquisition methods and protocols for MRI examination of the head and neck. b. Identify correct acquisition methods and protocols for MRI examination of the spine. c. Identify correct acquisition methods and protocols for MRI examination of the thorax. d. Identify correct acquisition methods and protocols for MRI examination of the abdomen. e. Identify correct acquisition methods and protocols for MRI examination of the pelvis. f. Identify correct acquisition methods and protocols for MRI examination of the musculoskeletal system.
5. Discuss data acquisition and image processing. <ol style="list-style-type: none"> a. Describe methods of pulse sequencing. b. Explain processes in data manipulation. c. Discuss special procedures. d. Explain how parameters and options affect image quality and contrast.

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| 6. Discuss physical principles of image formation. <ol style="list-style-type: none"> Describe the instrumentation used for MRI imaging. Discuss the fundamental physical principles of image formation. Explain causes, appearances, and methods of compensation for artifacts. Discuss quality control measures for MRI imaging. |
| 7. Compare normal and abnormal structures in each of the anatomical regions of the body. <ol style="list-style-type: none"> Compare normal and abnormal structures of the head and brain. Compare normal and abnormal structures of the neck. Compare normal and abnormal structures of the chest and mediastinum. Compare normal and abnormal structures of the abdomen. Compare normal and abnormal structures of the pelvis. Compare normal and abnormal structures of the musculoskeletal system and spine. |

STANDARDS

Standards Based on the ARRT Content Specifications

- MRI1 The student will be competent in patient care.
- MRI2 The student will be competent in imaging procedures.
- MRI3 The student will be competent in data acquisition and processing.
- MRI4 The student will be competent in physical principles of image formation.

Related Academic Standards

- C1 Interpret written material.
- C2 Interpret visual materials (maps, charts, graphs, tables, etc.).
- C3 Listen, comprehend, and take appropriate actions.
- C4 Access, organize, and evaluate information.
- C5 Use written and/or oral language skills to work cooperatively to solve problems, make decisions, take actions, and reach agreement.
- C6 Communicate ideas and information effectively using various oral and written forms for a variety of audiences and purposes.
- M1 Relate number relationships, number systems, and number theory.
- M3 Explore algebraic concepts and processes.
- M4 Explore the concepts of measurement.
- M5 Explore the geometry of one-, two-, and three-dimensions.
- M7 Apply mathematical methods, concepts, and properties to solve a variety of real-world problems.
- S1 Explain the Anatomy and Physiology of the human body.
- S5 Investigate the properties and reactions of matter to include symbols, formulas and nomenclature, chemical equations, gas laws, chemical bonding, acid-base reactions, equilibrium, oxidation-reduction, nuclear chemistry, and organic chemistry.
- S6 Explore the principles and theories related to motion, mechanics, electricity, magnetism, light energy, thermal energy, wave energy, and nuclear physics.

- S8 Apply concepts related to the scientific process and method to include safety procedures for classroom and laboratory; use and care of scientific equipment; interrelationships between science, technology and society; and effective communication of scientific results in oral, written, and graphic form.

Workplace Skills for the 21st Century

- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

- T1 Basic operations and concepts
- T2 Social, ethical, and human issues
- T3 Technology productivity tools
- T4 Technology communications tools
- T5 Technology research tools
- T6 Technology problem-solving and decision-making tools

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Course Name: Magnetic Resonance Imaging Clinical

Course Abbreviation: MRI 2124

Classification: Adult Short-Term

Description: This course is designed to offer the radiographer or student radiographer instruction and clinical experience in Magnetic Resonance Imaging (MRI). The student will provide patient care, protection, and MRI safety; and perform imaging procedures, data acquisition, image post-processing, and evaluation. Students should be knowledgeable in sectional anatomy. Additional competencies beyond this course are required for students seeking ARRT certification. (4 sch: 12 hr. clinical)

Pre/Corequisite: Magnetic Resonance Imaging (MRI 2113)

Competencies and Suggested Objectives	
1. Demonstrate proper patient care, assessment, and safety precautions.	<ul style="list-style-type: none"> a. Evaluate requisition and/or medical records. b. Verify identification of patient. c. Perform patient care, assessment, and safety screening. d. Provide education for the patient concerning the procedure. e. Document patient history (including allergies), procedures performed, treatment, and data. f. Adhere to universal precautions. g. Provide post-procedural patient instructions. h. Employ MRI safety procedures and precautions as recommended by FDA guidelines.
2. Prepare for procedure.	<ul style="list-style-type: none"> a. Prepare the scan room for a scheduled procedure. b. Prepare and position the patient for the procedure. c. Select optimal imaging coil. d. Prepare and administer contrast media if required for the procedure.
3. Demonstrate system operation and scanning.	<ul style="list-style-type: none"> a. Perform system start-up procedures. b. Perform standard and emergency system shutdown procedures. c. Perform quality assurance procedures. d. Enter patient data. e. Select the correct protocol, parameters, and options for the procedure on the operator's console. f. Perform the selected procedure.
4. Perform image processing and post-processing activities.	<ul style="list-style-type: none"> a. Select images for viewing. b. Perform image reconstruction. c. Modify image display for maximum visibility of structures. d. Film, archive, and transmit images as appropriate.

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| <p>5. Evaluate images for patient identification, proper anatomic display, completeness, and diagnostic quality.</p> <ol style="list-style-type: none"> Assure proper identification and patient data. Assure optimal demonstration of structures. Evaluate image quality. Assess image for presence of artifacts. Identify normal and abnormal anatomy on images. |
| <p>6. Perform MRI clinical competencies.</p> <ol style="list-style-type: none"> Perform 3 head MRI clinical competencies. Perform 2 spine MRI clinical competencies. Perform 3 musculoskeletal MRI clinical competencies (must be different regions of the musculoskeletal system). Perform 2 MRI clinical competencies from the following: abdomen, thorax, pelvis, neck, and special. |

STANDARDS

Standards Based on the ARRT Content Specifications

- MRI1 The student will be competent in patient care.
- MRI2 The student will be competent in imaging procedures.
- MRI3 The student will be competent in data acquisition and processing.
- MRI4 The student will be competent in physical principles of image formation.

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- C4 Access, organize, and evaluate information.
- C5 Use written and/or oral language skills to work cooperatively to solve problems, make decisions, take actions, and reach agreement.
- C6 Communicate ideas and information effectively using various oral and written forms for a variety of audiences and purposes.
- M4 Explore the concepts of measurement.
- M5 Explore the geometry of one-, two-, and three-dimensions.
- M6 Explore concepts of statistics and probability in real world situations.
- M7 Apply mathematical methods, concepts, and properties to solve a variety of real-world problems.
- S1 Explain the Anatomy and Physiology of the human body.
- S8 Apply concepts related to the scientific process and method to include safety procedures for classroom and laboratory; use and care of scientific equipment; interrelationships between science, technology and society; and effective communication of scientific results in oral, written, and graphic form.

Workplace Skills for the 21st Century

- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

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- T1 Basic operations and concepts
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Recommended Tools and Equipment

CAPITALIZED ITEMS

1. Human cross-sectional model

NON-CAPITALIZED ITEMS

1. Viewbox (4 bank)

INSTRUCTIONAL AIDS

1. Computer
2. LCD projector
3. VCR
4. Television
5. Magnetic Resonance Imaging System (energized)
6. Quality assurance and/or imaging phantoms

Student Competency Profile for Magnetic Resonance Imaging

Student: _____

This record is intended to serve as a method of noting student achievement of the competencies in each course. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Magnetic Resonance Imaging (MRI 2113)

- _____ 1. Describe preparation, assessment, and monitoring of the patient for a MRI procedure.
- _____ 2. Discuss safety and patient care considerations for MRI exams.
- _____ 3. Describe biological considerations for MRI procedures.
- _____ 4. Identify correct acquisition methods and protocols for MRI examination of each of the anatomical regions of the body, to include modifications for pathology, trauma, and special procedures.
- _____ 5. Discuss data acquisition and image processing.
- _____ 6. Discuss physical principles of image formation.
- _____ 7. Compare normal and abnormal structures in each of the anatomical regions of the body.

Magnetic Resonance Imaging Clinical (MRI 2124)

- _____ 1. Demonstrate proper patient care, assessment, and safety precautions.
- _____ 2. Prepare for procedure.
- _____ 3. Demonstrate system operation and scanning.
- _____ 4. Perform image processing and post-processing activities.
- _____ 5. Evaluate images for patient identification, proper anatomic display, completeness, and diagnostic quality.
- _____ 6. Perform MRI clinical competencies.

Appendix A: Standards Based on the American Registry of Radiologic Technologists (ARRT) Content Specifications¹

- MRI1 The student will be competent in patient care.
- MRI2 The student will be competent in imaging procedures.
- MRI3 The student will be competent in data acquisition and processing.
- MRI4 The student will be competent in physical principles of image formation.

¹ The American Registry of Radiologic Technologists. (2002). *Content specifications for the examination in magnetic resonance imaging*. St. Paul, MN: Author.

Appendix B: Related Academic Standards

RELATED ACADEMIC TOPICS FOR COMMUNICATIONS

- C1 Interpret written material.
- C2 Interpret visual materials (maps, charts, graphs, tables, etc.).
- C3 Listen, comprehend, and take appropriate actions.
- C4 Access, organize, and evaluate information.
- C5 Use written and/or oral language skills to work cooperatively to solve problems, make decisions, take actions, and reach agreement.
- C6 Communicate ideas and information effectively using various oral and written forms for a variety of audiences and purposes.

EXPANDED TOPICS FOR COMMUNICATIONS

TOPIC C1: Interpret written material.

- C1.01 Read and follow complex written directions.
- C1.02 Recognize common words and meanings associated with a variety of occupations.
- C1.03 Adjust reading strategy to purpose and type of reading.
- C1.04 Use sections of books and reference sources to obtain information.
- C1.05 Compare information from multiple sources and check validity.
- C1.06 Interpret items and abbreviations used in multiple forms.
- C1.07 Interpret short notes, memos, and letters.
- C1.08 Comprehend technical words and concepts.
- C1.09 Use various reading techniques depending on purpose for reading.
- C1.10 Find, read, understand, and use information from printed matter or electronic sources.

TOPIC C2: Interpret visual materials (maps, charts, graphs, tables, etc.).

- C2.01 Use visuals in written and in oral presentations.
- C2.02 Recognize visual cues to meaning (layout, typography, etc.).
- C2.03 Interpret and apply information using visual materials.

TOPIC C3: Listen, comprehend, and take appropriate action.

- C3.01 Identify and evaluate orally-presented messages according to purpose.
- C3.02 Recognize barriers to effective listening.
- C3.03 Recognize how voice inflection changes meaning.
- C3.04 Identify speaker signals requiring a response and respond accordingly.
- C3.05 Listen attentively and take accurate notes.
- C3.06 Use telephone to receive information.
- C3.07 Analyze and distinguish information from formal and informal oral presentations.

- TOPIC C4: Access, organize, and evaluate information.
- C4.01 Distinguish fact from opinion.
 - C4.02 Use various print and non-print sources for specialized information.
 - C4.03 Interpret and distinguish between literal and figurative meaning.
 - C4.04 Interpret written or oral communication in relation to context and writer's point of view.
 - C4.05 Use relevant sources to gather information for written or oral communication.
- TOPIC C5: Use written and/or oral language skills to work cooperatively to solve problems, make decisions, take actions, and reach agreement.
- C5.01 Select appropriate words for communication needs.
 - C5.02 Use reading, writing, listening, and speaking skills to solve problems.
 - C5.03 Compose inquiries and requests.
 - C5.04 Write persuasive letters and memos.
 - C5.05 Edit written reports, letters, memos, and short notes for clarity, correct grammar, and effective sentences.
 - C5.06 Write logical and understandable statements, phrases, or sentences for filling out forms, for correspondence or reports.
 - C5.07 Write directions or summaries of processes, mechanisms, events, or concepts.
 - C5.08 Select and use appropriate formats for presenting reports.
 - C5.09 Convey information to audiences in writing.
 - C5.10 Compose technical reports and correspondence that meet accepted standards for written communications.
- TOPIC C6: Communicate ideas and information using oral and written forms for a variety of audiences and purposes.
- C6.01 Give complex oral instructions.
 - C6.02 Describe a business or industrial process/mechanism.
 - C6.03 Participate effectively in group discussions and decision making.
 - C6.04 Produce effective oral messages utilizing different media.
 - C6.05 Explore ideas orally with partners.
 - C6.06 Participate in conversations by volunteering information when appropriate and asking relevant questions when appropriate.
 - C6.07 Restate or paraphrase a conversation to confirm one's own understanding.
 - C6.08 Gather and provide information utilizing different media.
 - C6.09 Prepare and deliver persuasive, descriptive, and demonstrative oral presentations.

RELATED ACADEMIC TOPICS FOR MATHEMATICS

- M1 Relate number relationships, number systems, and number theory.
- M2 Explore patterns and functions.
- M3 Explore algebraic concepts and processes.

- M4 Explore the concepts of measurement.
- M5 Explore the geometry of one-, two-, and three-dimensions.
- M6 Explore concepts of statistics and probability in real world situations.
- M7 Apply mathematical methods, concepts, and properties to solve a variety of real-world problems.

EXPANDED TOPICS FOR MATHEMATICS

TOPIC M1: Relate number relationships, number systems, and number theory.

- M1.01 Understand, represent, and use numbers in a variety of equivalent forms (integer, fraction, decimal, percent, exponential, and scientific notation) in real world and mathematical problem situations.
- M1.02 Develop number sense for whole numbers, fractions, decimals, integers, and rational numbers.
- M1.03 Understand and apply ratios, proportions, and percents in a wide variety of situations.
- M1.04 Investigate relationships among fractions, decimals, and percents.
- M1.05 Compute with whole numbers, fractions, decimals, integers, and rational numbers.
- M1.06 Develop, analyze, and explain procedures for computation and techniques for estimations.
- M1.07 Select and use an appropriate method for computing from among mental arithmetic, paper-and-pencil, calculator, and computer methods.
- M1.08 Use computation, estimation, and proportions to solve problems.
- M1.09 Use estimation to check the reasonableness of results.

TOPIC M2: Explore patterns and functions.

- M2.01 Describe, extend, analyze, and create a wide variety of patterns.
- M2.02 Describe and represent relationships with tables, graphs, and rules.
- M2.03 Analyze functional relationships to explain how a change in one quantity results in a change in another.
- M2.04 Use patterns and functions to represent and solve problems.
- M2.05 Explore problems and describe results using graphical, numerical, physical, algebraic, and verbal mathematical models or representations.
- M2.06 Use a mathematical idea to further their understanding of other mathematical ideas.
- M2.07 Apply mathematical thinking and modeling to solve problems that arise in other disciplines, such as art, music, and business.

TOPIC M3: Explore algebraic concepts and processes.

- M3.01 Represent situations and explore the interrelationships of number patterns with tables, graphs, verbal rules, and equations.
- M3.02 Analyze tables and graphs to identify properties and relationships and to interpret expressions and equations.

- M3.03 Apply algebraic methods to solve a variety of real world and mathematical problems.
- TOPIC M4: Explore the concepts of measurement.
- M4.01 Estimate, make, and use measurements to describe and compare phenomena.
M4.02 Select appropriate units and tools to measure to the degree of accuracy required in a particular situation.
M4.03 Extend understanding of the concepts of perimeter, area, volume, angle measure, capacity, and weight and mass.
M4.04 Understand and apply reasoning processes, with special attention to spatial reasoning and reasoning with proportions and graphs.
- TOPIC M5: Explore the geometry of one-, two-, and three-dimensions.
- M5.01 Identify, describe, compare, and classify geometric figures.
M5.02 Visualize and represent geometric figures with special attention to developing spatial sense.
M5.03 Explore transformations of geometric figures.
M5.04 Understand and apply geometric properties and relationships.
M5.05 Classify figures in terms of congruence and similarity and apply these relationships.
- TOPIC M6: Explore the concepts of statistics and probability in real world situations.
- M6.01 Systematically collect, organize, and describe data.
M6.02 Construct, read, and interpret tables, charts, and graphs.
M6.03 Develop an appreciation for statistical methods as powerful means for decision making.
M6.04 Make predictions that are based on exponential or theoretical probabilities.
M6.05 Develop an appreciation for the pervasive use of probability in the real world.
- TOPIC M7: Apply mathematical methods, concepts, and properties to solve a variety of real-world problems.
- M7.01 Use computers and/or calculators to process information for all mathematical situations.
M7.02 Use problem-solving approaches to investigate and understand mathematical content.
M7.03 Formulate problems from situations within and outside mathematics.
M7.04 Generalize solutions and strategies to new problem situations.

RELATED ACADEMIC TOPICS FOR SCIENCE

- S1 Explain the Anatomy and Physiology of the human body.

- S2 Apply the basic biological principles of Plants, Viruses and Monerans, Algae, Protista, and Fungi.
- S3 Relate the nine major phyla of the kingdom animalia according to morphology, anatomy, and physiology.
- S4 Explore the chemical and physical properties of the earth to include Geology, Meteorology, Oceanography, and the Hydrologic Cycle.
- S5 Investigate the properties and reactions of matter to include symbols, formulas and nomenclature, chemical equations, gas laws, chemical bonding, acid-base reactions, equilibrium, oxidation-reduction, nuclear chemistry, and organic chemistry.
- S6 Explore the principles and theories related to motion, mechanics, electricity, magnetism, light energy, thermal energy, wave energy, and nuclear physics.
- S7 Explore the principles of genetic and molecular Biology to include the relationship between traits and patterns of inheritance, population genetics, the structure and function of DNA, and current applications of DNA technology.
- S8 Apply concepts related to the scientific process and method to include safety procedures for classroom and laboratory; use and care of scientific equipment; interrelationships between science, technology and society; and effective communication of scientific results in oral, written, and graphic form.

EXPANDED TOPICS FOR SCIENCE

TOPIC S1: Explain the Anatomy and Physiology of the human body.

- S1.01 Recognize common terminology and meanings.
- S1.02 Explore the relationship of the cell to more complex systems within the body.
- S1.03 Summarize the functional anatomy of all the major body systems.
- S1.04 Relate the physiology of the major body systems to its corresponding anatomy.
- S1.05 Compare and contrast disease transmission and treatment within each organ system.
- S1.06 Explore the usage of medical technology as related to human organs and organ systems.
- S1.07 Explain the chemical composition of body tissue.

TOPIC S2: Apply the basic biological principles of Plants, Viruses and Monerans, Algae, Protista, and Fungi.

- S2.01 Identify the major types and structures of plants, viruses, monera, algae protista, and fungi.
- S2.02 Explain sexual and asexual reproduction.
- S2.03 Describe the ecological importance of plants as related to the environment.
- S2.04 Analyze the physical chemical and behavioral process of a plant.

TOPIC S3: Relate the nine major phyla of the kingdom animalia according to morphology, anatomy, and physiology.

- S3.01 Explain the morphology, anatomy, and physiology of animals.
- S3.02 Describe the characteristics, behaviors, and habitats of selected animals.
- TOPIC S4: Explore the chemical and physical properties of the earth to include Geology, Meteorology, Oceanography, and the Hydrologic Cycle.
- S4.01 Examine minerals and their identification, products of the rock cycle, byproducts of weathering, and the effects of erosion.
- S4.02 Relate the Hydrologic Cycle to include groundwater its zones, movement, and composition; surface water systems, deposits, and runoff.
- S4.03 Consider the effects of weather and climate on the environment.
- S4.04 Examine the composition of seawater; wave, tides, and currents; organisms, environment, and production of food; energy, food and mineral resources of the oceans.
- TOPIC S5: Investigate the properties and reactions of matter to include symbols, formulas and nomenclature, chemical equations, gas laws, chemical bonding, acid-base reactions, equilibrium, oxidation-reduction, nuclear chemistry, and organic chemistry.
- S5.01 Examine the science of chemistry to include the nature of matter, symbols, formulas and nomenclature, and chemical equations.
- S5.02 Identify chemical reactions including precipitation, acids-bases, and reduction-oxidation.
- S5.03 Explore the fundamentals of chemical bonding and principles of equilibrium.
- S5.04 Relate the behavior of gases.
- S5.05 Investigate the structure, reactions, and uses of organic compounds; and investigate nuclear chemistry and radiochemistry.
- TOPIC S6: Explore the principles and theories related to motion, mechanics, electricity, magnetism, light energy, thermal energy, wave energy, and nuclear physics.
- S6.01 Examine fundamentals of motion of physical bodies and physical dynamics.
- S6.02 Explore the concepts and relationships among work, power, and energy.
- S6.03 Explore principles, characteristics, and properties of electricity, magnetism, light energy, thermal energy, and wave energy.
- S6.04 Identify principles of modern physics related to nuclear physics.
- TOPIC S7: Explore the principles of genetic and molecular Biology to include the relationship between traits and patterns of inheritance; population genetics, the structure and function of DNA, and current applications of DNA technology.
- S7.01 Examine principles, techniques, and patterns of traits and inheritance in organisms.
- S7.02 Apply the concept of population genetics to both microbial and multicellular organism.

S7.03 Identify the structure and function of DNA and the uses of DNA technology in science, industry, and society.

TOPIC S8: Apply concepts related to the scientific process and method to include safety procedures for classroom and laboratory; use and care of scientific equipment; interrelationships between science, technology and society; and effective communication of scientific results in oral, written, and graphic form.

S8.01 Apply the components of scientific processes and methods in classroom and laboratory investigations.

S8.02 Observe and practice safe procedures in the classroom and laboratory.

S8.03 Demonstrate proper use and care for scientific equipment.

S8.04 Investigate science careers, and advances in technology.

S8.05 Communicate results of scientific investigations in oral, written, and graphic form.

Appendix C: Workplace Skills for the 21st Century²

- WP1 Allocates resources (time, money, materials and facilities, and human resources).
- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

² Secretary's commission on achieving necessary skills. (1991). Retrieved July 13, 2004, from <http://wdr.doleta.gov/SCANS/>

Appendix D: National Educational Technology Standards for Students³

- T1 Basic operations and concepts
- Students demonstrate a sound understanding of the nature and operation of technology systems.
 - Students are proficient in the use of technology.
- T2 Social, ethical, and human issues
- Students understand the ethical, cultural, and societal issues related to technology.
 - Students practice responsible use of technology systems, information, and software.
 - Students develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.
- T3 Technology productivity tools
- Students use technology tools to enhance learning, increase productivity, and promote creativity.
 - Students use productivity tools to collaborate in constructing technology-enhanced models, prepare publications, and produce other creative works.
- T4 Technology communications tools
- Students use telecommunications to collaborate, publish, and interact with peers, experts, and other audiences.
 - Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.
- T5 Technology research tools
- Students use technology to locate, evaluate, and collect information from a variety of sources.
 - Students use technology tools to process data and report results.
 - Students evaluate and select new information resources and technological innovations based on the appropriateness for specific tasks.
- T6 Technology problem-solving and decision-making tools
- Students use technology resources for solving problems and making informed decisions.
 - Students employ technology in the development of strategies for solving problems in the real world.

³ *ISTE: National educational technology standards (NETS)*. (2000). Retrieved July 13, 2004, from <http://cnets.iste.org/>