GRADE EIGHT

Goal

Eighth grade science builds on the concepts and skills acquired in kindergarten through seventh grade. Instructional design should provide opportunities for understanding: the unifying concepts of science, the strands, conceptual goals and objectives. Connections to mathematics, technology, social science, and communication skills should be considered for instructional design. To assist teachers with instruction, materials explaining Unifying Concepts, Strands, Goals and Objectives with specific recommendations for classroom, laboratory, and/or field experiences are available through the Department of Public Instruction.

It is important that the nature of the adolescent be at the core of all curricula. Middle school students are undergoing extensive psychological, physiological, and social changes, which make them curious, energetic, and egocentric. Middle school science provides opportunities to channel the interests and concerns of adolescents, provided it maximizes their exposure to high interest topics. Middle school learners need to see a direct relationship between science education and daily life. Investigations designed to help students learn about themselves and their world motivate them.

Designing technological solutions and pondering benefits and risks should be an integral part of the middle school science experience. As students take the initiative to learn science and technology, they will learn about themselves, their community and potential career paths. The confidence to pursue such personal goals can be instilled through successful science experience.

Nature of Science

Science is a human endeavor that relies on reasoning, insight, skill, and creativity. A parallel reliance on scientific habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas is crucial to the advancement of science and technology. Science would be a stagnant body of knowledge, were it not for humans continually seeking to understand and explain the natural world and their role in it. Capitalizing on the continuous public review of science and technology, middle

school students should understand that the very nature of science is for some ideas to be constant yet tentative, probabilistic, historic, and replicable.

Many of science's universal laws are very old ideas that still apply today. In addition, using history to trace the technology evolution that led us from an agricultural to an industrial to an information and communication-based society exemplifies the nature of science. Public acceptance of modified or new ideas exemplifies the struggle of scientists who attempt to advance scientific knowledge or make breakthroughs. The learner should appreciate the efforts of past scientists that have given rise to modern science and technology.

A solid conceptual base of scientific principles, as well as knowledge of science safety, is necessary for inquiry. Students should be given a supportive learning environment based on how scientists and engineers work. Adherence to all science safety criteria and guidelines for classroom, field, and laboratory experiences is imperative. Contact the Science Section at DPI for information and professional development opportunities regarding North Carolina specific Science Safety laws, codes, and standards. The Science Section is spearheading a statewide initiative entitled *NC-The Total Science Safety System.*

Science as Inquiry

Traditional laboratory experiences provide opportunities to demonstrate how science is constant, historic, probabilistic, and replicable. Although there are no fixed steps that all scientists follow, scientific investigations usually involve collections of relevant evidence, the use of logical reasoning, the application of imagination to devise hypotheses, and explanations to make sense of collected evidence. Student engagement in scientific investigation provides background for understanding the nature of scientific inquiry. In addition, the science process skills necessary for inquiry are acquired through active experience. The process skills support development of reasoning and problem-solving ability and are the core of scientific methodologies. Students should:

- Structure questions that can be answered through scientific investigations.
- Clarify ideas that guide and influence the inquiry.

- Design and conduct scientific investigations to test ideas.
- Apply safe and appropriate abilities to manipulate materials, equipment, and technologies.
- Control and manipulate variables.
- Use appropriate resources and tools to gather, analyze, interpret, and communicate data.
- Use mathematics to gather, organize, and present data.
- Make inferences from data.
- Use evidence to offer descriptions, predictions and models.
- Think critically and logically to bridge the relationships between evidence and explanations.
- Recognize and evaluate alternative explanations.
- Review experimental procedures.
- Communicate scientific procedures, results, and explanations.
- Formulate questions leading to further investigations.

Science and Technology

Science is the foundation of technology and new technology is necessary for the advancement of science. This reciprocity of science and technology should be emphasized with middle school learners. Current media topics, emerging technologies, and research issues provide a real-world context for understanding and applying targeted grade-level skills and concepts.

A single problem often has both scientific and technological aspects. For example, investigating the salinity of the water in North Carolina's sounds is the pursuit of science, while creating a way to make this salt water drinkable is the pursuit of technology. In other words, while science tries to understand the natural world, technology tries to solve practical problems. Technology expands our capacity to understand the world and to control the natural and human-made environment. Technology asks questions like "How does this work?" and "How can it be improved?"

The word "technology" has many definitions. It may, for example, mean a particular way of doing things, or it may denote a specific object. Stephen Kiln, Professor of Mechanical Engineering at Stanford University has four definitions of technology (Kiln, 1985):

- artifact or hardware. (e.g., an aspirin, chair, computer, or video tape)
- methodology or technique. (e.g., painting, using a microscope or calculator)
- system of production. (e.g., the automobile assembly line, a process for manufacturing a product or an entire industry)
- social-technical system. (an airplane, for example, suggests a plethora of interrelated devices, human resources, and artifacts such as airports, passengers and pilots, fuel, regulations and ticketing).

Technology provides tools for understanding natural phenomena and often sparks scientific advances. It has always played a role in the growth of scientific knowledge. The techniques for shaping, producing or manufacturing tools, for example, are seen as the primary evidence of the beginning of human culture. Applying scientific knowledge of materials and processes to the benefit of people has been a determining factor in shaping our culture.

While understanding the connection of science and technology is critical, the ability to distinguish between the work of engineers and scientists also should be explored. Scientists propose explanations for questions about the natural world, and engineers propose solutions relating to human problems, needs, and aspirations. Technology design skills are parallel to inquiry skills in science. It is critical that students understand that technology enables us to design adaptations to the natural world but not without both positive and negative consequences. The limits on science's ability to answer all questions, and on technology's ability to design solutions for all adaptive problems, also must be stressed. Design requires that technological solutions adhere to the universal laws of nature. Constraints such as gravity or the properties of the materials to be used are critical to the success of a technological solution. Other constraints, including cost, time, politics, society, ethics, and aesthetics, also define parameters and limit choices. Students should analyze

benefits and costs of technological solutions. Fundamental abilities of technological design include the ability to:

- Identify problems appropriate for technological design.
- Develop criteria for evaluating the product or solution.
- Identify constraints that must be taken into consideration.
- Design a product or solution.
- Apply safe and appropriate abilities to manipulate materials, equipment, and technologies.
- Implement a proposed design.
- Evaluate completed design or product.
- Analyze the risks and benefits of the solution.
- Communicate the process of technological design.
- Review the process of technological design.

Science in Personal and Social Perspectives

The ultimate goal for a scientifically literate person is the ability to use appropriate scientific principles and processes in making personal decisions. Therefore, making personal and societal connections to scientific challenges is imperative for middle school learners. Concepts, skills and theories for middle school science afford opportunities to develop scientific understanding for many aspects of personal and societal health. Opportunities that nurture students' abilities to think creatively and scientifically abound, as students connect science to personal decision making. Personal and societal connections can be made as eighth grade students conduct in-depth investigations which:

- Evaluate the theories of biological, geological, and technological evolution.
- Analyze information from technologies utilized to monitor the earth from space.
- Evaluate the importance of water quality.
- Compare benefits and risks associated with chemicals.
- Evaluate the economic, social, and ethical issues related to biotechnology.

Science – Grade 8

Learners will study natural and technological systems. All goals should focus on the unifying concepts of science defined by the *National Science Education Standards*: Systems, Order, and Organization; Evidence, Models, and Explanation; Constancy, Change, and Measurement; Evolution and Equilibrium; and Form and Function. The skills of inquiry and technological design are targeted for mastery. The concepts for which in-depth studies should be designed at eighth grade level include: Scientific Inquiry, Technological Design, Hydrosphere, Chemistry, Evolution Theory and Cellular Biology.

Strands: The Nature of Science, Science as Inquiry, Science and Technology, Science in Personal and Social Perspectives Strands provide the context for content goals.

COMPETENCY GOAL 1: The learner will design and conduct investigations to demonstrate an understanding of scientific inquiry.

Objectives

1.01 Identify and create questions and hypotheses that can be answered through scientific investigations.

1.02 Develop appropriate experimental procedures for:
- Given questions.
- Student generated questions.

1.03 Apply safety procedures in the laboratory and in field studies:
- Recognize potential hazards.
- Safely manipulate materials and equipment.
- Conduct appropriate procedures.

1.04 Analyze variables in scientific investigations:
- Identify dependent and independent.
- Use of a control.
- Manipulate.
- Describe relationships between.
- Define operationally.

1.05 Analyze evidence to:
- explain observations.
- make inferences and predictions.
- develop the relationship between evidence and explanation.

1.06 Use mathematics to gather, organize, and present quantitative data resulting from scientific investigations:
- Measurement.
- Analysis of data.
- Graphing.
- Prediction models.

1.07 Prepare models and/or computer simulations to:
- Test hypotheses.
- Evaluate how data fit.
- Make predictions.

1.08 Use oral and written language to:
- Communicate findings.
- Defend conclusions of scientific investigations.
- Describe strengths and weaknesses of claims, arguments, and/or data

1.09 Use technologies and information systems to:
- Research.
- Gather and analyze data.
- Visualize data.
- Disseminate findings to others.

1.10 Analyze and evaluate information from a scientifically literate viewpoint by reading, hearing, and/or viewing:
- Scientific text.
- Articles.
- Events in the popular press.

COMPETENCY GOAL 2: The learner will demonstrate an understanding of technological design.

Objectives

2.01 Explore evidence that "technology" has many definitions.
- Artifact or hardware.
- Methodology or technique.
- System of production.
- Social-technical system.

2.02 Use information systems to:
- Identify scientific needs, human needs, or problems that are subject to technological solution.
- Locate resources to obtain and test ideas.

2.03 Evaluate technological designs for:
- Application of scientific principles.
- Risks and benefits.
- Constraints of design.
- Consistent testing protocols.

2.04 Apply tenets of technological design to make informed consumer decisions about:
- Products.
- Processes.
- Systems.

COMPETENCY GOAL 3: **The learner will conduct investigations and utilize appropriate technologies and information systems to build an understanding of the hydrosphere.**

Objectives

3.01 Analyze the unique properties of water including:
- Universal solvent.
- Cohesion and adhesion.
- Polarity.
- Density and buoyancy.
- Specific heat.

3.02 Explain the structure of the hydrosphere including:
- Water distribution on earth.
- Local river basin.
- Local water availability.

3.03 Evaluate evidence that Earth's oceans are a reservoir of nutrients, minerals, dissolved gases, and life forms:
- Estuaries.
- Marine ecosystems.
- Upwelling.
- Behavior of gases in the marine environment.
- Value and sustainability of marine resources.
- Deep ocean technology and understandings gained.

3.04 Describe how terrestrial and aquatic food webs are interconnected.

3.05 Analyze hydrospheric data over time to predict the health of a water system including:
- Temperature.
- Dissolved oxygen.
- pH.
- Nitrates.
- Turbidity.
- Bio-indicators.

3.06 Evaluate technologies and information systems used to monitor the hydrosphere.

3.07 Describe how humans affect the quality of water:
- Point and non-point sources of water pollution in North Carolina.
- Possible effects of excess nutrients in North Carolina waters.
- Economic trade-offs.
- Local water issues.

3.08 Recognize that the good health of environments and organisms requires:
- Monitoring of the hydrosphere.
- Water quality standards.
- Methods of water treatment.
- Maintaining safe water quality.
- Stewardship.

COMPETENCY GOAL 4: The learner will conduct investigations and utilize technology and information systems to build an understanding of chemistry.

Objectives

4.01 Understand that both naturally occurring and synthetic substances are chemicals.

4.02 Evaluate evidence that elements combine in a multitude of ways to produce compounds that account for all living and nonliving substances.

4.03 Explain how the periodic table is a model for:
- Classifying elements .
- Identifying the properties of elements.

4.04 Describe the suitability of materials for use in technological design:
- Electrical Conductivity.
- Density.
- Magnetism.
- Solubility.
- Malleability.

4.05 Identify substances based on characteristic physical properties:
- Density.
- Boiling/Melting points.
- Solubility.
- Chemical reactivity.
- Specific heat.

4.06 Describe and measure quantities related to chemical/physical changes within a system:
- Temperature.
- Volume.
- Mass.
- Precipitate.
- Gas production.

4.07 Identify evidence supporting the law of conservation of matter.
- During an ordinary chemical reaction matter cannot be created or destroyed.
- In a chemical reaction, the total mass of the reactants equals the total mass of the products.

4.08 Identify evidence that some chemicals may contribute to human health conditions including:
- Cancer.
- Autoimmune disease.
- Birth defects.
- Heart disease.
- Diabetes.
- Learning and behavioral disorders.
- Kidney disease.
- Asthma.

4.09 Describe factors that determine the effects a chemical has on a living organism including:
- Exposure.
- Potency.
- Dose and the resultant concentration of chemical in the organism.
- Individual susceptibility.
- Possible means to eliminate or reduce effects.

4.10 Describe risks and benefits of chemicals including:
- Medicines.
- Food preservatives.
- Crop yield.
- Sanitation.

COMPETENCY GOAL 5: **The learner will conduct investigations and utilize appropriate technologies and information systems to build an understanding of evidence of evolution in organisms and landforms.**

Objectives

5.01 Interpret ways in which rocks, fossils, and ice cores record Earth's geologic history and the evolution of life including:
- Geologic Time Scale.
- Index Fossils.
- Law of Superposition.
- Unconformity.
- Evidence for climate change.
- Extinction of species.
- Catastrophic events.

5.02 Correlate evolutionary theories and processes:
- Biological.
- Geological.
- Technological.

5.03 Examine evidence that the geologic evolution has had significant global impact including:
- Distribution of living things.
- Major geological events.
- Mechanical and chemical weathering.

5.04 Analyze satellite imagery as a method to monitor Earth from space:
- Spectral analysis.
- Reflectance curves.

5.05 Use maps, ground truthing and remote sensing to make predictions regarding:
- Changes over time.
- Land use.
- Urban sprawl.
- Resource management.

COMPETENCY GOAL 6: The learner will conduct investigations, use models, simulations, and appropriate technologies and information systems to build an understanding of cell theory.

Objectives

6.01 Describe cell theory:
- All living things are composed of cells.
- Cells provide structure and carry on major functions to sustain life.
- Some organisms are single cell; other organisms, including humans, are multi-cellular.
- Cell function is similar in all living things.

6.02 Analyze structures, functions, and processes within animal cells for:
- Capture and release of energy.
- Feedback information.
- Dispose of wastes.
- Reproduction.
- Movement.
- Specialized needs.

6.03 Compare life functions of protists:
- Euglena.
- Amoeba.
- Paramecium.
- Volvox.

6.04 Conclude that animal cells carry on complex chemical processes to balance the needs of the organism.
- Cells grow and divide to produce more cells.
- Cells take in nutrients to make the energy for the work cells do.
- Cells take in materials that a cell or an organism needs.

COMPETENCY GOAL 7: The learner will conduct investigations, use models, simulations, and appropriate technologies and information systems to build an understanding of microbiology.

Objectives

7.01 Compare and contrast microbes:
- Size, shape, structure.
- Whether they are living cells.

7.02 Describe diseases caused by microscopic biological hazards including:
- Viruses.
- Bacteria.
- Parasites.
- Contagions.
- Mutagens.

7.03 Analyze data to determine trends or patterns to determine how an infectious disease may spread including:
- Carriers.
- Vectors.
- Conditions conducive to disease.
- Calculate reproductive potential of bacteria.

7.04 Evaluate the human attempt to reduce the risk of and treatments for microbial infections including:
- Solutions with anti-microbial properties.
- Antibiotic treatment.
- Research.

7.05 Investigate aspects of biotechnology including:
- Specific genetic information available.
- Careers.
- Economic benefits to North Carolina.
- Ethical issues.
- Impact for agriculture.