

**MSAD #54 Science Curriculum**

Content Area: Science  
 Unit: Unifying Themes

Grade: Grade 11  
 MLR Span: 9-12

**MLR Content Standard: A: Unifying Themes**

Students apply the principles of systems, models, constancy and change, and scale in science and technology.

\*Assessment

<b>Unifying Themes:</b>	<b>MLR Performance Indicators</b>	<b>MSAD #54 Objectives</b>	<b>Instructional Resources/Activities</b>
<p><b>A1 Systems</b></p>	<p>1. Students apply an understanding of systems to explain and analyze man-made and natural phenomena.</p> <p>a. Analyze a system using the principles of boundaries, subsystems, inputs, outputs, feedback, or the system’s relation to other systems and design solutions to a system problem.</p> <p>b. Explain and provide examples that illustrate how it may not always be possible to predict the impact of changing some part of a man-made or natural system.</p>	<p>Students will:</p>	

<p><b>A2 Models</b></p>	<p>2.Students evaluate the effectiveness of a model by comparing its predictions to actual observations from the physical setting, the living environment, and the technological world.</p>	<p>Students will use models to</p> <p>2a.determine the atomic number (Z) and mass number (A) of given isotopes of elements.</p> <p>2b.differentiate among the major subatomic particles.</p> <p>2c.discuss the development of modern atomic theory.</p> <p>2d.apply concept of half life of radioactive elements.</p>	<p>2a-2d.</p> <p>Isotope-Penny lab</p> <p>Battleship Game</p> <p>Wrap box activity</p> <p>Cathode ray tube</p> <p>Probability lab</p> <p>“Pennium Lab” radioactive decay</p>
<p><b>A3 Constancy and Change</b></p>	<p>3.Students identify and analyze examples of constancy and change that result from varying types and rates of change in physical, biological, and technological systems with and without counterbalances.</p>	<p>Students will:</p>	
<p><b>A4 Scale</b></p>	<p>4.Students apply understanding of scale to explain phenomena in physical, biological, and technological systems.</p> <p>a.Describe how large changes of scale may change how physical and biological</p>	<p>Students will:</p>	

	<p>systems work and provide examples.</p> <p>b.Mathematically represent large magnitudes of scale.</p>	<p>b1.discuss the development of modern atomic theory.</p>	<p>b1.Thickness of aluminum Foil Lab</p> <p>b1.Battleship Game</p>
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**MSAD #54 Science Curriculum**

Content Area: Science  
Unit: Skills & Traits

Grade: Grade 11  
MLR Span: 9-12

**MLR Content Standard: B. The Skills and Traits of Scientific Inquiry And Technological Design**

Students plan, conduct, analyze data from and communicate results of in-depth scientific investigations; and they use a systematic process, tools, equipment, and a variety of materials to create a technological design and produce a solution or product to meet a specified need.

<b>Skills and Traits</b>	<b>MLR Performance Indicators</b>	<b>MSAD #54 Objectives</b>	<b>Instructional Resources/Activities</b>
<p><b>B1 Skills and Traits of Scientific Inquiry</b></p>	<p>1. Students methodically plan, conduct, analyze data from, and communicate results of in-depth scientific investigations, including experiments guided by a testable hypothesis.</p> <p>a. Identify questions, concepts, and testable hypotheses that guide scientific investigations.</p> <p>b. Design and safely conduct methodical scientific investigations, including experiments with controls.</p> <p>c. Use statistics to summarize, describe, analyze, and interpret results.</p> <p>d. Formulate and revise scientific investigations and models using logic</p>	<p>Students will:</p> <p>a1. develop an understanding of water pollution.</p> <p>c1. develop an understanding of water pollution.</p>	<p>a1. Water Projects</p> <p>c1. Water Projects</p>

	<p>and evidence.</p> <p>e. Use a variety of tools and technologies to improve investigations and communications.</p> <p>f. Recognize and analyze alternative explanations and models using scientific criteria.</p> <p>g. Communicate and defend scientific ideas.</p>	<p>e1. develop an understanding of water pollution.</p> <p>g1. discuss the development of modern atomic theory.</p>	<p>e1. Water Projects</p> <p>f1. Isotope-Penny lab Battleship Game Wrap box activity</p> <p>g1. Cathode ray tube Probability lab “Pennium Lab” radioactive decay</p>
<p><b>B2 Skills and Traits of Technological Design</b></p>	<p>2. Students use a systematic process, tools and techniques, and a variety of materials to design and produce a solution or product that meets new needs or improves existing designs.</p> <p>a. Identify new problems or a current design in need of improvement.</p> <p>b. Generate alternative design solutions.</p> <p>c. Select the design that best meets established criteria.</p> <p>d. Use models and simulations as prototypes in the design planning</p>	<p>Students will</p>	

	<p>process.</p> <p>e. Implement the proposed design solution.</p> <p>f. Evaluate the solution to a design problem and the consequences of that solution.</p> <p>g. Present the problem, design process, and solution to a design problem including models, diagrams, and demonstrations.</p>		
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**MSAD #54 Science Curriculum**

Content Area: Science  
Unit: Scientific & Technological Enterprise

Grade: Grade 11  
MLR Span: 9-12

MLR Content Standard: **C. The Scientific and Technological Enterprise**  
Students understand the history and nature of scientific knowledge and technology, the processes of inquiry and technological design, and the impacts science and technology have on society and the environment.

<b>Scientific &amp; Technological Enterprise</b>	<b>MLR Performance Indicators</b>	<b>MSAD #54 Objectives</b>	<b>Instructional Resources/Activities</b>
<b>C1 Understandings of Inquiry</b>	<p>1.Students describe key aspects of scientific investigations: that they are guided by scientific principles and knowledge, that they are performed to test ideas, and that they are communicated and defended publicly.</p> <p>a.Describe how hypotheses and past and present knowledge guide and influence scientific investigations.</p> <p>b.Describe how scientists defend their evidence and explanations using logical arguments and verifiable results.</p>	<p>Students will</p> <p>a1 &amp; b1. discuss the development of modern atomic theory.</p>	<p>a1 &amp; b1: Conservation of mass lab Cathode ray tube demos Isotope-Penny lab Bryson Articles Probability lab Thickness of Aluminum Foil Lab Battleship Game Energy change/cold pack lab Alcohol and water mix lab Wrap box activity</p>
<b>C2 Understandings About Science and Technology</b>	<p>2.Students explain how the relationship between scientific inquiry and technological design influences the advancement of ideas, products, and systems.</p>	<p>Students will</p>	

	<p>a. Provide an example that shows how science advances with the introduction of new technologies and how solving technological problems often impacts new scientific knowledge.</p> <p>b. Provide examples of how creativity, imagination, and a good knowledge base are required to advance scientific ideas and technological design.</p> <p>c. Provide examples that illustrate how technological solutions to problems sometimes lead to new problems or new fields of inquiry.</p>		
<p><b>C3 Science, Technology, and Society</b></p>	<p>3. Students describe the role of science and technology in creating and solving contemporary issues and challenges.</p> <p>a. Explain how science and technology influence the carrying capacity and sustainability of the planet.</p> <p>b. Explain how ethical, societal, political, economic, and cultural factors influence personal health, safety, and the quality of the environment.</p> <p>c. Explain how ethical,</p>	<p>Students will</p>	



	<p>societal, political, economic, religious, and cultural factors influence the development and use of science and technology.</p>		
<p><b>C4 History and Nature of Science</b></p>	<p>4.Students describe the human dimensions and traditions of science, the nature of scientific knowledge, and historical episodes in science that impacted science and society.</p> <p>a.Describe and provide examples of the ethical traditions in science including peer review, truthful reporting, and making results public.</p> <p>b.Select and describe one of the major episodes in the history of science including how the scientific knowledge changed over time and any important effects on science and society.</p> <p>c.Give examples that show how societal, cultural, and personal beliefs and ways of viewing the world can bias scientists.</p> <p>d.Provide examples of criteria that distinguish scientific explanations from pseudoscientific ones.</p>	<p>Students will</p>	

**MSAD #54 Science Curriculum**

Content Area: Science  
 Unit: Physical Setting

Grade: Grade 11  
 MLR Span: 9-12

**MLR Content Standard: D. The Physical Setting**

Students understand the universal nature of matter, energy, force, and motion and identify how these relationships are exhibited in Earth Systems, in the solar system, and throughout the universe.

<b>Physical Setting</b>	<b>MLR Performance Indicators</b>	<b>MSAD #54 Objectives</b>	<b>Instructional Resources/Activities</b>
<b>D1 Universe and Solar System</b>	<p>1. Students explain the physical formation and changing nature of our universe and solar system, and how our past and present knowledge of the universe and solar system developed.</p> <p>a.Explain why the unit of light years can be used to describe distances to objects in the universe and use light years to describe distances.</p> <p>b.Explain the role of gravity in forming and maintaining planets, stars, and the solar system.</p> <p>c.Outline the age, origin, and process of formation of the universe as currently understood by science.</p> <p>d.Describe the major events that have led to our current understanding of the</p>	Students will	

	<p>universe and the current technologies used to further our understanding.</p>		
<p><b>D2 Earth</b></p>	<p>2.Students describe and analyze the biological, physical, energy, and human influences that shape and alter Earth Systems.</p> <p>a.Describe and analyze the effect of solar radiation, ocean currents, and atmospheric conditions on the Earth’s surface and the habitability of Earth.</p> <p>b.Describe Earth’s internal energy sources and their role in plate tectonics.</p> <p>c.Describe and analyze the effects of biological and geophysical influences on the origin and changing nature of Earth Systems.</p> <p>d.Describe and analyze the effects of human influences on Earth Systems.</p>	<p>Students will</p>	
<p><b>D3 Matter and Energy</b></p>	<p>3.Students describe the structure, behavior, and interactions of matter at the atomic level and the relationship between matter and energy.</p>	<p>Students will</p>	

	<p>a. Describe the structure of atoms in terms of neutrons, protons, and electrons and the role of the atomic structure in determining chemical properties.</p> <p>b. Describe how the number and arrangement of atoms in a molecule determine a molecule's properties, including the types of bonds it makes with other molecules and its mass, and apply this to predictions about chemical reactions.</p> <p>c. Explain the essential roles of carbon and water in life processes.</p> <p>d. Describe how light is emitted and absorbed by atoms' changing energy levels, and how</p>	<p>a1. discuss early development in atomic theory.</p> <p>a2. explain the laws of multiple and definite proportions and give examples.</p> <p>a3. determine the atomic number (<math>Z</math>) and mass number (<math>A</math>) of given isotopes of elements.</p> <p>a4. differentiate among the major subatomic particles.</p> <p>a5. discuss the development of modern atomic theory.</p> <p>a6. calculate the average atomic mass of a mixture of isotopes of an element.</p> <p>a7. relate the chemical and physical properties based on electron structure.</p> <p>b1. distinguish the properties of compounds from those of the elements of which they are composed.</p> <p>b2. compare the effect of covalent and ionic bonding on physical properties of compounds.</p> <p>d1. relate emission spectra to electrons and atoms.</p> <p>d2. relate energy levels and</p>	<p>a1-a7: Conservation of mass lab</p> <p>Cathode ray tube demos</p> <p>Isotope-Penny lab</p> <p>Bryson Articles</p> <p>Probability lab</p> <p>Thickness of Aluminum Foil Lab</p> <p>Battleship Game</p> <p>Energy change/cold pack lab</p> <p>Alcohol and water mix lab</p> <p>Wrap box activity</p> <p>b1 &amp; b2: Evidence of chemical reaction lab</p> <p>Physical and chemical reaction lab</p> <p>Types of compounds lab-bonding</p> <p>d1 &amp; d2: Spectroscope lab</p> <p>Flame test lab</p>
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	<p>the results can be used to identify a substance.</p> <p>e. Describe factors that affect the rate of chemical reactions (including concentration, pressure, temperature, and the presence of molecules that encourage interaction with other molecules).</p> <p>f. Apply an understanding of the factors that affect the rate of chemical reaction to predictions about the rate of chemical reactions.</p> <p>g. Describe nuclear reactions, including fusion and fission, and the energy they release.</p> <p>h. Describe radioactive decay and half-life.</p> <p>i. Explain the relationship between kinetic and potential energy and apply the knowledge to solve problems.</p> <p>j. Describe how in energy transformations the total amount of energy remains the same, but because of inefficiencies (heat, sound, and vibration)</p>	<p>orbital's within the atom.</p> <p>e &amp; f:</p> <ol style="list-style-type: none"> <li>1. demonstrate and describe the factors that influence the rate of reaction.</li> <li>2. relate chemical changes and macroscopic properties.</li> <li>3. demonstrate how chemical equations describe chemical reactions.</li> <li>4. illustrate how to balance chemical reactions by changing coefficients.</li> <li>5. distinguish and classify reaction types.</li> </ol> <p>g1. compare and contrast nuclear fission and fusion.</p> <p>h1. compare and contrast alpha, beta, and gamma rays.</p> <p>h2. apply concept of half life of radioactive element.</p>	<p>e &amp; f:</p> <p>iodine clock reaction</p> <p>Lycopodium powder demo</p> <p>Alka-seltzer: temp and surface area lab</p> <p>Alcohol and water mix lab</p> <p>Types of chemical reactions lab</p> <p>g1-h2:</p> <p>“Pennium Lab” radioactive decay</p> <p>Jigsaw Article Radioactivity Fission vs. Fusion vs. Radon</p>
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	<p>useful energy is often lost through radiation or conduction.</p> <p>k. Apply an understanding of energy transformations to solve problems.</p> <p>l. Describe the relationship among heat, temperature, and pressure in terms of the actions of atoms, molecules, and ions.</p>		
<p><b>D4 Force and Motion</b></p>	<p>4. Students understand that the laws of force and motion are the same across the universe.</p> <p>a. Describe the contribution of Newton to our understanding of force and motion, and give examples of and apply Newton's three laws of motion and his theory of gravitation.</p> <p>b. Explain and apply the ideas of relative motion and frame of reference.</p> <p>c. Describe the relationship between electric and magnetic fields and forces, and give examples of how this relationship is used in modern technologies.</p> <p>d. Describe and apply characteristics of</p>	<p>Students will</p>	

	<p>waves including wavelength, frequency, and amplitude.</p> <p>e. Describe and apply an understanding of how waves interact with other waves and with materials including reflection, refraction, and absorption.</p> <p>f. Describe kinetic energy (the energy of motion). Potential energy (dependent on relative position), and energy contained by a field (including electromagnetic waves) and apply these understandings to energy problems.</p>		
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**MSAD #54 Science Curriculum**

Content Area: Science  
 Unit: The Living Environment

Grade: Grade 11  
 MLR Span: 9-12

**MLR Content Standard: E. The Living Environment**

Students understand that cells are the basic unit of life, that all life as we know it has evolved through genetic transfer and natural selection to create a great diversity of organisms, and that these organisms create interdependent webs through which matter and energy flow. Students understand similarities and differences between humans and other organisms and the interconnections of these interdependent webs.

<b>Living Environment</b>	<b>MLR Performance Indicators</b>	<b>MSAD #54 Objectives</b>	<b>Instructional Resources/Activities</b>
<b>E1 Biodiversity</b>	<p>1.Students describe and analyze the evidence for relatedness among and within diverse populations of organisms and the importance of biodiversity.</p> <p>a.Explain how the variation in structure and behavior of a population of organisms may influence the likelihood that some members of the species will have adaptations that allow them to survive in a changing environment.</p> <p>b.Describe the role of DNA sequences in determining the degree of kinship among organisms and the identification of species.</p> <p>c.Analyze the</p>	Students will	



	<p>relatedness among organisms using structural and molecular evidence.</p> <p>d. Analyze the effects of changes in biodiversity and predict possible consequences.</p>		
<p><b>E2 Ecosystems</b></p>	<p>2. Students describe and analyze the interactions, cycles, and factors that affect short-term and long-term ecosystem stability and change.</p> <p>a. Explain why ecosystems can be reasonably stable over hundreds of thousands of years, even though populations may fluctuate.</p> <p>b. Describe dynamic equilibrium in ecosystems and factors that can, in the long run, lead to change in the normal pattern of cyclic fluctuations and apply that knowledge to actual situations.</p> <p>c. Explain the concept of carrying capacity and list factors that determine the amount of life that any environment can</p>	<p>Students will</p>	

	<p>support.</p> <p>d. Describe the critical role of photosynthesis and how energy and the chemical elements that make up molecules are transformed in ecosystems and obey basic conservation laws.</p>		
<p><b>E3 Cells</b></p>	<p>3. Students describe structure and function of cells at the intracellular and molecular level including differentiation to form systems, interactions between cells and their environment, and the impact of cellular processes and changes on individuals.</p> <p>a. Describe the similarities and differences in the basic functions of cell membranes and to the specialized parts within cells that allow them to transport materials, capture and release energy, build proteins, dispose of waste, communicate, and move.</p> <p>b. Describe the relationship among DNA, protein molecules, and amino acids in carrying out</p>	<p>Students will</p>	

	<p>the work of cells and how this is similar among all organisms.</p> <p>d. Describe the interactions that lead to cell growth and division (mitosis) and allow new cells to carry the same information as the original cell (meiosis).</p> <p>e. Describe ways in which cells can malfunction and put an organism at risk.</p> <p>e. Describe the role of regulation and the processes that maintain an internal environment amidst changes in the external environment.</p> <p>f. Describe the process of metabolism that allows a few key biomolecules to provide cells with necessary materials to perform their functions.</p> <p>g. Describe how cells differentiate to form specialized systems for carrying out life functions.</p>		
<p><b>E4 Heredity and Reproduction</b></p>	<p>4. Students examine the role of DNA in transferring traits from generation to generation, in</p>	<p>Students will</p>	

	<p>differentiating cells, and in evolving new species.</p> <p>a.Explain some of the effects of the sorting and recombination of genes in sexual reproduction.</p> <p>b.Describe genes as segments of DNA that contain instruction for the cells and include information that leads to the differentiation of cells.</p> <p>c.Explain how the instructions in DNA that lead to cell differentiation result in varied cell functions in the organism and DNA.</p> <p>d.Describe the possible causes and effects of gene mutations.</p>		
<p><b>E5 Evolution</b></p>	<p>5.Students describe the interactions between and among species, populations, and environments that lead to natural selection and evolution.</p> <p>a.Describe the premise of biological evolution, citing evidence from the fossil record and evidence based on the</p>	<p>Students will</p>	

	<p>observation of similarities within the diversity of existing organisms.</p> <p>b. Describe the origins of life and how the concept of natural selection provides a mechanism for evolution that can be advantageous or disadvantageous to the next generation.</p> <p>c. Explain why some organisms may have characteristics that have no apparent survival or reproduction advantage.</p> <p>d. Relate structural and behavioral adaptations of an organism to its survival in the environment.</p>		
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