DRAFT

MSAD#54 Science Curriculum

Content Area: Science
Unit: Unifying Themes

Grade: Grade 12
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

Unifying Themes:	MLR Performance Indicators 9-12	MSAD #54 Objectives	Instructional Resources/Activities
A1 Systems	1.Students apply an understanding of systems to explain and analyze man-made and natural phenomena.	Students will:	
	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. 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.	a1.Discuss how feedback is used to help maintain the speed of the Watt Steam engine and explain why it was more efficient than previous engines	a1.Overlays and scale models of steam engines

A2 Models	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.	Students will	
A3 Constancy and Change	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.	Students will: 3.observe that constellations named thousands of years ago still fit. Also that stars can and do change and are born and die throughout time.	3.Class Discussion Star Planet Locators Overlays Computer Programs
A4 Scale	4.Students apply understanding of scale to explain phemomena in physical, biological, and technological systems. a.Describe how large changes of scale may change how physical and biological	Students will: a1.use scientific notation to measure the distances in space and the mass of stellar objects	 a1.Class discussion

	systems work and provide examples. b.Mathematically represent large magnitudes of scale.		

DRAFT

MSAD #54 Science Curriculum

Content Area: Science
Unit: Skills & Traits

Grade: Grade 12
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.

Skills and Traits	MLR Performance Indicators 9-12	MSAD #54 Objectives	Instructional Resources/Activities
B1 Skills and Traits of Scientific Inquiry	1. Students methodically plan, conduct, analyze data from, and communicate results of in-depth scientific investigations, including experiments guided by a testable hypothesis. a.Identify questions, concepts, and testable hypotheses that guide scientific investigations. b.Design and safely conduct methodical scientific investigations, including experiments with controls. c.Use statistics to summarize, describe, analyze, and interpret results. d.Formulate and revise scientific investigations and models using logic	Students will:	

	and evidence. e.Use a variety of tools and technologies to improve investigations and communications. f.Recognize and analyze alternative explanations and models using scientific criteria. g.Communicate and defend scientific ideas.	f1.discuss the differences between the Geocentric and the Heliocentric model of the solar system and discuss why the scientifically the Heliocentric won out.	**f1.Class Discussion Overlays**
B2 Skills and Traits of Technological Design	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. a.Identify new problems or a current design in need of improvement. b.Generate alternative design solutions. c.Select the design that best meets established criteria. d.Use models and simulations as prototypes in the	Students will	

	design planning process. e.Implement the proposed design solution. f.Evaluate the solution to a design problem and the consequences of that solution. g.Present the problem, design process, and solution to a design problem including models, diagrams, and demonstrations.		

DRAFT

MSAD #54 Science Curriculum

Content Area: Science | Grade: Grade 12
Unit: Scientific & Technological Enterprise | 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.

Scientific & Technological Enterprise	MLR Performance Indicators 9-12	MSAD #54 Objectives	Instructional Resources/Activities
C1 Understandings of Inquiry	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. a.Describe how hypotheses and past and present knowledge guide and influence scientific investigations. b.Describe how scientists defend their evidence and explanations using logical arguments and verifiable results.	Students will	
C2 Understandings About Science and Technology	2.Students explain how the relationship between scientific inquiry and technological design influences the advancement of ideas, products, and systems.	Students will	

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

	societal, political, economic, religious, and cultural factors influence the development and use of science and technology.		
C4 History and Nature of Science	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. a.Describe and provide examples of the ethical traditions in science including peer review, truthful reporting, and making results public. 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. c.Give examples that show how societal, cultural, and personal beliefs and ways of viewing the world can bias scientists. d.Provide examples of criteria that distinguish scientific explanations form pseudoscientific ones.	Students will 4. describe the differences between the Geocentric and the Heliocentric model of the solar system and the historical consequences and impact on society.	4. Class Discussion

DRAFT

MSAD #54 Science Curriculum

Content Area: Science
Unit: Physical Setting

Grade: Grade 12
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.

Physical Setting	MLR Performance Indicators 9-12	MSAD #54 Objectives	Instructional Resources/Activities
D1 Universe and Solar System	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.	Students will 1.describe the general motions of the sun, moon, planets, and the stars. 1.locate objects in the sky and distinguish between stars and planets.	Star and planet locators, overlays, computer programs such as Star Calc and Home Planet
	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.	a1.show how to compute how far light travels in a year with correct units.	a1.Solve problems measuring the distance to stars using the unit of light years.
	b.Explain the role of gravity in forming and maintaining planets, stars, and the solar system.	b1.use the universal law of gravitation to compute the gravitational force between planets and stars.	b1.Class Discussion
	c.Outline the age, origin, and process of formation of the universe as currently understood by science.		
	d.Describe the major events that have led to our current understanding of the	d1.explain how spectroscopy has lead to our understanding of the chemical composition of stars and how it has also helped us	

	universe and the current technologies used to further our understanding.	determine whether they are approaching or going away from us. d2.show how telescopes have aided our present understanding of the universe.	
D2 Earth	2.Students describe and analyze the biological, physical, energy, and human influences that shape and alter Earth Systems. a.Describe and analyze the effect of solar radiation, ocean currents, and atmospheric conditions on the Earth's surface and the habitability of Earth. b.Describe Earth's internal energy sources and their role in plate tectonics. c.Describe and analyze the effects of biological and geophysical influences on the origin and changing nature of Earth Systems. d.Describe and analyze the effects of human influences on Earth Systems.	Students will	

D3 Matter and Energy	3.Students describe the structure, behavior, and interactions of matter at the atomic level and the relationship between matter and energy. a.Describe the structure of atoms in terms of neutrons, protons, and electrons and the role of the atomic structure in determining chemical properties. 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. c.Explain the essential roles of carbon and water in life processes. d.Describe how light is emitted and absorbed by atoms' changing energy levels, and how the results can be used to identify a substance. e.Describe factors that affect he rate of chemical reactions (including concentration, pressure, temperature,		

	and the presence of molecules that encourage interaction with other molecules). f.Apply an a understanding of the factors that affect the rate of chemical reaction to predictions about the rate of chemical reactions. g.Describe nuclear reactions, including fusion and fission, and the energy they release. h.Describe radioactive decay and half-life.		
	i.Explain the relationship between kinetic and potential energy and apply the knowledge to solve problems.	i1.display an understanding of the laws of conservation of mass, momentum and energy. i2.explain how impulse effects the change and momentum of objects and the design of modern cars.	i1-i2.Flash cube before and after firing, study of energy conservation with a swinging pendulum and the loop to loop roller coasters. i1-i2.Elastic and inelastic collisions using computers to gather data.
	j.Describe how in energy transformations the total amount of energy remains the same, but because of inefficiencies (heat, sound, and vibration) useful energy is often lost through radiation or conduction.	j1.explain why a pendulum rises less high with each consecutive swing and why a ball rolling down a ramp does not go to the same height on the other side. j2.observe temperature change and heat generated with loss of PE.	j1-j2.Loop to loop demonstration j1-j2. Mechanical equivalent of heat apparatus and mechanical hammer using computer software.
	k.Apply an understanding of energy transformations to solve problems.	k1.solve problems measuring the PE, KE, and heat generated when energy changes from one form to another.	k1.Class discussion

	l.Describe the relationship among heat, temperature, and pressure in terms of the actions of atoms, molecules, and ions.	l1.compute work input and output in simple machines and be able to calculate the power. l2.distinguish between heat and temperature and solve heat problems. l3.state the law of heat and the laws of thermodynamics. l4.explain in terms of the kinetic molecular theory why boiling is a cooling process and why rapid compression is a warming process. l5.use Newton's Universal Law to solve problems and to measure the mass of planets. l6.state Archemedes', Bernoulli's and Pascal's Principles. l7.do pressure problems and discuss why we have atmospheric pressure and why it changes. l8.state Boyle's and the Ideal gas law and discuss how they relate to the kinetic molecular theory. l9.list the three methods of heat transfer and discuss why vacuum bottles work so well.	l1-l9.Heat labs, expansion demos, boiling water in a vacuum, fire syringe. l1-l9.Class Discussion l1-l9.Overlays, computer generated graphs from labs, individuals graphs of data obtained from labs. l1-l9.Do motion acceleration, and Newton's 2nd law labs using dragstrip timers and computer software. l1-l9.Do a vector lab l1-l9.Boyles law with computer
D4 Force and Motion	4.Students understand that the laws of force and motion are the same across the universe.	Students will	

	a.Describe the contribution of Newton to our understanding of force an motion, and give examples of and apply Newton's three laws of motion and his theory of gravitation.	a1.define uniform speed, average speed, velocity, acceleration, and solve problems with correct units. a2.discuss graphs qualitatively and quantitatively. a3.do freefall problems. a4.state Newton's 3 laws and show how they apply to everyday activities. a5.Do vector problems and describe the difference between vector and scalar quantities. a6.solve projectile and circular motion problems.	a1-a6. Class Discussion a1-a6. Overlays, computer generated graphs from labs, individuals graphs of data obtained from labs. a1-a6. Do motion acceleration, and Newton's 2nd law labs using dragstrip timers and computer software. a1-a6.Ball in cup lab and Vernier projectile software. a1-a6.Monkey gun demonstration
	b.Explain and apply the ideas of relative motion and frame of reference.	b1.discuss when you appear to be at rest that you are really moving at whatever the earth's speed is. b2.explain how you can tell the difference between constant speed and acceleration, and the different ways that one can accelerate.	b1-b2. Class Discussion
	c.Describe the relationship between electric and magnetic fields and forces, and give examples of how this relationship is used in modern technologies.	c1.discuss how like poles of magnets react and how unlike poles react. c2.discuss low like charges react and how unlike charges react. c3.discuss what an inverse square relationship means.	c1-c3.Demo using magnets and electrostatic materials.
	d.Describe and apply characteristics of waves including wavelength, frequency, and amplitude.	d1.describe the three types of mechanical waves and the relationship between wavelength and frequency.	d1.Demos and waves on a spring lab. d1.Mechanical Wave Driver d1.Tacoma Narrows Bridge film

			d1.Standing wave lab and demos.
	e.Describe and apply an understanding of how waves interact with other waves and with materials including reflection, refraction, and absorption.	e1.state the law of reflection. e2.define diffraction, refraction, and interference.	e1-e2.Demos and ripple tank lab. e1-e2.Wave labs and overlays e1-e2. Class Discussion
	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.	f1.discuss the particle and wave model of light and the differences between them. f2.discuss the photoelectric effect and the significance to the theory of what light is. f3.do KE and PE problems and state the law of conservation of Mechanical Energy f4.discuss the energy transformations from PE to KE to electrical, to heat, light, sound, etc.	f1-f4. Class Discussion f1-f4.Measure the wavelength of light using Young's double slit experiment and lasers.

DRAFT

MSAD #54 Science Curriculum

Content Area: Science | Grade: Grade 12
Unit: The Living Environment | 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 an energy flow. Students understand similarities and differences between humans and other organisms and the interconnections of these interdependent webs.

Living Environment	MLR Performance Indicators 9-12	MSAD #54 Objectives	Instructional Resources/Activities
E1 Biodiversity	1.Students describe and analyze the evidence for relatedness among and within diverse populations of organisms and the importance of biodiversity. 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. b.Describe the role of DNA sequences in determining the degree of kinship among organisms and the identification of species. c.Analyze the	Students will	

	relatedness among organisms using structural and molecular evidence. d.Analyze the effects of changes in biodiversity and predict possible consequences.		
E2 Ecosystems	2. Students describe and analyze the interactions, cycles, and factors that affect short-term and long-term ecosystem stability and change. a.Explain why ecosystems can be reasonably stable over hundreds of thousands of years, even though populations may fluctuate. 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. c.Explain the concept of carrying capacity and list factors that determine the amount of life that any environment can	Students will	

	support. 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.		
E3 Cells	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. 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. b.Describe the relationship among DNA, protein molecules, and amino acids in carrying out	Students will	

	the work of cells and how this is similar among all organisms. 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). e.Describe ways in which cells can malfunction and put an organism at risk. e.Describe the role of regulation and the processes that maintain an internal environment amidst changes in the external environment. f.Describe the process of metabolism that allows a few key biomolecules to provide cells with necessary materials to perform their functions. g.Describe how cells differentiate to form specialized systems for carrying out life functions.		
E4 Heredity and Reproduction	4.Students examine the role of DNA in transferring traits from generation to generation, in	Students will	

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

	evidence based on the observation of similarities within the diversity of existing organisms. 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. c.Explain why some organisms may have characteristics that have no apparent survival or reproduction advantage. d.Relate structural and behavioral adaptations of an organism to its survival in the environment.		