

SCIENCE

SC81 PHYSICS

Course #: SC-81	Grade Level: 10 - 12
Course Name: Physics	Level of Difficulty: Medium
Prerequisites: Algebra with Geometry recommended	# of Credits: 1

Strand 1: Inquiry Process

“Science as inquiry is basic to science education and a controlling principle in the continuing organization and selection of students’ activities. Students at all grade levels and in every domain of science should have the opportunity to use scientific inquiry and develop the ability to think and act in ways associated with inquiry...” (National Science Education Standards, 1995).

Inquiry Process establishes the basis for students’ learning in science. Students use scientific processes: questioning, planning and conducting investigations, using appropriate tools and techniques to gather data, thinking critically and logically about relationships between evidence and explanations, and communicating results.

- Concepts**
- Concept 1: Observations, Questions, and Hypotheses**
- Formulate predictions, questions, or hypotheses based on observations. Evaluate appropriate resources.
- Concept 2: Scientific Testing (Investigating and Modeling)**
- Design and conduct controlled investigations.
- Concept 3: Analysis, Conclusions, and Refinements**
- Evaluate experimental design, analyze data to explain results and propose further investigations. Design models.
- Concept 4: Communication**
- Communicate results of investigations.

Students should know and be able to...					
Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S1C1	Observations, Questions, and Hypotheses	1	Evaluate scientific information for relevance to a given problem.		
		2	Develop questions from observations that transition into testable hypotheses.		
		3	Formulate a testable hypothesis.		
		4	Predict the outcome of an investigation based on prior evidence, probability, and/or modeling (not guessing or inferring).		

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S1C2	Scientific Testing (Investigating and Modeling)	1	Demonstrate safe and ethical procedures (e.g., use and care of technology, materials, and organisms) and behavior in all science inquiry.		
		2	Identify the resources needed to conduct an investigation.		
		3	Design an appropriate protocol (written plan of action) for testing a hypothesis: <ul style="list-style-type: none"> ▪ Identify dependent and independent variables in a controlled investigation. ▪ Determine an appropriate method for data collection (e.g., using balances, thermometers, microscopes, spectrophotometer, using qualitative changes). ▪ Determine an appropriate method for recording data (e.g., notes, sketches, photographs, videos, journals (logs), charts, computers/calculators). 		
		4	Conduct a scientific investigation that is based on a research design.		
		5	Record observations, notes, sketches, questions, and ideas using tools such as journals, charts, graphs, and computers.		

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S1C3	Analysis and Conclusions, and Refinements	1	<i>Interpret data that show a variety of possible relationships between variables, including:</i> <ul style="list-style-type: none"> ▪ <i>positive relationship</i> ▪ <i>negative relationship</i> ▪ <i>no relationship</i> 		
		2	Evaluate whether investigational data support or do not support the proposed hypothesis.		
		3	Critique reports of scientific studies (e.g., published papers, student reports).		
		4	Evaluate the design of an investigation to identify possible sources of procedural error, including: <ul style="list-style-type: none"> ▪ sample size ▪ trials ▪ controls ▪ analyses 		
		5	Design models (conceptual or physical) of the following to represent "real world" scenarios. <ul style="list-style-type: none"> ▪ carbon cycle ▪ water cycle ▪ phase change ▪ collisions 		
		6	Use descriptive statistics to analyze data, including: <ul style="list-style-type: none"> ▪ mean ▪ frequency ▪ range (see MHS-S2C1-10)		
		7	Propose further investigations based on the findings of a conducted investigation.		

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Students should know and be able to...					
Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S1C4	Communication	1	For a specific investigation, choose an appropriate method for communicating the results.		
		2	Produce graphs that help communicate data. (See MHS-S2C1-02)		
		3	Communicate results clearly and logically.		
		4	Support conclusions with logical scientific arguments.		

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Strand 2: History and Nature of Science

Knowledge of the nature of science is central to the understanding of the scientific enterprise” (National Assessment of Educational Progress, 2000).

Scientific investigation grows from the contributions of many people. History and Nature of Science emphasizes the importance of the inclusion of historical perspectives and the advances that each new development brings to technology and human knowledge. This strand focuses on the human aspects of science and the role that scientists play in the development of various cultures.

Concepts

Concept 1: History of Science as a Human Endeavor

- Identify individual, cultural, and technological contributions to scientific knowledge.

Concept 2: Nature of Scientific Knowledge

- Understand how science is a process for generating knowledge.

Students should know and be able to...

Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S2C1	History of Science as a Human Endeavor	1	Describe how human curiosity and needs have influenced science, impacting the quality of life worldwide.		
		2	<i>Describe how diverse people and/or cultures, past and present, have made important contributions to scientific innovations.</i>		
		3	Analyze how specific changes in science have affected society.		
		4	Analyze how specific cultural and/or societal issues promote or hinder scientific advancements.		

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Students should know and be able to...					
Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S2C2	Nature of Scientific Knowledge	1	<p>Specify the requirements of a valid, scientific explanation (theory), including that it be:</p> <ul style="list-style-type: none"> ▪ logical ▪ subject to peer review ▪ public ▪ respectful of rules of evidence 		
		2	<p>Explain the process by which accepted ideas are challenged or extended by scientific innovation.</p>		
		3	<p>Distinguish between pure and applied science.</p>		
		4	<p>Describe how scientists continue to investigate and critically analyze aspects of theories.</p>		

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Strand 3: Science in Personal and Social Perspectives

Science in Personal and Social Perspectives emphasizes developing the ability to design a solution to a problem, to understand the relationship between science and technology, and the ways people are involved in both. Students understand the impact of science and technology on human activity and the environment. This strand affords students the opportunity to understand their place in the world – as living creatures, consumers, decision makers, problem solvers, managers, and planners.

Concepts

Concept 1: Changes in Environments

- Describe the interactions between human populations, natural hazards, and the environment.

Concept 2: Science and Technology in Society

- Develop viable solutions to a need or problem.

Concept 3: Human Population Characteristics

- Analyze factors that affect human populations.

Students should know and be able to...

Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S3C2	Science and Technology in Society	2	Recognize the importance of basing arguments on a thorough understanding of the core concepts and principles of science and technology.		
		3	Support a position on a science or technology issue.		

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Strand 5: Physical Science

The physical science component ... should probe the following major topics: matter and its transformations, energy and its transformations, and the motion of things” (NAEP 2000).

Physical Science affords students the opportunity to increase their understanding of the characteristics of objects and materials they encounter daily. Students gain an understanding of the nature of matter and energy, including their forms, the changes they undergo, and their interactions. By studying objects and the forces that act upon them, students develop an understanding of the fundamental laws of motion, knowledge of the various ways energy is stored in a system, and the processes by which energy is transferred between systems and surroundings.

Concepts

Concept 1: Structure and Properties of Matter

- Understand physical, chemical, and atomic properties of matter.

Concept 2: Motions and Forces

- Analyze relationships between forces and motion.

Concept 3: Conservation of Energy and Increase in Disorder

- Understand ways that energy is conserved, stored, and transferred.

Concept 4: Chemical Reactions

- Investigate relationships between reactants and products in chemical reactions.

Concept 5: Interactions of Energy and Matter

- Understand the interactions of energy and matter.

Students should know and be able to...

Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S5C2	Motions and Forces	1	Determine the rate of change of a quantity (e.g., rate of erosion, rate of reaction, rate of growth, velocity).	position, displacement, velocity, acceleration, vectors	Constant velocity lab Constant acceleration lab
		2	Analyze the relationships among position, velocity, acceleration, and time: <ul style="list-style-type: none"> - numerically • graphically • mathematically 	slopes, area, delta y, delta x, rise over run, linear, non-linear, negative vs. positive changes and directions. freefall	Stacks of graphs Develop Kinematic equations

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S5C2 (cont.)	Motions and Forces	3	<p>Explain how Newton's 1st Law applies to objects at rest or moving at constant velocity.</p> <ul style="list-style-type: none"> - The simplest state of motion for an object is to have a constant velocity. - An object at rest is just a specific example of an object with constant velocity. 	Inertia, mass, weight, net-force, force, acceleration, constant velocity.	Demonstrations to illustrate Newton's 1 st law: <ul style="list-style-type: none"> • Dry ice • Hover puck • Air tracks
		4	<p>Using Newton's 2nd Law of Motion, analyze the relationships among the net force acting on a body, the mass of the body, and the resulting acceleration:</p> <ul style="list-style-type: none"> - numerically • graphically • mathematically <ul style="list-style-type: none"> - Draw and label force diagrams 	force, mass and acceleration net-force, freefall, terminal velocity. force diagrams, friction, inclines, Atwood's machine	Lab work to discover the relationship between the net force, acceleration, and mass of an object.
		5	<p>Use Newton's 3rd Law to explain forces as interactions between bodies (e.g., a table pushing up on a vase that is pushing down on it; an athlete pushing on a basketball as the ball pushes back on her).</p>	action, reaction	Examples of action reaction.
		6	<p>Analyze the two-dimensional motion of objects by using vectors and their components.</p>	projectile motion, x component, y component, resultant, horizontal vs vertical components, range	Projectile motion lab
		7	<p>Give an example that shows the independence of the horizontal and vertical components of projectile motion.</p>		
8	<p>Analyze the general relationships among force, acceleration, and motion for an object undergoing uniform circular motion.</p>	centripetal force, centrifugal force, centripetal acceleration, velocity vs. speed in a circle, period, tangent, orbits	Circular Motion Lab		

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S5C2 (cont.)	Motions and Forces	9	Represent the force conditions required to maintain static equilibrium.	Kilograms vs. Newtons, net-force, vector sums using vector rules.	Force-Table Labs
		10	Describe the nature and magnitude of frictional forces. - Friction is a force that opposes motion.	static friction, sliding friction, normal, coefficient of Friction	Friction lab
		11	Using the Law of Universal Gravitation, predict how the gravitational force will change when the distance between two masses changes or the mass of one of them changes.	Inverse-Square Law	Orbit problems. Integrate with circular motion.
		12	Using Coulomb's Law, predict how the electrical force will change when the distance between two point charges changes or the charge of one of them changes. - Like charges repel - Unlike charges attract	electrostatic Forces Inverse-square law	Practice problems using charges and changing separation distances. Electrostatic lab
		13	Analyze the impulse required to produce a change in momentum. - An impulse is a force applied over a time. - Momentum is moving inertia. - Force vs. time graphs	momentum	Impulse lab
		14	Quantify interactions between objects to show that the total momentum is conserved in both collision and recoil situations. - Connect conservation of momentum to Newton's 3rd Law - Calculate initial and final velocities using conservation of momentum.	collisions, elastic, inelastic, conservation	Conservation of Momentum Lab

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S5C3	Conservation of Energy and Increase in Disorder	1	<p>Describe the following ways in which energy is stored in a system:</p> <ul style="list-style-type: none"> • mechanical • electrical • chemical • nuclear 	kinetic energy, gravitational, elastic and chemical potential energy, dissipated energy (heat)	
		2	<p>Describe various ways in which energy is transferred from one system to another (e.g., mechanical contact, thermal conduction, electromagnetic radiation.)</p> <ul style="list-style-type: none"> - Work is done by an external force - Work changes the energy of a system 	work	
		3	<p>Recognize that energy is conserved in a closed system.</p> <ul style="list-style-type: none"> - Illustrate conservation of energy using conceptual graphical representations. 		
		4	<p>Calculate quantitative relationships associated with the conservation of energy.</p> <ul style="list-style-type: none"> - Use conservation of energy to solve quantitative problems. 		

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S5C5	Interactions of Energy and Matter	2	Describe the following characteristics of waves: <ul style="list-style-type: none"> • wavelength • frequency • period • amplitude <ul style="list-style-type: none"> - Connect wave properties to both light and sound 	standing waves Doppler effect superposition	Lab to discover the relationship between the wavelength, frequency, and velocity of a wave
		3	Quantify the relationships among the frequency, wavelength, and the speed of light.		Solve quantitative problems using the wave equation.
		8	Describe the relationship among electric potential, current, and resistance in an ohmic system.	voltage, batteries, circuits, resistors	Ohm's Law Lab
		9	Quantify the relationships among electric potential, current, and resistance in an ohmic system. <ul style="list-style-type: none"> - Analyze simple circuits to determine voltage, current and power of both individual components of the circuit and the total circuit - Understand how conservation of energy applies to circuit analysis. - Understand how power relates to the brightness of a light bulb - Display knowledge of basic household electrical safety. 	series circuits, parallel circuits, combination circuits, total resistance.	Analyze circuits by completing a voltage, current, and power table
	Geometric Optics	MPS	Qualitatively and Quantitatively analyze optical phenomena. <ul style="list-style-type: none"> - Predict the path of light rays using reflection and refraction. - Draw ray diagrams for lenses and mirrors. - Algebraically solve for image distance, object distance, and magnification. - Apply geometric optics to simple optical devices. (magnifying glass, telescopes, eye glasses.....) 	mirrors, lenses, converging, diverging, concave, convex, focal point, magnification, reflection, refraction, dispersion	Lab to discover the relationship between image distance and object distance.

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