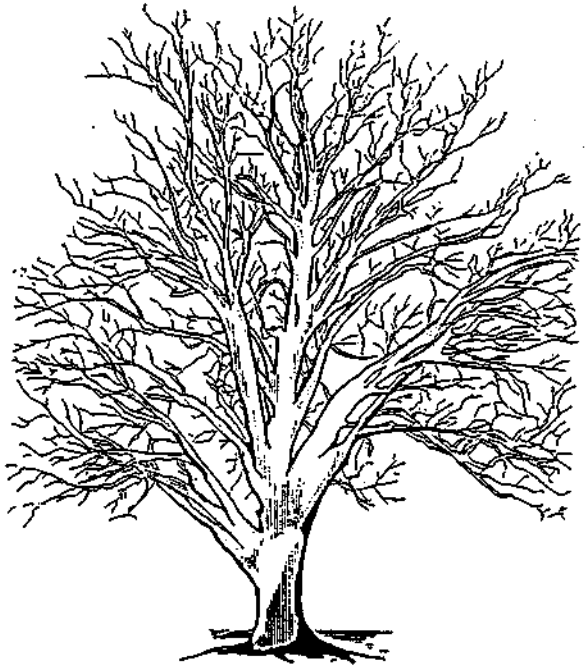
Monroe Township Schools



Curriculum Management System

Advanced Placement Physics

Grade 11-12

July 2005

*** For adoption by all regular education programs as specified and for adoption or adaptation by**

Board Approved: August 2005

all Special Education Programs in accordance with Board of Education Policy # 2220.

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Acknowledgments

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Monroe Township Schools
Mission and Goals

Mission

The mission of the Monroe Township School District, a unique multi-generational community, is to collaboratively develop and facilitate programs that pursue educational excellence and foster character, responsibility, and life-long learning in a safe, stimulating, and challenging environment to empower all individuals to become productive citizens of a dynamic, global society.

Goals

To have an environment that is conducive to learning for all individuals.

To have learning opportunities that are challenging and comprehensive in order to stimulate the intellectual, physical, social and emotional development of the learner.

To procure and manage a variety of resources to meet the needs of all learners.

To have inviting up-to-date, multifunctional facilities that both accommodate the community and are utilized to maximum potential.

To have a system of communication that will effectively connect all facets of the community with the Monroe Township School District.

To have a staff that is highly qualified, motivated, and stable and that is held accountable to deliver a safe, outstanding, and superior education to all individuals.

INTRODUCTION, PHILOSOPHY OF EDUCATION, AND EDUCATIONAL GOALS

Introduction and Philosophy

The effective district K-12 Science Education program will provide students with inquiry- based skills and an understanding of the scientific process, which will enable them to be successful in their exploration and investigation of our ever-changing technological world. Students will develop higher - level critical thinking and problem - solving skills that will allow them to explore their scientific environment in a multi-sensory "hands-on" and "minds-on" manner. Students' inquiry-oriented experiences will allow them to construct their own understanding of science and technology and provide opportunities for modeling true scientific practices. Students will use the Scientific Method as an approach to inquiry-based investigations. Other approaches, such as "ACACC" (developed at Monroe), the "5 E's" used by McGraw Hill or the Frisch model, may be used. Students will be able to recognize the contributions, as well as, the diverse, cultural, and social backgrounds of scientists. Students will be exposed to and use scientific tools and apparatus, scientific nomenclature and SI (metric) measurement. Students will learn and understand the underlying safety principles during their practice of Science. Workplace Readiness and Process skills will be embedded in the Program. The use of technology is infused throughout the curriculum.

As the Science program becomes more inquiry-based, the program will also become more interdisciplinary. The students will be exposed to opportunities to develop their skills and knowledge in Mathematics and Language Arts as they practice Science.

The primary beliefs of this philosophy are:

- to provide experiences that will foster and develop scientific inquiry,
- to allow students to construct their own understanding of science,
- to understand and utilize the scientific process,
- to promote an awareness of the availability and diversity of the scientific profession,
- to apply safety practices in scientific exploration,
- to integrate technology and other tools throughout the scientific process.

Each of the Science Curriculum Writing Teams, K-2, 3-5, 6-8 and the High School courses, selected topics that would address the New Jersey Core Content Standards. Additionally, these topics address some of the National Science Standards that are covered by the TerraNova Assessment. Most of the activities are based on an inquiry approach to Science and address this process standard. Additionally, Work Readiness Standards and other interdisciplinary standards, in particular Math and Language Arts, are embedded in the curriculum.

The curriculum was recently correlated with the revised Science Standards, which were adopted by the State BoE in July 2002. Our program is consistent with these standards even though some of the CPI's are in a different order. The new standards now contain four process standards and six content areas: Life Science **(LS)**, Chemistry **(C, PS)**, Physics **(P, PS)**, Earth Science **(ES),** Space Science **(SS)** and Environmental Science **(EnS).**

The K-2 program is very cursory and provides a brief glimpse into the 6 content areas and 1 of the process standards, Scientific Processes, 5.1. The grades 3-5 Science curriculum was written as a continuation of the K-2 program. Theses students will study three different units from the six major content areas: Each year, different topics in Earth Science and Physical Science are explored. The third unit rotates between Life Science and Environmental Science.

The new McGraw Hill textbook series for grades 1 through 5, incorporates many activities and experiments based on an inquiry approach. The new science kits provide many of the materials and supplies for the lab activities. Each of the elementary teachers will receive a SciKit of consumable materials, which will be replenished each year. Additionally, each grade level will receive 2 or 3 "Share Kits" to be rotated throughout the grade level as the need arises. The Share Kits contain the more durable items, such as balances, metal spatulas, PVC pipe, plastic ware, extension cords, surge protectors, microscopes, etc.

As a means to develop depth in Content Area knowledge and skill, grades 6 - 8 will study two different units. Grade 6 will cover Chemistry and Physics; Grade 7, Life Science and Environmental Science; and Grade 8, Earth Science and Space Science.

The High School program will develop depth, allow for greater flexibility and emphasize the content areas to be tested in the HSPA during grade 11. The plan is to satisfy the 3-year District and State requirement with a year of Physics, a year of Chemistry and a year of Biology. Each grade level course will have three different levels of the content area – an advanced level, a general level and a less-mathematically-challenging level, but all courses will meet the minimum requirements for the Core Curriculum Content Standards. The current grade 8 students will take Biology in grade 9, then Chemistry in the tenth grade, and Physics in the eleventh grade.

Grade K	4 Units, LS, PS, ES, EnS
Grade 1	3 Units, LS, PS, ES
Grade 2	4 Units, LS, PS, ES, SS
Grade 3	3 Units, LS, PS, ES
Grade 4	3 Units, PS, ES, EnS
Grade 5	3 Units, LS, PS, ES
Grade 6	2 Units, Chemistry, Physics
Grade 7	2 Units, Life Science, Environmental Science
Grade 8	2 Units, Earth Science, Space Science
Grade 9-11	1 Unit of Life Science, Chemistry and Physics

Educational Goals

The K-8 planned course is designed to provide all students with the skills, knowledge, and abilities to explore and observe their natural world. Students will develop an understanding of the scientific process, be able to utilize inquiry-based skills, and construct meaning from their observations and investigations, as they become proficient in:

- Life Science,
- Physical Sciences of Chemistry and Physics,
- Environmental Sciences,
- Earth and Space Sciences.

To address the Standards, the High School program includes Biology in grade 9, chemistry in grade 10 and Physics in grade 11. Additionally, a number of electives are available which may be taken in addition to the required course or in the senior year.

New Jersey State Department of Education
Core Curriculum Content Standards

The New Jersey Core Curriculum Content Standards for Science were revised in 2002. The Cumulative Progress Indicators (CPI's) referenced in this curriculum guide refer to these new standards and may be found in the Curriculum folder on the district servers. A complete copy of the new Core Curriculum Content Standards for Science may also be found at: http://www.nj.gov/njded/cccs.htm.

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade 12: AP Physics	Goal 1: The student will be able to describe and complete calculations for 1D and 2D motion using vectors.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade 12: AP Physics	Goal 1: The student will be able to describe and complete calculations for 1D and 2D motion using vectors.	
	ESPA	GEPA	HSPA	TERRA NOVA	**Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's)** **The student will be able to:**	**Instructional Tools / Materials / Technology / Resources**	**Learning Activities / Interdisciplinary Activities / Assessment Model**
15 periods					1.1. analyze position, velocity, and acceleration verse time graphs for an object moving along a straight line to determine if variables are constant, positive, negative or zero and sketch a graph of each as a function of time (5.7.12.A, 5.3.12.D.1) 1.2. write expressions for velocity and position as functions of time, and identify and sketch graphs of these quantities for an object moving with a constant acceleration (5.7.12.A, 5.3.12.D.1) 1.3. use kinematic equations to solve problems involving one-dimensional motion with constant acceleration (5.7.12.A) 1.4. relate velocity, displacement and time for motion with constant velocity (5.7.12.A) 1.5. use vectors to calculate the component of a vector along a specified axis, or resolve a vector into components along two specified mutually perpendicular axes (5.7.12.A, 5.3.12.B.1) 1.6. add vectors in order to find the net displacement of a particle that undergoes successive straight-line displacement (5.7.12.A, 5.3.12.B.1) 1.7. subtract displacement vectors	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 2 and Chapter 3 • Ticker Tape constant velocity, variable velocity and constant acceleration • 'Physics Demos' 1.4 Guinea and Feather Tube **(APP 3)** • 'Physics Demos' 1.15 Reaction Time **(APP 3)** • 'Great Adventure' Lesson Plan 2: Kinematics, p L15 **(APP 4)** • ESPN VIDEO – Sports Figures: 'Pulling G's' • DEMO illustrating that an object dropped and one projected horizontally will hit ground at same time • ESPN VIDEO – Sports Figures: 'Batting By the Books' & 'The Racquet Racket • 'Physics Demos' 1.5 Monkey and the Coconut **(APP 3)** • 'Physics Demos' 1.6 Ballistics Car **(APP 3)** • PASCO PASPORT Projectile Launcher Experiment 8: DEMO Do 30 and 60 Give Same Range? Experiment 9: DEMO Simultaneously Shoot Two Balls Horizontally at Different Speeds Experiment 10: DEMO Shoot Through Hoops	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 2 and Chapter 3 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice • Concurrent Forces in Equilibrium Experiment **(APP 11)** • Bull's Eye Lab CONCEPTUAL PHYSICS, Hewitt **(APP 12)** • PASCO PASPORT Lab 01 Relative Motion-Frame of Reference Lab 04 Acceleration- Cart on an Inclined Track Lab 12 Projectile Motion- Initial Speed and Time of Flight • PASCO PASPORT Time of Flight Experiment 1: The Relationship between Time of Flight and Initial Velocity Experiment 2: Predicting the Horizontal Distance Traveled from a Launched Projectile Experiment 3: Horizontal Velocity of a Projectile • PASCO PASPORT Projectile Launcher Experiment 1: Projectile Motion Experiment 2: Projectile Motion Using Photogates Experiment 3: Projectile Range versus Angle

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 2: The student will be able to demonstrate an understanding of the forces of nature and describe how one or more forces affect the motion of the objects.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 2: The student will be able to demonstrate an understanding of the forces of nature and describe how one or more forces affect the motion of the objects.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model
10 periods					2.1. analyze situations in which a particle remains at rest, or moves with constant velocity, under the influence of several forces (5.7.12.A.1) 2.2. understand the relation between the force that acts on a body and the resulting change in the body's velocity (5.7.12.A.1) 2.3. calculate, for a body moving in one direction, the velocity change that results when a constant force acts over a specified time interval (5.7.12.A.1) 2.4. determine, for a body moving in a plane whose velocity vector undergoes a specified change over a specified time interval, the average force that acted on the body (5.7.12.A.1) 2.5. understand how Newton's Second Law of motion applies to a body subject to forces such as gravity, the pull of strings, or contact forces (5.7.12.A.1) 2.6. draw a well-labeled diagram showing all real forces that act on the body (5.7.12.A) 2.7. write down the vector equation that results from applying Newton's Second Law to the body, and take components of this equation along appropriate axes (5.7.12.A.1)	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 4 • Fan Cart DEMO • NJ Framework Indicator 17: Newton's Third Law of Motion **(APP 1)** • Newton's Laws Demos ~ Teachers Discover **(APP 13)** • 'Physics Demos' 1.8 Inertia Balls **(APP 3)** • 'Physics Demos' 1.16 Beaker and Tablecloth **(APP 3)** • 'Physics Demos' 1.17 Inclined Plane **(APP 3)** • ESPN VIDEO – Sports Video: 'What a Drag' and 'Newton's Hat Trick' • Carpenter, D. Rae JR and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • www.skilinks.org Forces KEYWORD: HF2041 Newton's Laws KEYWORD: HF2042 Friction KEYWORD: HF2044 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 4 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice • Dynamics Experiment **(APP 17)** • Coefficient of Friction Lab **(APP 14)** • Flight Testing Newton's Laws ~ NASA CD • PASCO PASPORT Lab 05 Newton's First Law of Motion- No Net Force Lab 06 Newton's Second Law of Motion- Acceleration Lab 07 Newton's Third Law of Motion- Tug-of-War Lab 08 Friction Forces- Static and Sliding • PASCO PASPORT Fan Accessory Experiment 1 – Experiment 4 • PASCO PASPORT Force Sensor Bracket and Collision Bumpers

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 3: The student will be able to define, explain and calculate work, different forms of energy and energy transformations.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 3: The student will be able to define, explain and calculate work, different forms of energy and energy transformations.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model
8 periods					3.1. understand the definition of work (5.7.12.A) 3.2. calculate the work done by a specified constant force on a body that undergoes a specified displacement (5.7.12.A) 3.3. relate the work done by a force to the area under a graph of force as a function of position, and calculate the work in the case where the force is a linear function of position(5.3.12.D.1, 5.7.12.A) 3.4. use the scalar product operation to calculate the work performed by a specified constant force on a body that undergoes a displacement in a plane (5.7.12.A) 3.5. state the work-energy theorem and calculate the change in kinetic energy or speed that results from performing a specified amount of work on a body (5.7.12.B) 3.6. calculate the work performed by the net force, or by each of the forces that makes up the net force, on a body that undergoes a specified change in speed it kinetic energy (5.7.12.B) 3.7. apply the work-energy theorem to determine the change in a body's kinetic energy and speed that results	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 5 • 'Physics Demos' 1.1 Bowling Ball Pendulum **(APP 3)** • 'Physics Demos' 1.2 Come Back Can **(APP 3)** • 'Great Adventure' Lesson Plan 3: Work and Energy, p L8-L9 **(APP 4)** • 'Great Adventure' Lesson Plan 4: Potential and Kinetic Energy, p L11-L12 **(APP 4)** • ESPN VIDEO – Sports Figures: 'Energizer Bungee' and 'Bouncing Bungee' • Carpenter, D. Rae JR and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • www.scilinks.org Work KEYWORD: HF2051 Potential and Kinetic Energy KEYWORD: HF2052 Conservation of Energy KEYWORD: HF2053 Nuclear Reactions KEYWORD: HF2054 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 5 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice • Hooke's Law and Conservation of Energy Lab **(APP 15)** • Stretch Lab **(APP 16)** • 'Great Adventure' Classroom Lab: Inclined to Work, p L10 **(APP 4)** • 'Great Adventure' Classroom Lab: Using Your Potential to Hit that Spot, p L13-L14 **(APP 4)** • Releasing Your Potential Lab **(APP 18)** • 'Physics Research Project' The Energy in a Spring **(APP 2)** • PASCO PASPORT Lab 10 Conserve Energy – GPE and KE • PASCO PASPORT Projectile Launcher Experiment 5: Conservation of Energy

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 4: The student will be able to calculate linear momentum based on the definition and the law of conservation of momentum for different types of collisions.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 4: The student will be able to calculate linear momentum based on the definition and the law of conservation of momentum for different types of collisions.	
	ESPA	GEPA	HSPA	TERRA NOVA	**Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's)** **The student will be able to:**	**Instructional Tools / Materials / Technology / Resources**	**Learning Activities / Interdisciplinary Activities / Assessment Model**
8 periods					4.1. relate mass, velocity, and linear momentum for a moving body, and calculate the total linear momentum of a system of bodies (5.7.12.A) 4.2. relate impulse to the change in linear momentum and the average force acting on a body (5.7.12.A) 4.3. identify situations in which linear momentum, or a component of the linear momentum vector, is conserved (5.7.12.A) 4.4. apply linear momentum conservation to determine the final velocity when two bodies that are moving along the same line, or at right angles, collide and stick together, and calculate how much kinetic energy is lost in such a situation (5.7.12.A, 5.7.12.B) 4.5. analyze collisions of particles in one or two dimensions to determine unknown masses or velocities, and calculate how much kinetic energy is lost in a collision (5.7.12.A, 5.7.12.B)	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 6 • Collision of Balls DEMOS **(APP 19-20)** • Air Track DEMOS **(APP 21-26)** • Collision in 2-D DEMO • 'Great Adventure' Lesson Plan 5: Impulse and Momentum, p L15-L16 **(APP 4)** • Carpenter, D. Rae JR and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • www.scilinks.org Momentum KEYWORD: HF2061 Rocketry KEYWORD: HF2062 Collisions KEYWORD: HF2064 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 6 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice • Conservation of Momentum Lab **(APP 27)** • 'Physics Research Activities': The Conservation of Momentum **(APP 2)** • PASCO PASPORT Lab 11 Impulse and Change in Momentum- Collision • PASCO PASPORT Projectile Launcher Experiment 6: Conservation of Momentum in Two Dimension

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 5: The student will be able to exhibit an understanding of rotational motion, rotational equilibrium and rotational dynamics.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 5: The student will be able to exhibit an understanding of rotational motion, rotational equilibrium and rotational dynamics.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model
10 periods					5.1. relate the radius of the circle and the speed or rate of revolution of the particle undergoing uniform circular motion, to the magnitude of the centripetal acceleration (5.7.12.A) 5.2. describe the direction of the particle's velocity and acceleration at any instant during uniform circular motion (5.7.12.A) 5.3. determine the components of the velocity and acceleration vectors at any instant of uniform circular motion, and sketch or identify graphs of these quantities (5.7.12.A) 5.4. recognize the conditions under which the law of conservation of angular momentum is applicable and relate this law to one- and two-particle systems such as satellite orbits (5.7.12.A) 5.5. calculate the magnitude and sense of the torque associated with a given force (5.7.12.A) 5.6. calculate the torque on a rigid body due to gravity (5.7.12.A) 5.7. analyze problems in statics and state the conditions for translational and rotational equilibrium of a rigid body (5.7.12.A) 5.8 analyze and apply	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 7 and Chapter 8 • 'Physics Demos' 1.3 Bicycle Wheel Gyroscope **(APP 3)** • Linear Momentum/Center of Mass DEMO **(APP 28)** • Rotating Candles DEMO • Loop the Loop DEMO • Centrifugal Hoop DEMO • 'Great Adventure' Lesson Plan 6: Vectors and Circular Motion, p L17-L18 **(APP 4)** • 'Great Adventure' Swing Ride Demonstrator, p L21-L22 **(APP 4)** • 'Great Adventure' Lesson Plan 7: Circular Motion and Friction, p L25-L26 **(APP 4)** • 'Great Adventure' Lesson Plan 8: Forces and Vertical Circles, p L29-L32 **(APP 4)** • ESPN VIDEO – Sports Video: 'Balanced Forces' • Carpenter, D. Rae JR and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • www.scilinks.org Torque KEYWORD: HF2081 Center of Mass KEYWORD: HF2082 Simple Machines KEYWORD: HF2083 Rutherford Model of Atom KEYWORD: HF2084	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 7 and 8 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice • 'Great Adventure' Swing Ride Problems, p L19 **(APP 4)** • 'Great Adventure' Classroom Lab: On the Swing Ride, p L23-L24 **(APP 4)** • 'Great Adventure' On the Merry-Go-Round and Typhoon Problems, p L27 **(APP 4)** • 'Great Adventure' Roller Coaster Problems, p L35 **(APP 4)** • Torque Lab **(APP 31)** • Bridge Contest **(APP 32)** • PASCO PASPORT Lab 13 Circular Motion- Centripetal Force

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 6: The student will be able to apply Newton's Law of Universal Gravitation.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 6: The student will be able to apply Newton's Law of Universal Gravitation.	
	ESPA	GEPA	HSPA	TERRA NOVA	**Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's)** **The student will be able to:**	**Instructional Tools / Materials / Technology / Resources**	**Learning Activities / Interdisciplinary Activities / Assessment Model**
5 periods					6.1. use Newton's Law of Gravitation to determine the force that one spherically symmetrical mass exerts on another (5.7.12.A.3) 6.2. use Newton's Law of Gravitation to determine the strength of the gravitational field at a specified point outside a spherically symmetrical mass (5.7.12.A.3) 6.3. recognize that the motion of a body in circular orbit under the influence of gravitational forces does not depend on the body's mass (5.7.12.A.3) 6.4. describe qualitatively how the velocity, period of revolution, and centripetal acceleration depend upon the radius of the circular orbit (5.7.12.A.3) 6.5. derive expressions for the velocity and period of revolution of a body in circular orbit (5.7.12.A.3) 6.6. apply conservation of angular momentum to determine the velocity and radial distance of an object in a general orbit at any point (5.7.12.A.3) 6.7. apply angular momentum conservation and energy conservation to relate the speeds of a body at the two extremes of an elliptic orbit (5.7.12.B.2)	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 7 • NJ Framework Indicator 17: Gravity and Distance **(APP 1)** • 'Physics Demos' 1.7 Pail of Water **(APP 3)** • Carpenter, D. Rae JR and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • www.scilinks.org Law of Gravitation KEYWORD: HF2073 Black Holes KEYWORD: HF2074 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 7 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice • Measuring Acceleration Due to Gravity Lab **(APP 30)** • 'Enrichment' Timing a Comet Enrichment **(APP 29)** • PASCO PASPORT Lab 22 Archimedes' Principle-Buoyant Force

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 7: The student will be able to demonstrate an understanding of fluid mechanics.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 7: The student will be able to demonstrate an understanding of fluid mechanics.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model
5 periods					7.1. understand that a fluid exerts pressure in all directions (5.7.12.A) 7.2. understand that a fluid at rest exerts pressure perpendicular to any surface that it contacts (5.7.12.A) 7.3. understand and be able to use the relationship between pressure and depth in a liquid (5.7.12.A) 7.4. understand that the difference in the pressure in the upper and lower surfaces of an object immersed in liquid results in an upward force on the object (5.7.12.A) 7.5. understand and be able to apply Archimedes' principle: the buoyant force in a submerged object is equal to the weight of the liquid it displaces (5.7.12.A) 7.6. understand that for laminar flow, the flow rate of a liquid through its cross section is the same at any point along its path (5.7.12.A) 7.7. understand and be able to apply the equation of continuity (5.7.12.A) 7.8. understand that the pressure of a flowing liquid is low where the velocity is high, and vice versa (5.7.12.A) 7.9. understand and be able to	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 9 • DEMO – vacuum, bell jar and balloon, beaker of water, marshmallow • DEMO- how a suction cup works • Carpenter, D. Rae Jr. and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • www.scilinks.org Archimedes KEYWORD: HF2091 Buoyancy KEYWORD: HF2092 Atmospheric Pressure KEYWORD: HF 2093 Bernoulli's Principle KEYWORD: HF2094 Gas Laws KEYWORD: HF2095 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 9 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 8: The student will be able to define, explain and perform various temperature and heat calculations.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 8: The student will be able to define, explain and perform various temperature and heat calculations.	
	ESPA	GEPA	HSPA	TERRA NOVA	**Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's)** **The student will be able to:**	**Instructional Tools / Materials / Technology / Resources**	**Learning Activities / Interdisciplinary Activities / Assessment Model**
5 periods					8.1. understand the 'mechanical equivalent of heat' so they can calculate how much a substance will be heated by the performance of a specified quantity of mechanical heat (5.7.12.B) 8.2. understand the concepts of specific heat, heat of fusion, and heat of vaporization so they can identify, given a graph relating the quantity of heat added to a substance and its temperature , the melting point, and boiling point and determine the heats of fusion and vaporization and the specific heat of each phase (5.7.12.B) 8.3. determine how much heat must be added to a sample to raise its temperature from one specified value to another, or to cause it to melt or vaporize (5.7.12.B) 8.4. understand heat transfer and thermal expansion so they can determine the final temperature achieved when substances, all at different temperatures, are mixed and allowed to come to thermal equilibrium (5.7.12.B) 8.5. calculate how the flow of heat through a slab of material is affected by changes in the thickness or area of the slab,	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 10 • Carpenter, D. Rae Jr. and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • www.scilinks.org Temperature Scales KEYWORD: HF2101 James Prescott Joule KEYWORD: HF2102 Specific Heat KEYWORD: HF2103 Heat Pumps KEYWORD: HF2104 Conduction and Convention KEYWORD: HF2105 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 10 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice • PASCO PASPORT Lab 23 Transfer of Energy - Radiation

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 9: The student will be able to exhibit as understanding of kinetic theory, ideal gas laws and thermodynamics.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 9: The student will be able to exhibit as understanding of kinetic theory, ideal gas laws and thermodynamics.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model
5 periods					9.1. state the assumptions of the kinetic theory model of an ideal gas (5.7.12.B) 9.2. state the connection between temperature and mean translational kinetic energy, and apply it to determine the mean speed of gas molecules as a function of their mass and the temperature of the gas (kinetic theory model of an ideal gas) (5.7.12.B) 9.3. state the relationship among Avogadro's number, Boltzmann's constant, and the gas constant *R*, and express the energy of a mole of monatomic ideal gas as a function of its temperature (5.7.12.B) 9.4. explain qualitatively how the kinetic theory model of an ideal gas explains the pressure of a gas in terms of collisions with the container walls, and explains how the model predicts that pressure must be proportional to temperature for a fixed volume (5.7.12.B) 9.5. relate the pressure and volume of a gas during an isothermal expansion or compression by applying the ideal gas law and thermodynamics principles (5.7.12.B)	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 11 • Carpenter, D. Rae Jr. and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • www.scilinks.org Energy Transfer KEYWORD: HF2111 Thermodynamics KEYWORD: HF2112 Heat Engine KEYWORD: HF2113 Stirling Engines KEYWORD: HF2114 Entropy KEYWORD: HF2115 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 11 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 10: The student will be able to define, explain, and demonstrate an understanding of the Laws of Thermodynamics.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 10: The student will be able to define, explain, and demonstrate an understanding of the Laws of Thermodynamics.	
	ESPA	GEPA	HSPA	TERRA NOVA	**Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's)** **The student will be able to:**	**Instructional Tools / Materials / Technology / Resources**	**Learning Activities / Interdisciplinary Activities / Assessment Model**
5 periods					10.1. apply the first law of thermodynamics to relate the heat absorbed by a gas, the work performed by the gas, and the internal energy change of the gas for isothermal expansion or compression, constant-volume heating or cooling, constant-pressure heating or cooling, adiabatic expansion or compression (5.7.12.B) 10.2. apply first law of thermodynamics to relate the work preformed by a gas in a cyclic process to the area enclosed by a curve on a *pV* diagram (5.7.12.B, 5.3.12.D.1) 10.3. understand the second law of thermodynamics, the concept of entropy, and heat engines and the Carnot cycle (5.7.12.B) 10.4. determine whether entropy will increase, decrease, or remain the same during a particular situation (5.7.12.B) 10.5. compute the maximum possible efficiency of heat engine operating between two given temperatures (5.7.12.B) 10.6. compute the actual efficiency of a heat engine (5.7.12.B) 10.7. relate the heats exchanged at each thermal reservoir in a Carnot cycle to the temperature of the reservoirs	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 12 • Carpenter, D. Rae Jr. and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • www.scilinks.org Energy Transfer KEYWORD: HF2111 Thermodynamics KEYWORD: HF2112 Heat Engine KEYWORD: HF2113 Stirling Engines KEYWORD: HF2114 Entropy KEYWORD: HF2115 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 12 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 11: The student will be able to illustrate an understanding of simple harmonic motion.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 11: The student will be able to illustrate an understanding of simple harmonic motion.	
	ESPA	GEPA	HSPA	TERRA NOVA	**Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's)** **The student will be able to:**	**Instructional Tools / Materials / Technology / Resources**	**Learning Activities / Interdisciplinary Activities / Assessment Model**
8 periods					11.1. understand the kinematics of simple harmonic motion so they can sketch and identify a graph of displacement as a function of time, and determine from such a graph the amplitude, period, and frequency of the motion (5.7.12.A) 11.2. write down an appropriate expression for displacement of the form *A*sin*ωt* or *A*cos*ωt* to describe the motion (5.7.12.A) 11.3. identify the points in the motion where the velocity is zero and achieves its maximum positive or negative value (5.7.12.A) 11.4. state qualitatively the relation between acceleration and displacement (5.7.12.A) 11.5. identify points in the motion where the acceleration is zero and achieves its greatest positive or negative value (5.7.12.A) 11.6. state and apply the relation between frequency and period (5.7.12.A) 11.7. state how the total energy of an oscillating system depends on the amplitude of the motion, sketch and identify a graph of kinematic or potential energy as a function of time, and identify points in the motion where this energy is all	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 13 • Carpenter, D. Rae Jr. and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • ESPN Sports Video 'How Sweet It Is' • www.scilinks.org Hooke's Law KEYWORD: HF2121 Pendulums KEYWORD: HF2122 Wave Motion KEYWORD: HF2123 Electron Microscope KEYWORD: HF2124 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 13 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice • The Pendulum – Experiment 10 **(APP 41)** • A Controlled Experiment: The Simple Pendulum **(APP 42)** • Ripple Tank Experiments **(APP 43)**

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 12: The student will be able to explain and calculate the properties and effects of basic wave motion and sound waves.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 12: The student will be able to explain and calculate the properties and effects of basic wave motion and sound waves.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model
13 periods					12.1. Sketch or identify graphs that represent traveling waves and determine the amplitude, wavelength and frequency of a wave from such a graph (5.7.12.B.1) 12.2. state and apply the relation among wavelength, frequency, and velocity for a traveling wave (5.7.12.B.1) 12.3. sketch or identify graphs that describe reflection of a wave from the fixed or free end of a string (5.7.12.B.1) 12.4. know qualitatively what factors determine the speed of waves on a string and the speed of sound (5.7.12.B.1) 12.5. sketch possible standing wave modes for a stretched string that is fixed at both ends, and determine the amplitude, wavelength, and frequency of such standing waves (5.7.12.B.1) 12.6. describe possible standing sound waves in a pipe that has either open or closed ends, and determine the wavelength and frequency of such standing waves (5.7.12.B.1) 12.7. explain the mechanism that gives rise to a frequency shift in both the moving-source and moving-observer case, and derive an expression for the	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 13 and Chapter 14 • Carpenter, D. Rae Jr. and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • Wave Pulses and Coat Hanger DEMO **(APP 44)** • Rotating Slinky on Overhead DEMO **(APP 45)** • Fundamental Frequency of a Bar DEMO **(APP 46)** • Singing Rod DEMO • www.scilinks.org Sound KEYWORD: HF2131 Doppler Effect KEYWORD: HF2133 Resonance KEYWORD: HF2134 Harmonics KEYWORD: HF2135 Acoustics KEYWORD: HF2132 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 13 and Chapter 14 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice • Speed of Sound Lab **(APP 47)** • PASCO PASPORT Lab 20 Sound Wave properties Lab 21 Superposition and Interference in Sounds • Sound Barrier Lab **(APP 48)** • 'Physics Research Activities' Resonance **(APP 2)**

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 13: The student will be able to exhibit an understanding of electrostatics.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 13: The student will be able to exhibit an understanding of electrostatics.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model
5 periods					13.1. define electric field in terms of the force on a test charge (5.7.12.A) 13.2. calculate the magnitude and direction of the electric force on a positive or negative charge placed in a specific field (5.7.12.A.4) 13.3. given a diagram on which an electric field is represented by flux lines, determine the direction of the field at a given point, identify locations where the field is strong and where it is weak, and identify where positive or negative charges must be present (5.7.12.A) 13.4. analyze the motion of a particle of specified charge and mass in a uniform electric field (5.7.12.A.4) 13.5. apply the concept of electric potential to calculate the electrical work done on a positive or negative charge that moves through a specified potential difference (5.7.12.B) 13.6. given a sketch of equipotentials for a charge configuration, determine the direction an approximate magnitude of the electric field at various positions (5.7.12.A) 13.7. apply conservation of energy to determine the speed of a charged particle that has been	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 15 • Carpenter, D. Rae Jr. and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • NJ Framework Indicator 19: Electrostatic **(APP 1)** • NJ Framework Indicator 19: Gravitational and Electrostatic Forces **(APP 1)** • Van de Graaff DEMOS **(APP 33)** • Static Electric DEMOS **(APP 34)** • 'Physics Research Activities' The Static Electric Magic Wand **(APP 2)** • www.scilinks.org Electric Charge KEYWORD: HF2171 Conductors and Insulators KEYWORD: HF2172 Coulomb's Law KEYWORD: HF2173 Microwaves KEYWORD: HF2174 Van de Graaff Generator KEYWORD: HF2175 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 15 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice • PASCO PASPORT Lab 17 Electric Field • Static Electricity Activity **(APP 35)** • Investing Static Electricity Lab **(APP 36)** • 'Physics Research Activity' Do Electrical Opposites Attract? **(APP 2)**

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 14: The student will be able to explain the properties of conductors, capacitors, and dielectric.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 14: The student will be able to explain the properties of conductors, capacitors, and dielectric.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model
5 periods					14.1. explain the mechanics responsible for the absence of electric field inside a conductor, and why all excess charge must reside on the surface of the conductor due to the nature of the electric fields in and around conductors (5.7.12.A.4) 14.2. explain why a conductor must be an equipotential, and apply this principle in analyzing what happens when conductors are connected by wires (5.7.12.A) 14.3. determine the direction of the force on a charged particle brought near an uncharged or grounded conductor due to the nature of the electric fields in and around conductors (5.7.12.A) 14.4. describe and sketch a graph of the electric field and potential inside and outside a charged conducting sphere (5.7.12.A) 14.5. describe qualitatively the process of charging by induction (5.7.12.A) 14.6. determine the direction of the force on a charged particle brought near an uncharged or grounded conductor due to electrostatic shielding (5.7.12.A) 14.7. define capacitance and relate stored charge and voltage for	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 16 • Carpenter, D. Rae Jr. and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • www.scilinks.org Electrical Energy KEYWORD: HF2181 Batteries KEYWORD: HF2182 Michael Faraday KEYWORD: HF2184 Capacitance KEYWORD: HF2183 Electric Vehicles KEYWORD: HF2185 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 16 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice • 'Physics Research Activities' What is Your Electric Potential? **(APP 2)**

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 15: The student will be able to illustrate an understanding of electric current, resistance, electric circuits and be able to compute values of electric circuits.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 15: The student will be able to illustrate an understanding of electric current, resistance, electric circuits and be able to compute values of electric circuits.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model
10 periods					15.1. understand the definition of electric current so they can relate the magnitude and direction of the current in a wire or ionized medium to the rate of flow of positive and negative charge (5.7.12.A) 15.2. understand conductivity, resistivity, and resistance (5.7.12.A) 15.3. relate current and voltage for a resistor (5.7.12.A) 15.4. describe how the resistance of a resistor depends upon its length and cross-sectional area (5.7.12.A) 15.5. apply the relationships for the rate of heat production in a resistor (5.7.12.B) 15.6. identify on an circuit diagram whether resistors are in series or in parallel (5.7.12.A) 15.7. determine the ratio of the voltages across resistors connected in series or the ratio of the currents through resistors connected in parallel (5.7.12.A) 15.8. calculate the equivalent resistance of two or more resistors connected in series or in parallel, or of a network of resistors that can be broken down into series and parallel combinations (5.7.12.A) 15.9. calculate the voltage, current,	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 17 and Chapter 18 • Carpenter, D. Rae Jr. and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • Human Circuit DEMO **(APP 37)** • www.scilinks.org Electric Current KEYWORD: HF2191 Generators KEYWORD: HF2192 Ohm's Law KEYWORD: HF2193 Superconductors KEYWORD: HF2194 Electric Circuit KEYWORD: HF2201 Resistors KEYWORD: HF2202 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 17 and Chapter 18 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice • PASCO PASPORT Lab 16 Ohm's Law • 'Physics Research Activities' Billions upon Billions of Electrons per Second **(APP 2)** • 'Physics Research Activities' Series Circuits **(APP 2)** • 'Physics Research Activities' Parallel Circuits **(APP 2)** • EKI Science Electronic Lab – Circuit Board Labs with LED and Speakers **(APP 38 & 39)**

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 16: The student will be able to display an understanding of magnetostatics.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 16: The student will be able to display an understanding of magnetostatics.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model
8 periods					16.1. calculate the magnitude and direction of the force in terms of *q, **v**, and **B***, and explain why the magnetic force can perform no work (5.7.12.A) 16.2. deduce the direction of a magnetic field from information about the forces experienced by charged particles moving through that field (5.7.12.A.7) 16.3. state and apply the formula for the circular path of a charge that moves perpendicular to a uniform magnetic field, and derive this formula from Newton's Second Law and the magnetic force law (5.7.12.A.8) 16.4. describe the most general path possible for a charged particle moving in a uniform magnetic field, and describe the motion of a particle that enters a uniform magnetic field moving with specified initial velocity (5.7.12.A.7) 16.5. describe quantitatively under what conditions particles will move with constant velocity through crossed electric and magnetic fields (5.7.12.A.8) 16.6. calculate the magnitude and direction of the force on a straight segment of current-carrying wire in a uniform magnetic field (5.7.12.A.8)	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 19 • Carpenter, D. Rae Jr. and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • Magnetic Compass Board and Field on overhead DEMO • www.skilinks.org Magnets KEYWORD: HF2211 Electromagnets KEYWORD: HF2212 Magnetic Fields KEYWORD: 2221 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 19 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice • 'Physics Research Activities' Do Magnetic Opposites Attract? **(APP 2)**

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 17: The student will be able to exhibit an understanding of electromagnetism.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 17: The student will be able to exhibit an understanding of electromagnetism.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model
8 periods					17.1. understand the concept of magnetic flux so they can calculate the flux of a uniform magnetic field through a loop of arbitrary orientation (5.7.12.A.8) 17.2. understand Faraday's Law and Lenz's Law so they can recognize situations in which changing flux though a loop will cause an induced emf or current in the loop (5.7.12.A.7) 17.3. calculate magnitude and direction of the induced emf and current in square loop of wire pulled at a constant velocity into or out of a uniform magnetic field (5.7.12.A.7) 17.4. calculate magnitude and direction of the induced emf and current in a loop of wire placed in a spatially uniform magnetic field whose magnitude is changing at a changing at constant rate (5.7.12.A.7) 17.5. calculate magnitude and direction of the induced emf and current in a loop of wire that rotates at a constant rate about an axis perpendicular to a uniform magnetic field (5.7.12.A.7) 17.6. calculate magnitude and direction of the induced emf and current in a conducting	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 20 and Chapter 21 • Carpenter, D. Rae Jr. and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • www.skilinks.org Magnets KEYWORD: HF2211 Electromagnets KEYWORD: HF2212 Transformers KEYWORD: HF2224 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 19 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice • PASCO PASPORT Lab 18 Magnetic Field- Current in a Coil Lab 19 Faraday's Law-Electromagnetic Induction

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 18: The student will be able to demonstrate an understanding of the principles of geometric optics.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 18: The student will be able to demonstrate an understanding of the principles of geometric optics.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model
15 periods					18.1. understand the principles of reflection and refraction (5.7.12.B.4) 18.2. determine how the speed and wavelength of light changes when light passes from one medium into another (5.7.12.B.4) 18.3. show on a diagram the directions of reflected and refracted rays (5.7.12.B.4) 18.4. use Snell's Law to relate the direction of the incident ray and the refracted ray, and the indices of refraction of the media (5.7.12.B.4) 18.5. identify conditions under which total internal reflection will occur (5.7.12.B.4) 18.6. understand image formation by plane or spherical mirrors (5.7.12.B.4) 18.7. relate the focal point of a spherical mirror to its center of curvature (5.7.12.B.4) 18.8. given a diagram of a mirror with the focal point shown, locate by ray tracking the image of a real object and determine whether the image is real or virtual, upright or inverted, enlarged or reduced in size (5.7.12.B.4) 18.9. understand the image formation by converging or diverging lenses (5.7.12.B.4)	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 22 and Chapter 23 • Carpenter, D. Rae Jr. and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • NJ Frameworks Indicator 22: Color **(APP 1)** • Reflection DEMO **(APP 50)** • Persistence of Vision **(APP 51)** • 'Physics Research Activities' Why the Sky is Blue **(APP 2)** • DEMOS with flat, concave, and convex mirrors • Fish tank & milk water DEMOS • www.scilinks.org Electromagnetic Spectrum KEYWORD: HF2141 Light Bulbs KEYWORD: HF2142 Mirrors KEYWORD: HF2143 Telescopes KEYWORD: HF2144 Color KEYWORD: HF2145 Snells' Law KEYWORD: HF2151 Lenses KEYWORD: HF2152 Abnormalities KEYWORD: HF2153 Fiber Optics KEYWORD: HF2154 Dispersion of Light KEYWORD: HF2155 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 22 and Chapter 23 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice • Critical Thinking – Using Light it Estimate Distance **(APP 49)** • Periscope **(APP 52)** • Building and Using a Pinhole Tube **(APP 53)** • Building an Astronomical Telescope **(APP 54)** • Making a Pinhole Viewer **(APP 55)** • The Amies Window – a simple illusion **(APP 56)** • 'Physics Research Activities' Through the Looking Glass **(APP 2)** • 'Physics Research Activities' Lenses **(APP 2)** • Ripple Tank Experiments **(APP 43)** • PASCO PASPORT Basic Optics Experiment 1: Color Addition Experiment 2: Prisms Experiment 3: Reflection; Plane and Curved Mirrors Experiment 4: Snell's Law Experiment 5: Total Internal Reflection Experiment 6: Refraction; Convex and Concave Lenses Experiment 7: Lensmaker's Equation Experiment 8: Apparent Depth

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 19: The student will be able to illustrate an understanding of physical optics.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 19: The student will be able to illustrate an understanding of physical optics.	
	ESPA	GEPA	HSPA	TERRA NOVA	**Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's)** **The student will be able to:**	**Instructional Tools / Materials / Technology / Resources**	**Learning Activities / Interdisciplinary Activities / Assessment Model**
10 periods					19.1. understand the interference and diffraction of waves (5.7.12.B.4) 19.2. describe the conditions under which the waves reaching an observation point from two or more sources will all interfere constructively, or under which the waves from two sources will interfere destructively (5.7.12.B.4) 19.3. determine location of interference maxima or minima for two sources or determine the frequencies or wavelengths that can lead to constructive or destructive interference at a certain point (5.7.12.B.4) 19.4. relate the amplitude and intensity produced by two or more sources that interfere constructively to the amplitude and intensity produced by a single source (5.7.12.B.4) 19.5. Sketch or identify the intensity pattern that results when monochromatic waves pass through a single slit and fall on a distant screen, and describe how this pattern will change if the slit width or the wavelength of the waves is changed (5.7.12.B.4) 19.6. calculate, for single-slit pattern, the angles or the positions on a distant screen	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 24 and Chapter 25 • Carpenter, D. Rae Jr. and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • www.scilinks.org Interference KEYWORD: HF2161 Diffraction KEYWORD: HF2162 Lasers KEYWORD: HF2163 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 24 and Chapter 25 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice • PASCO PASPORT Lab 24 Inverse Square Law- Light Intensity vs. Distance Lab 25 Polarization • PASCO PASPORT Basic Optics Experiment 1: Color Addition Experiment 12: Shadows Experiment 13: Inverse Square Law Experiment 14: Polarization • PASCO PASPORT Polarization Analyzer Verify Malus' Law of Polarization

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 20: The student will be able to display an understanding of the concepts of atomic physics and quantum effects.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 20: The student will be able to display an understanding of the concepts of atomic physics and quantum effects.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model
5 periods					20.1. describe the Rutherford Scattering experiment and explain how it provides evidence for the existence of the atomic nucleus (5.7.12.A.5) 20.2. know the properties of photons and understand the photoelectric effect (5.7.12.A.5) 20.3. relate the energy of a photon in joules or electron-volts to its wavelength or frequency (5.7.12.A.5) 20.4. relate the linear momentum of a photon to its energy or wavelength, and apply linear momentum conservation to simple processes involving the emission, absorption, or reflection of photons (5.7.12.A.5) 20.5. calculate the number of photons per second emitted by a monochromatic source of specific wavelength and power (5.7.12.A.5) 20.6. describe a typical photoelectric effect experiment, and explain what experimental observations provide evidence for the photon nature of light (5.7.12.A.5) 20.7. describe qualitatively how the number of photoelectrons and their maximum kinetic energy	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 27 and Chapter 28 • Carpenter, D. Rae Jr. and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • www.scilinks.org Photoelectric Effect KEYWORD: 2232 Arthur Compton KEYWORD: HF2233 Early Atomic Theory KEYWORD: HF2234 Modern Atomic Theory KEYWORD: HF2235 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 27 and Chapter 28 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 21: The student will be able to exhibit an understanding of the principles of nuclear physics.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model

Suggested days of Instruction	Mandated Assessment				Curriculum Management System Grade Level/Subject: Grade12: AP Physics	Goal 21: The student will be able to exhibit an understanding of the principles of nuclear physics.	
	ESPA	GEPA	HSPA	TERRA NOVA	Objectives / Cluster Concepts / Cumulative Progress Indicators (CPI's) The student will be able to:	Instructional Tools / Materials / Technology / Resources	Learning Activities / Interdisciplinary Activities / Assessment Model
5 periods					21.1. recognize that half-life in radio-active decay is independent of the number of nuclei present or of external conditions (5.7.12.A.5) 21.2. sketch of identify a graph to indicate what fraction of a radioactive sample remains as a function of time, and indicate the half-life on such a graph (5.3.23.D.1) 21.3. determine, for an isotope of specified half-life, what fraction of the nuclei have decayed after a given time has elapsed (5.7.12.A.5) 21.4. understand the significance of the mass number and charge of nuclei so they can interpret symbols for nuclei that indicate these quantities (5.7.12.A.5) 21.5. use conservation of mass number and charge to complete nuclear reactions (5.7.12.A.5) 21.6. determine the mass number and charge of a nucleus after it has undergone specified decay processes (5.7.12.A.5) 21.7. describe the process of α, β, and λ decay and write a reaction to describe each (5.7.12.A.5) 21.8. explain why the existence of the neutron had to be	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 29 and Chapter 30 • Carpenter, D. Rae Jr. and Richard B. Minnix, *The Dick and Rae Physics Demo Notebook* • www.scilinks.org Atomic Nucleus KEYWORD: HF2251 Radioactive Decay KEYWORD: HF2252 Fission/fusion KEYWORD: HF2253 • Also reference websites under Goal 1 • Sample problems of teacher's choice	• Serway, Raymond A. and Jerry S. Faughn, *College Physics*, Chapter 29 and Chapter 30 Quick Quizzes and Chapter Problems • AP Practice multiple choice questions and problems of teacher's choice

ADDENDUM

Student Handouts

ADVANCED PLACEMENT PHYSICS

COURSE BENCHMARKS

1. **The student will be able to describe and complete calculations for 1D and 2D motion using vectors.**
2. **The student will be able to demonstrate an understanding of the forces of nature and describe how one or more forces affect the motion of the objects.**
3. **The student will be able to define, explain and calculate work, different forms of energy and energy transformations.**
4. **The student will be able to calculate linear momentum based on the definition and the law of conservation of momentum for different types of collisions.**
5. **The student will be able to exhibit an understanding of rotational motion, rotational equilibrium and rotational dynamics.**
6. **The student will be able to apply Newton's Law of Universal Gravitation.**
7. **The student will be able to demonstrate an understanding of fluid mechanics.**
8. **The student will be able to define, explain and perform various temperature and heat calculations.**
9. **The student will be able to exhibit as understanding of kinetic theory, ideal gas laws and thermodynamics.**
10. **The student will be able to define, explain, and demonstrate an understanding of the Laws of Thermodynamics.**
11. **The student will be able to illustrate an understanding of simple harmonic motion.**
12. **The student will be able to explain and calculate the properties and effects of basic wave motion and sound waves.**
13. **The student will be able to exhibit an understanding of electrostatics.**
14. **The student will be able to explain the properties of conductors, capacitors, and dielectric.**

15. **The student will be able to illustrate an understanding of electric current, resistance, electric circuits and be able to compute values of electric circuits.**

16. **The student will be able to display an understanding of magnetostatics.**

17. **The student will be able to exhibit an understanding of electromagnetism.**

18. **The student will be able to demonstrate an understanding of the principles of geometric optics.**

19. **The student will be able to illustrate an understanding of physical optics.**

20. **The student will be able to display an understanding of the concepts of atomic physics and quantum effects**

21. **The student will be able to exhibit an understanding of the principles of nuclear physics.**