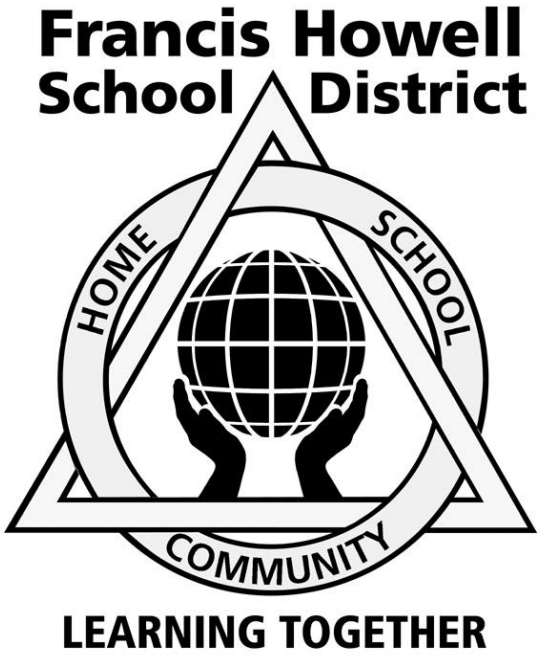
Physics Honors
Science Curriculum
Francis Howell School District



Board Approved: March 3, 2011

Francis Howell School District

Mission Statement

Francis Howell School District is a learning community where all students reach their full potential.

Vision Statement

Francis Howell School District is an educational leader that builds excellence through a collaborative culture that values students, parents, employees, and the community as partners in learning.

Values

Francis Howell School District is committed to:

- Providing a consistent and comprehensive education that fosters high levels of academic achievement for all
- Operating safe and well-maintained schools
- Promoting parent, community, student, and business involvement in support of the school district
- Ensuring fiscal responsibility
- Developing character and leadership

Francis Howell School District Graduate Goals

Upon completion of their academic study in the Francis Howell School District, students will be able to:

1. Gather, analyze and apply information and ideas.
2. Communicate effectively within and beyond the classroom.
3. Recognize and solve problems.
4. Make decisions and act as responsible members of society.

Science Graduate Goals

The students in the Francis Howell School District will graduate with the knowledge, skills, and attitudes essential to leading a productive, meaningful life.

Graduates will:

- Understand and apply principles of scientific investigation.
- Utilize the key concepts and principles of life, earth, and physical science to solve problems.
- Recognize that science is an ongoing human endeavor that helps us understand our world.
- Realize that science, mathematics, and technology are interdependent, each with strengths and limitations that impact the environment and society.
- Use scientific knowledge and scientific ways of thinking for individual and social purposes.

Course Rationale

Science education develops science literacy. Scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity. A sound grounding in science strengthens many of the skills that people use every day, like solving problems creatively, thinking critically, working cooperatively in teams, using technology effectively, and valuing life-long learning. Scientific literacy has become a necessity for everyone.

To accomplish this literacy, science courses will reflect the following:

- Develop scientific reasoning and critical thinking skills.
- Extend problem-solving skills using scientific methods.
- Include lab-based experiences.
- Strengthen positive attitudes about science.
- Incorporate the use of new technologies.
- Provide relevant connections to personal and societal issues and events.

Course Description

Physics I Honors – Course # 131265
Credit: 1 unit
Prerequisite: Completion of Algebra II with a grade of "B" or better; concurrent enrollment in Trigonometry recommended; meet honors criteria

This course is designed for the advanced physics student who is comfortable in applying problem-solving skills and higher level mathematics. Topics include: linear motion, projectile motion, rotational motion, force, energy, momentum, vectors, fluid and thermodynamics, electricity and magnetism, and introductory atomic and nuclear structures. The student should have solid algebra skills and have been introduced to trigonometry. Concepts will be developed through lab activities and lecture. This course requires a high degree of independent initiative.

Notes on color coding:

- Any type that is in **red** indicates the information is new to that curriculum from DESE's original document.
- Anything that is highlighted in yellow, DESE originally indicated that it may be tested on the End of Course Exam (EOC); this has been retained on this document to show teachers the importance DESE has put on those particular objectives.
- Any type that is in **black** is a continuation of what has been included in the strands in previous years.
- Any type that is in **blue** indicates the information has been specifically added to the Honors curriculum and not found in the regular Physics curriculum.
- Any type that is highlighted in gray will not be assessed until Physics II.

Francis Howell School District
Physics Curriculum Writers

Karen Brown
Tony Roungon

Secondary Content Leader Donna Taylor

Director of Student Learning	Travis Bracht
Chief Academic Office	Mary Hendricks-Harris
Superintendent	Dr. Pam Sloan

Francis Howell School District
Physics Honors Curriculum Map

First Semester: (First and Second Quarters – 15 weeks)

Inquiry	**Motion**	**Forces**	**Work, Energy, & Power**
● Scientific Process ● Measurement	● Uniform Linear Motion ● Accelerated Linear Motion ● Two Dimensional Motion ● Uniform Circular Motion	● Forces ● Newton's First Law ● Newton's Second Law ● Newton's Third Law ● Inertia ● Universal Gravitation	● Energy ● Work ● Power
IN1Aa IN1Ab IN1Ac IN1Ad IN1Ae IN1Af IN1Ag IN1Ba IN1Bb IN1Bc IN1Bd IN1Be IN1Bf IN1Ca IN1Cb IN1Cc IN1Cd	IN1Da IN1Db IN1Dc	FM1Aa FM1Ab FM1Ba FM2Bd	FM2Aa FM2Ba FM2Bb FM2Bc FM2Bd FM2Da FM2Db FM2Dc FM2Dd FM2De FM2Ea FM2Eb FM2Ec	UN2Ca UN2Cb UN2Cc UN2Cd UN2Ce UN2Da UN1Aa UN1Ba UN1Bb	FM2Fa FM2Fb FM2Fc FM2Fd ME2Ad ME2Ba ME2Bb ME2Bc ME2Bd ME2Fa ME2Fb ME2Fc
1 week	**6 weeks**	**6 weeks**	**2 weeks**

Francis Howell School District
Physics Honors Curriculum Map

Second Semester: (Third and Fourth Quarters – 19 weeks)

Work, Energy, & Power Continued	**Rotational Motion**	**Oscillations**	**Electricity & Magnetism**	**Thermodynamics**	**Nuclear Physics**	**Science &Technology**
● Momentum ● Impulse	● Moment of Inertia ● Angular Velocity ● Angular Acceleration ● Torque ● Angular Momentum ● Uniform Circular Motion	● Springs ● Simple Harmonic Motion (SHM) ● Waves	● Circuits ● Electric and Magnetic Fields ● Electromagnetic Waves	● Conduction ● Convection ● Radiation ● The Laws of Thermodynamics ● Phase Change	● Atomic Structure ● Nuclear Physics	● Human effect on environment, science, and technology.
FM1Ca FM1Cb FM2Fa ME2Ad ME2Ba ME2Bb ME2Bc ME2Bd ME2Fa ME2Fc	FM2E FM2D FM2A	ME2Ab ME2Fa FM2Db FM2Aa	FM2Ca FM2Cb ME2Af ME2Ca ME2Cb UN1Ca UN1Cb ME2Ac ME2Ae	ME2Aa ME1Aa ME1Da ME1Db ME1Dc ME2Ag ME1Ab ES2Ba ES2Bb ES2Bc ES2Bd ES2Be ES2Bf ES2Fb	ME2Ea ME2Eb ES2Da ME1Ac ME1Ad ME1Ea ME1Eb ME1Ec	ST1Ba ST2Aa ST2Ab ST2Ba ST2Bb ST3Ba ST3Bb ST3Bc ST3Ca ST3Cb ST3Cc ST3Da ST3Db ES3Aa ES3Ab
2 weeks	**2 weeks**	**3 weeks**	**5 weeks**	**3 weeks**	**2 weeks**	**2 weeks**

Content Area: Science	Course: Physics Honors	Strand: Scientific Inquiry

Learner Objectives:

- Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning, and critical thinking. (IN1)

Concepts:

A. Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation. (IN1A)

B. Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning, and critical thinking. (IN1B)

C. Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings). IN1C

D. The nature of science relies upon communication of results and justification of explanations. (IN1D)

Students Should Know	Students Should Be Able to
• It is not always possible, for practical or ethical reasons, to control some conditions (e.g., when sampling or testing humans, when observing animal behaviors in nature) (IN1Ad) • Some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using a controlled laboratory experiment, but instead by using a model, due to the limits of the laboratory environment, resources, and/or technologies (IN1Ae) • There is no fixed procedure called "the scientific method", but that some investigations involve systematic observations, carefully collected and relevant evidence, logical reasoning, and some imagination in developing hypotheses and other explanations (IN1Af) • An observation is biased by the experiences and knowledge of the observer (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results) (IN1Bf)	• Formulate testable questions and hypotheses (IN1Aa) • Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment (IN1Ab) • Design and conduct a valid experiment (IN1Ac) • Evaluate the design of an experiment and make suggestions for reasonable improvements (IN1Ag) • Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders) (IN1Ba) • Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second (IN1Bb) • Determine the appropriate tools and techniques to collect, analyze, and interpret data (IN1Bc) • Judge whether measurements and computation of quantities are reasonable (IN1Bd)

	• Calculate the range, average/mean, percent, and ratios for sets of data (IN1Be) • Use quantitative and qualitative data as support for reasonable explanation (conclusions) (IN1Ca) • Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable (IN1Cb) • Identify the possible effect of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions) (IN1Cc) • Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models) (IN1Cd) • Communicate the procedures and results of investigations and explanations through: ➢ Oral presentations ➢ Drawings and maps ➢ Data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) ➢ Graphs (bar, single, and multiple line) ➢ Equations and writings (IN1Da, DOK3) • Communicate and defend a scientific argument (IN1Db, DOK3) • Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work) (IN1Dc, DOK2)

Instructional Support

Student Essential Vocabulary					
Force	Acceleration	Mass	Vector	Velocity	Displacement
Position	Linear equation	Slope	Linerize	Logger pro	

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA =** Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	SLA
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities	Sample Assessments

Learning Activity #1: (See Appendix A)
Scientific Journal Item Analysis -
Time in the library is recommended for this activity. Have students use one of the recommended resources (found in the Resource section of the template) to choose a current journal article about a topic in physics of interest to them.

The purpose is to have students analyze other scientific "write-ups" using guiding questions and the lab rubric for the course in an attempt to help them improve their own scientific writing. Students will read the article, answer the journal article worksheet, and score the article using the class lab rubric. Emphasis should be placed on elements of the lab rubric.

If you can not take time out in the library, use the attached article or download one and make copies using the resources given.

Activity's Alignment	
GLE/CLE	IN1Dc, IN1Db, IN1Ag
CONTENT	SC7
PROCESS	1.7 –Evaluate Information
DOK	2- Skill/Concept
INSTRUCTIONAL STRATEGIES	Setting objectives and providing feedback

Assessment #1:
Scientific Write Up Exit Card

1. When are graphs used in a lab write up and what types of graphs are acceptable?
2. State three characteristics of a good conclusion.
3. Describe the basic components of an acceptable scientific report or laboratory write up.

Answer Key:

1. *Graphs are used MOST OF THE TIME in solid scientific writing. They are appropriate whenever they simplify the presentation of information. In other words, if a graph makes results easier to interpret or a graph's slope, mean, or critical points provide critical information then a graph should be provided. The type of graph we usually use is a line graph, however, the best graph provides the most information "at a glance" so we occasionally use bar graphs, pie charts, scatter plots, etc…*

2. *A good conclusion will refer back to specific data and interpret it, speculate on sources of error and state percentages of error, and suggest methods of improving an experiment.*

3. *A basic scientific write up should have a meaningful title, a one or two line purpose, an organized procedure that would allow someone to reproduce the experiment you conducted EXACTLY, organized data in data tables with titles and units in appropriate places, graphs, charts*

and diagrams when helpful and a significant conclusion that states what happened, why you think it happened, what went wrong, why it went wrong and how you could fix it.

Assessment's Alignment	
GLE/CLE	IN1Ab
CONTENT	SC7
PROCESS	1.8- Organize data and ideas
DOK	2- Skill/Concept
LEVEL OF EXPECTATION	80%

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #2: (See Appendix B)

Tennis Ball Lab (See Appendix for rubric)

This lab poses the question "Does mass affect the rate at which an object falls?" State the question on the board. Have tennis balls with slits cut in them, various masses, stop watches, photo gates, and motion detectors lying on a cart at the front of the lab. (If you want to challenge students more, have billiard balls, tennis balls, golf balls, and ping pong balls as well. Some students will choose to use the different balls which cause a slight "glitch" in the data due to the varying surface areas. Tennis balls with masses inserted works the best.) Then put students in groups of two or three. Have them design possible experiments to answer the question. Students should first talk about their hypothesis and observations they have made in real life that support the hypothesis. From there, students should develop a purpose and procedure. Make sure students take careful notes in their lab notebooks. Emphasize the importance of taking clear and organized notes on every aspect of the lab development and implementation process. Use the class lab rubric to grade the final write-up. It is also an option to grade the lab notebook for process or to provide helpful feedback on improving process

Activity's Alignment	
GLE/CLE	IN1Ac
CONTENT	SC7

Sample Assessments

Assessment #2:

Exit Card

Given the following data, what can you conclude about the relationship between mass and rate of fall? State your conclusion and <u>detail</u> the reasoning behind the conclusion.

Data for time of fall for various masses from a height of 2 m

Trial	Mass (kg)	Time (s)
Trial 1	10	1.43
Trial 2	20	1.45
Trial 3	50	1.56
Trial 4	100	1.29
Trial 5	500	1.17

KEY: 1 point for conclusion stating that mass has little or no effect on the time it takes the ball to fall. 1point for stating the times do not vary enough for one to conclude mass has an effect. 3 points for providing a percent change in mass and comparing it to a percent change in time to support the conclusion.

Assessment's Alignment	
GLE/CLE	IN1Ag
CONTENT	SC7

PROCESS	1.3-Design/conduct investigations
DOK	4 – Extended Thinking
INSTRUCTIONAL STRATEGIES	Generating and testing hypotheses

PROCESS	1.6-Discover/evaluate relationships
DOK	3-Strategic Thinking
LEVEL OF EXPECTATION	80%

Student Resources	Teacher Resources
General: ● http://www.2facts.com/tsof_home_feature.aspx ● http://www.2facts.com/icof_home_feature.aspx ● http://find.galegroup.com/srcx/start.do?prodId=DC&userGroupName=morefrancis&finalAuth=true ● Giancoli Physics 6th edition **Enrichment:** **Intervention:**	**General:** ● http://www.2facts.com/tsof_home_feature.aspx ● http://www.2facts.com/icof_home_feature.aspx ● http://find.galegroup.com/srcx/start.do?prodId=DC&userGroupName=morefrancis&finalAuth=true ● Giancoli Physics 6th edition **Enrichment:** **Intervention:**

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Content Area: Science	Course: Physics Honors	Strand: Motion
Learner Objectives: ● The motion of an object is described by its change in position relative to another object or point (FM1)		

Concepts:

A. The motion of an object is described as a change in position, direction, and speed relative to another object (frame of reference) (FM1A)
B. An object that is accelerating is speeding up, slowing down, or changing direction (FM1B)
C. Every object exerts a gravitational force on every other object (FM2B)

Students Should Know	Students Should Be Able to
● Scalar quantities have a size (magnitude) but not a direction ● Speed and distance are scalar quantities ● The average speed of an object is the total distance divided by the total time ● Vector quantities have both a size (magnitude) and a direction (positive or negative) ● Position is the measured displacement from a reference point called the origin ● The slope of a x/t graph is the velocity of the object for any point along the graph ● A straight line on an x/t graph indicates a constant velocity ($a = 0$) ● Acceleration is any change in velocity (over time) ● A curved line on an x/t graph indicates a changing velocity ($a \neq 0$) ● The slope of a v/t graph is the acceleration of the object for any point along the graph ● The area under the curve of a v/t graph represents displacement of the object	● Mathematically calculate the resultant of two or more vector quantities. (Concept A) ● Represent and analyze the motion of an object graphically (FM1Aa) ● Analyze the velocity of two objects in terms of distance and time (i.e., verbally, diagrammatically, graphically, mathematically) (FM1Ab) ● Measure and analyze an object's motion in terms of speed, velocity, and acceleration (i.e., verbally, diagrammatically, graphically, mathematically) (FM1Ba) ● Relate the motion of one object to that of a second object in motion. Solving for the motion using simultaneous equations. (Concept A) ● Recognize all free falling bodies accelerate at the same rate due to gravity regardless of their mass (FM2Bd)

Instructional Support

Student Essential Vocabulary

Speed	Velocity	Position	Acceleration	Slope	Motion
Origin	Vector	Scalar	Meter	Tangent	Positive
Negative	Displacement	Average speed	Instantaneous speed		

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	SLA
Information, Media, & Technology Skills	SA	Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #1 : (See Appendix C)
Relative Motion -
This activity reinforces the concepts learned in the study of kinematics, namely the relationships between the position (x), velocity (v), and acceleration (a) of an object. Students should work in pairs during the lab.

Activity's Alignment	
GLE/CLE	FM1Aa, FM1Ab, FM1Ba
CONTENT	SC2,
PROCESS	1.6 Discover/evaluate relationships
DOK	3-Strategic Thinking
INSTRUCTIONAL STRATEGIES	Cooperative Learning Non-linguistic Representation

Sample Assessments

Assessment #1: (See Appendix D)
Relative Motion Assessment-
The assessment checks the student's understanding of the relationship between an object's position, velocity, and acceleration and their ability to represent the relationship graphically.

Assessment's Alignment	
GLE/CLE	FM1Aa, FM1Ba
CONTENT	SC2
PROCESS	1.6 Discover/evaluate relationships
DOK	3-Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level – 80%

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA =** Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities	Sample Assessments

Learning Activity #2 : (See Appendix E)
2-Dimensional Motion –
This activity reinforces the concepts learned in the study of two dimensional motions, also referred to as projectile motion. This is an inquiry based lab in which the students will derive the basic understanding of an objects two dimensional motion. The motion of the projectile will be divided into its horizontal and vertical components in order to bring to light the facts that a projectiles horizontal velocity remains constant while its vertical velocity is changing due to gravity.

Activity's Alignment	
CLE	FM1Aa, FM1Ab, FM1Ba
CONTENT	SC2
PROCESS	1.6 Discover/evaluate relationships
DOK	3-Strategic Thinking
INSTRUCTIONAL STRATEGIES	Cooperative Learning Non-linguistic Representation

Assessment #2: (See Appendix F)
2-Dimensional Motion Assessment –
This assessment is intended to be used as an individual quiz. The assessment evaluates the student's understanding of the facts associated with 2-dimensional motion (horizontal acceleration is zero and vertical acceleration is due to gravity) and their ability to problem solve using vector mathematics.

Assessment's Alignment	
CLE	FM1Aa, FM1Ba
CONTENT	SC2
PROCESS	1.6 Discover/evaluate relationships
DOK	3-Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level – 75%

Student Resources	Teacher Resources
General: ● *Physics*, Holt-Rinehart; textbook ● Giancoli Physics 6th edition **Enrichment:** ● The Physics Classroom, www.physicsclassroom.com	**General:** ● *Physics*, Holt-Rinehart; textbook ● Giancoli Physics 6th edition **Enrichment:** ● The Physics Classroom, www.physicsclassroom.com

Intervention:	Intervention:

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Content Area: Science	Course: Physics Honors	Strand: Forces

Learner Objectives:

- Forces affect motion (FM2)
- Regular and predictable motions of objects in the universe can be described and explained as the result of gravitational forces (UN2)
- The universe has observable properties and structure (UN1)

Concepts:

A. Forces are classified as either contact forces (pushes, pulls, friction, buoyancy) or non-contact forces (gravity, magnetism), that can be described in terms of direction and magnitude (FM2A)
B. Every object exerts a gravitational force on every other object (FM2B)
C. Newton's Laws of Motion explain the interaction of mass and forces, and are used to predict changes in motion (FM2D)
D. Perpendicular forces act independently of each other (FM2E)
E. The regular and predictable motions of a planet and moon relative to the Sun explain natural phenomena, such as day, month, year, shadows, moon phases, eclipses, tides, and seasons (UN2C)
F. Gravity is a force of attraction between objects in the solar system that governs their motion (UN2D)
G. The Earth, Sun, and moon are part of a larger system that includes other planets and smaller celestial bodies (UN1A)
H. The Earth has a composition and location suitable to sustain life (UN1B)

Students Should Know	Students Should Be Able to
• There are four fundamental forces: Electromagnetic, gravity, strong and weak nuclear forces • Gravity and Electromagnetic forces are field forces • Forces are measured with spring scales, calibrated in Newtons • Forces are vector quantities • In-line forces can be added together to find the net force • The electromagnetic force can manifest itself in the form of friction, normal force, tension, and elastic force • All forces have an agent and a receiver • An unbalanced (net) force causes acceleration in the direction of the net force • Balanced forces result in zero acceleration • Large net forces cause large accelerations	• Identify and describe the forces acting on an object (i.e., type of force, direction, magnitude in Newtons) using a force diagram and calculating net force (FM2Aa) • Construct a force diagram and decompose vector quantities in order to mathematically apply Newton's' Laws of Motion (Concept A) • Recognize that inertia is a property of matter that can be described as an object's tendency to resist a change in motion, and is dependent upon the object's mass (Newton's First Law of Motion) (FM2Da) • Determine the effect (i.e., direction and magnitude) of the sum of the forces acting on an object (i.e., net force) (FM2Db) • Using information about net force and mass determine the effect on acceleration (Newton's Second Law of Motion) (FM2Dc) • Predict the path of an object when the net force changes (FM2Ec)

• Larger masses will have smaller accelerations with an identical net force • $F_{12} = -F_{21}$ • Newton's Third Law of Motion: for every action force there is an equal and opposite reaction force • Newton's Law of Universal Gravitation: the force of gravity is directly proportional to the product of the masses and inversely proportional to the distance between the masses squared • Mass is a measure of the amount of matter (atoms) in an object and is measured in grams (or Kg) • The presence of mass warps (bends, distorts, contracts) space and time • Mass does not change when placed in different gravitational fields • The strength of the gravitational field on the surface of the earth is 9.8N/kg • The effects of a gravitational field and of an accelerated reference frame are indistinguishable except by measuring motion relative to some other system of reference • Objects traveling in a circle are accelerating toward the center of the circle • The Cartesian coordinate system is only a model of space and it has limitations in describing our universe • The universe is expanding • Planetary motion can be described by linear and rotational kinematic equations • Planetary motion is caused by centripetal force and acceleration • Planetary motion follows the Law of Conservation of Energy	• Analyze force pairs (i.e., action/reaction forces) when given a scenario (e.g., handball hits concrete wall, shotgun firing) and describe their magnitudes and directions (Newton's Third Law of Motion) (FM2De) • Identify forces acting on a falling object (i.e., weight, air resistance) and how those forces affect the rate of acceleration (FM2Dd) • Describe the force(s) that keep an object traveling in a circular path (FM2Ea) • Describe weight in terms of the force of a planet's or moon's gravity acting on a given mass (FM2Bc) • Describe the force(s) acting on a projectile on the Earth (FM2Eb) Describe gravity as an attractive force among all objects (FM2Ba) • **Physics II Content** Compare and describe the gravitational forces between two objects in terms of their masses and the distances between them (FM2Bb) • Use Newton's Law of Universal Gravitation to solve problems involving gravitational pull between cosmological objects (Concept F) • Use centripetal motion equations to calculate orbital speed, distance, and centripetal acceleration (Concept F) • Provide evidence that can be observed from Earth that supports the fact Earth rotates on its axis and revolves around the Sun (UN2Cc) • Relate units of time (i.e., day, month, year) to the regular and predictable motion of the planets and moons and their positions in the Solar system (UN2Ca) • Explain seasonal phenomena (i.e., weather, length of day, temperature, intensity of sunlight) as a consequence of a planet's axial tilt as it rotates and a planet's orbital position as it revolves around the Sun (UN2Cb) • Predict the moon rise/set times, phases of the moon, and/or eclipses when given the relative positions of the moon, planet, and Sun (UN2Cd) • Explain how the gravitational forces, due to the relative positions of a planet, moon, and Sun, determine the height and frequency of tides (UN2Ce) • Explain orbital motions of moons around planets, and planets around the Sun, as the result of gravitational forces between those objects (UN2Da) • Describe and relate the positions and motions of the Sun-Earth solar system, the Milky-Way galaxy, and other galaxies within the universe (i.e., it is just one of several solar systems orbiting the center of a

	rotating spiral galaxy; that spiral galaxy is just one of many galaxies which orbit a common center of gravity; the expanding universe causes the distance between galaxies to increase) (UN1Aa) ● Explain how Earth's environmental characteristics and location in the universe (e.g., atmosphere, temperature, orbital path, magnetic field, mass-gravity, location in solar system) provide a life-supporting environment (UN1Ba) ● Compare the environmental characteristics and location in the universe of Earth and other celestial bodies (e.g., planets, moons) to determine ability to support life (UN1Bb)

Instructional Support

Student Essential Vocabulary					
Force	Mass	Acceleration	Energy	Joule	Newton
Agent	Receiver	Magnitude	Vector	Scalar	Motion
Directly proportional	Inversely proportional	Net force	Balanced forces	Centripetal force	

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA =** Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills	SA	Enrichment Opportunity	SLA
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities	Sample Assessments

Learning Activity #1 : (See Appendix G)

Newton's 2nd Law Lab –

Prior to defining Newton's laws of motion, this inquiry lab is used to develop Newton's 2nd law which is the relationship between an object's mass, the rate of its acceleration and the net force acting on the object. Lab activity will be done in pairs.

Activity's Alignment	
CLE	FM2Aa, FM2Ba
CONTENT	SC2
PROCESS	1.6 Discover/evaluate relationships
DOK	2-Skills and Concepts
INSTRUCTIONAL STRATEGIES	Cooperative Learning Non-linguistic Representation

Assessment #1: (See Appendix H)

Newton's Laws Test-

Assesses the student's understanding of the relationship between force, mass, and acceleration.

Assessment's Alignment	
CLE	FM2Aa, FM2Ba
CONTENT	SC2
PROCESS	1.6 Discover/evaluate relationships
DOK	3-Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level – 85%

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills	SA	Enrichment Opportunity	SLA
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities	Sample Assessments
Learning Activity #2 : (See Appendix I) **Force Diagrams –** The understanding of forces acting on an object is essential to the application of Newton's Laws of motion. Force diagrams are a tool that students use to identify all of the forces acting on an object. In this activity, the students apply their understanding of Newton's Laws of motion to object through the use of force diagrams. Students will work in pairs with lab partners.	**Assessment #2: (See Appendix J)** **Force Diagrams and Statics Assessment-** The assessment checks the student's ability to analyze forces acting on an object and how those forces affect the motion of the object.

Activity's Alignment	
CLE	FM2Aa, FM2Ba, FM2Db, FM2Dc
CONTENT	SC2
PROCESS	1.6 Discover/evaluate relationships
DOK	2-Skills and Concepts
INSTRUCTIONAL STRATEGIES	Cooperative Learning Non-linguistic Representation

Assessment's Alignment	
CLE	FM2Aa, FM2Ba, FM2Db, FM2Dc
CONTENT	SC2
PROCESS	1.6 Discover/evaluate relationships
DOK	3-Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level – 80%

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	

Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities	Sample Assessments

Learning Activity #3 : (See Appendix K)

Effect of Distance on Gravitational Force

This lab allows students to derive the relationship between gravitational force and distance between masses by using actual astronomical data. This activity can be increased in difficulty by allowing students to research the data they need on the internet. It can be simplified by providing the data exact data required so students are simply plugging numbers into a graphing program.

Activity's Alignment	
CLE	UN2Da, UN1Aa
CONTENT	SC 6
PROCESS	1.6-Discover/Evaluate Relationships
DOK	3-Strategic Thinking
INSTRUCTIONAL STRATEGIES	Nonlinguistic Representations

Assessment #3:

Exit Card

1. If the distance between the Earth and the moon were doubled, what would happen to the gravitational force? What if the distance were halved?
2. Use Newton's Law of Universal Gravitation to determine the acceleration due to gravity near the surface of the earth.

Key:

1. *If the distance were doubled, the force would be ¼ as much. If the distance were halved, the force would be 4 times as great.*
2. $F_g=Gm_1m_2/r^2$
   $mg=[(6.67x10^{-11}Nm^2/kg^2)(m)(5.98x10^{24}kg)] / (6.38x10^6m)^2$
   dividing both sides by "m" will get rid of the extra "m's" floating around.
   $g=9.799\ N/kg = 9.8\ m/s^2$

Assessment's Alignment	
CLE	UN2Da
CONTENT	SC6
PROCESS	1.6-Discover/Evaluate Relationships
DOK	3-Strategic Thinking
LEVEL OF EXPECTATION	80%

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA =** Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	

Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities	Sample Assessments
Learning Activity #4 : (See Appendix L) **Deriving Kepler's Third Law** This activity walks students through a step by step derivation of Keplers 3rd law from Newton's Law of Universal Gravitation. This activity builds on the concepts of circular motion, the inverse square relationship for distance, and Newton's Laws.	**Assessment #4:** **Exit Card (allow 10 minutes)** 1. Determine the mass of the Sun given the Earth's distance from the Sun is $r=1.5x10^{11}m$ **Key** *1. $2x10^{30}$ kg* *(Students will use Kepler's Third Law to solve this problem.)*

Activity's Alignment	
CLE	UN2Da, UN1Aa
CONTENT	SC6
PROCESS	1.6-Discover/Evaluate Relationships 3.5-Reason logically
DOK	3-Strategic Thinking
INSTRUCTIONAL STRATEGIES	Questions, Cues, and Advanced Organizers

Assessment's Alignment	
CLE	UN2Da
CONTENT	SC6
PROCESS	3.5-Reason logically
DOK	3-Strategic Thinking
LEVEL OF EXPECTATION	70%

Student Resources	Teacher Resources

General: • *Physics*, Holt-Rinehart; textbook • Giancoli Physics 6th edition • http://observe.arc.nasa.gov/nasa/education/referance/orbits/orbit3.html • http://edinburghcreationgroup.org/moon-orbit.php • http://janus.astro.umd.edu/AW/awtools.html#viewers • http://www.arachnoid.com/gravitation/small.html • http://phet.colorado.edu/sims/my-solar-system/my-solar-system_en.html **Enrichment:** • The Physics Classroom, www.physicsclassroom.com • To make the activity more challenging have students use the link below and the information on the link to calculate velocity, orbital distance, and centripetal acceleration. This requires a strong set of math skills, geometry, and unit conversion. • http://www.solarviews.com/eng/data1.htm **Intervention:** • In order to simplify the assignment use the http://janus.astro.umd.edu/AW/awtools.html#viewers link and provide specific instructions on how to find the orbital speed and how to use this to find centripetal acceleration. You can also let students know they need to graph acceleration vs. $1/r^2$ to get a linear graph.	**General:** • *Physics*, Holt-Rinehart; textbook • Giancoli Physics 6th edition • http://observe.arc.nasa.gov/nasa/education/referance/orbits/orbit3.h • http://edinburghcreationgroup.org/moon-orbit.php • http://janus.astro.umd.edu/AW/awtools.html#viewers • http://www.arachnoid.com/gravitation/small.html • http://phet.colorado.edu/sims/my-solar-system/my-solar-system_en.html **Enrichment:** • To make the activity more challenging have students use the link below and the information on the link to calculate velocity, orbit distance, and centripetal acceleration. This requires a strong set math skills, geometry, and unit conversion. • http://www.solarviews.com/eng/data1.htm • The Physics Classroom, www.physicsclassroom.com **Intervention:**

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Content Area: Science	Course: Physics Honors	Strand: Work, Energy, & Power

Learner Objectives:

- Energy has a source, can be stored, and can be transferred but is conserved within a system (ME2)
- Forces affect motion (FM2)
- The motion of an object is described by its change in position relative to another object or point (FM1)

Concepts:

A. Forms of energy have a source, a means of transfer (work and heat), and a receiver (ME2A)
B. Mechanical energy comes from the motion (kinetic energy) and/or relative position (potential energy) of an object (ME2B)
C. Energy can be transferred within a system as the total amount of energy remains constant (i.e., Law of Conservation of Energy) (ME2F)
D. Work transfers energy into and out of a mechanical system (FM2F)
E. Momentum depends on the mass of the object and the velocity with which it is traveling (FM1C)

Students Should Know	Students Should Be Able to
• Kinetic energy is the energy of motion and is equal to one-half the mass of the object times the velocity of the object squared • Potential energy is the energy of position and is equal to the mass of the object times strength of the gravitational field times the object's height above the earth • The total mechanical energy of an object is the sum of the object's gravitational potential energy, elastic potential energy, and kinetic energy • The work-energy theorem states that work is equal to the change in energy of a system • The efficiency of any system is calculated by work output / work input	• Describe sources and common uses of different forms of energy: chemical, nuclear, thermal, mechanical, electromagnetic (ME2Ad) • Classify the different ways to store energy (i.e., chemical, nuclear, thermal, mechanical, electromagnetic) and describe the transfer of energy as it changes from kinetic to potential, while the total amount of energy remains constant, within a system (e.g., using gasoline to move a car, photocell generating electricity, electromagnetic motor doing work, energy generated by nuclear reactor) (ME2Fc) • Relate kinetic energy to an object's mass and its velocity (ME2Ba) • Relate an object's gravitational potential energy to its weight and height relative to the surface of the Earth (ME2Bb) • Distinguish between examples of kinetic and potential energy (i.e., gravitational, elastic) within a system (ME2Bc) • Describe the transfer of energy that occurs as energy changes from kinetic to potential within a system (e.g., car moving on rollercoaster track, child swinging, diver jumping off a board) (ME2Fa)

	• Describe the effect of work on an object's kinetic and potential energy (ME2Bd) • Describe the relationships among work, applied net force, and the distance an object moves (FM2Fa) • Explain how the efficiency of a mechanical system can be expressed as a ratio of work output to work input (FM2Fb) • Describe power in terms of work and time (FM2Fc) • Describe and analyze the relationships among force, distance, work, efficiency, and power (FM2Fd) • Compare the efficiency of systems (recognizing that, as work is done, the amount of usable energy decreases) (ME2Fb) • Compare the momentum of two objects in terms of mass and velocity (Do NOT assess calculations) (FM1Ca) • Explain that the total momentum remains constant within a system (FM1Cb)

Instructional Support

Student Essential Vocabulary					
Energy	Potential Energy	Law of Conservation of Energy	Kinetic Energy	Spring Constant	Gravitational Energy
Mechanical Energy	Temperature	Thermal Energy	Work	Energy	System
Power	Efficiency				

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	SLA
Information, Media, & Technology Skills	SLA	Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities	Sample Assessments

Learning Activity #1 : (See Appendix M)
Energy Transfer - Hot Wheel Lab
This is an inquiry based, collaborative learning activity in which the students explore the relation between heights, potential energy, mass, velocity, and kinetic energy of an object. The students conduct the experiment, collecting data which will be analyzed.

Activity's Alignment	
CLE	ME2Bb, ME2Ba
CONTENT	SC7
PROCESS	1.6 Discover/evaluate relationships
DOK	3 – Strategic thinking
INSTRUCTIONAL STRATEGIES	Cooperative Learning Non-linguistic Representation

Assessment #1: (See Appendix N)
Energy Transfer Graphical Assessment
In this unit the students explored the concept that energy is conserved within a system and this concept was expressed analytically as well as graphically. This assessment tests the students understanding of graphically showing conservation of energy.

Assessment's Alignment	
CLE	ME2Bb, ME2Ba, ME2Bd
CONTENT	SC1
PROCESS	1.6 Discover/evaluate relationships
DOK	DOK2-Skills & Concepts
LEVEL OF EXPECTATION	Mastery Level – 80%

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills	SLA	Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities	Sample Assessments

Learning Activity #2 : (See Appendix O)
Energy Pie Charts
This is a collaborative activity that each group will present to the class upon completion. The students determine the energy in the system and specific moments in time and use pie charts to represent the energy within the systems and any energy transferred (work) into or out of the system.

Activity's Alignment	
CLE	ME2Fc, ME2Bd
CONTENT	SC1, SC7
PROCESS	1.6 Discover/evaluate relationships
DOK	2-Skills & Concepts
INSTRUCTIONAL STRATEGIES	Cooperative Learning Non-linguistic Representation

Assessment #2: (See Appendix P)
Work – Energy Theorem Assessment
This assesses the students understanding and application of the Work – Energy Theorem. The student is assessed on the concept of energy being conserved within a systems and work is the transfer of energy into or out of a system.

Assessment's Alignment	
CLE	ME2Fc
CONTENT	SC1
PROCESS	1.6 Discover/evaluate relationships
DOK	3 – Strategic thinking
LEVEL OF EXPECTATION	Mastery Level – 75%

Student Resources	Teacher Resources
General: ● *Physics*, Holt-Rinehart; textbook ● *Giancoli Physics 6th edition;* Pearson **Enrichment:** ● The Physics Classroom (www.physicsclassroom.com)	**General:** ● *Physics*, Holt-Rinehart; textbook ● *Giancoli Physics 6th edition*; Pearson **Enrichment:** ● The Physics Classroom (www.physicsclassroom.com) ● "The Mechanical Universe and Beyond" DVD series

• University of Colorado at Boulder: Physics Education Technology (http://phet.colorado.edu) **Intervention:**	**Intervention:**

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Content Area: Science	Course: Physics Honors	Strand: Rotational Motion

Learner Objectives:

- Forces affect motion (FM2)
- Energy has a source, can be stored, and can be transferred but is conserved within a system (ME2)
- The motion of an object is described by its change in position relative to another object or point (FM1)

Concepts:

A. Forces are classified as either contact forces (pushes, pulls, friction, buoyancy) or non-contact forces (gravity, magnetism), that can be described in terms of direction and magnitude (FM2A)
B. Newton's Laws of Motion explain the interaction of mass and forces, and are used to predict changes in motion (FM2D)
C. Perpendicular forces act independently of each other (FM2E)
D. The rotational motion of an object can be described in terms of a change in the angle over time
E. An object undergoing angular acceleration is changing the rate of rotation
F. Angular momentum depends on the moment of inertia of an object and its angular velocity
G. Rotating objects have an angular kinetic energy

Students Should Know	Students Should Be Able to
• Angular position is measured in terms of "θ" • Angular velocity is represented by "ω" • Angular velocity can be calculated using 2Πf or v/r • Angular acceleration is represented by "α" • Angular acceleration is calculated using ω/t or a/r • Torque is a force that depends upon the distance between the agent and the receiver • Moment of inertia is a property of a rotating body and it describes the points about which an object rotates • Angular kinetic energy is the energy of a rotating body and is equal to one half the moment of inertial times the angular velocity of the object squared	• Transition between angular and linear quantities (Concept D) • Analyze the angular velocity of an object in terms of rotations per minute (Concept D) • Measure and analyze an object's motion in terms of angular velocity and angular acceleration (Concept D, E) • Solve problems using kinematic equations for constant angular acceleration (Concept E, D) • Identify and describe the torque acting on a rotating body (Concept A) • Calculate torques using objects with different moments of inertia (Concept A, B) • Explain that the total angular momentum remains constant within a system (Concept F) • Calculate angular kinetic energy (Concept G)

Instructional Support

Student Essential Vocabulary					
Angular acceleration	Angular velocity	Radians	Angular displacement	Torque	Moment of inertia
Axis of rotation	Center of mass				

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	SLA

Sample Learning Activities	Sample Assessments

Learning Activity #1 : (See Appendix Q)
Rotational Motion
This lab allows students to move between lab stations and see the concepts of conservation of angular momentum, center of mass, moment of inertia, and torque in action.

Activity's Alignment	
CLE	FM1, FM2, ME2; Concept (A, D, F)
CONTENT	SC-7
PROCESS	1.6-Discover/evaluate relationships
DOK	DOK-3 Strategic Thinking
INSTRUCTIONAL STRATEGIES	Cooperative Learning

Assessment #1: (See Appendix R)
Rotational Motion Assessment
This is a practice free response question from the AP-B test. It will require students to understand angular kinematics and torque.

Assessment's Alignment	
CLE	FM1, FM2, ME2; Concept (A, D, F)
CONTENT	SC-7
PROCESS	1.6-Discover/evaluate relationships
DOK	DOK-3 Strategic Thinking
LEVEL OF EXPECTATION	75%

Student Resources	Teacher Resources
General: ● Giancoli Physics 6th edition ● *Physics*, Holt-Rinehart; textbook	**General:** ● Giancoli Physics 6th edition ● *Physics*, Holt-Rinehart; textbook

Enrichment: ● The Physics Classroom (www.physicsclassroom.com) ● "The Mechanical Universe and Beyond" DVD series **Intervention:**	**Enrichment:** ● The Physics Classroom (www.physicsclassroom.com) ● "The Mechanical Universe and Beyond" DVD series **Intervention:**

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Content Area: Science	Course: Physics Honors	Strand: Oscillations
Learner Objectives: • Forces affect motion (FM2) • Energy has a source, can be stored, and can be transferred but is conserved within a system (ME2)		

Concepts:

A. Forces are classified as either contact forces (pushes, pulls, friction, buoyancy) or non-contact forces (gravity, magnetism), that can be described in terms of direction and magnitude (FM2A)
B. Newton's Laws of Motion explain the interaction of mass and forces, and are used to predict changes in motion (FM2D)
C. Perpendicular forces act independently of each other (FM2E)
D. Waves are the means of transporting energy from one system to another
E. Forms of energy have a source, a means of transfer (work and heat), and a receiver (ME2A)
F. Mechanical energy comes from the motion (kinetic energy) and/or relative position (potential energy) of an object (ME2B)
G. Energy can be transferred within a system as the total amount of energy remains constant (i.e., Law of Conservation of Energy) (ME2F)
H. Simple Harmonic Motion (SHM) are periodic oscillations in which both the net force and acceleration vectors are pointed towards the equilibrium position and opposite to the displacement vector.

Students Should Know	Students Should Be Able to
• Forces are measured with spring scales, calibrated in Newtons • In-line forces can be added together to find the net force • Wavelength is a measure of the distance from one point on a wave to the same point on the subsequent wave • Frequency is the number of wave cycles completed in a second. • Period is the time required to complete a wave cycle • Objects that are attached to compressed or stretched springs have a potential energy equivalent to ½ kx^2, where k is the spring constant and x is the displacement of the object from equilibrium • The electromagnetic force can manifest itself in the form of friction, normal force, tension, and elastic force • The Doppler Effect is the shift in frequency due to the relative motion of the source to the receiver of wave • SHM occurs when the restoring force is opposite the displacement vector	• Explain the similarities and differences in transverse and longitudinal waves (Concept D) • Define wavelength, energy, amplitude, and frequency (Concept D) • **Physics II Content** Describe the relationship among wavelength, energy, and frequency as illustrated by the electromagnetic spectrum (ME2Ab) • Describe the relationship between period and frequency (Concept D) • Calculate speed, amplitude, frequency, energy, and wavelength • Identify and describe the forces acting on an object (i.e., type of force, direction, magnitude in Newtons) using a force diagram and calculating net force (FM2Aa) • Determine the effect (i.e., direction and magnitude) of the sum of the forces acting on an object (i.e., net force) (FM2Db) • Recognize the properties of simple harmonic motion and identify objects experiencing simple harmonic motion (Concept D)

	• Relate the motion of a pendulum to simple harmonic motion (Concept D, H) • Describe the transfer of energy that occurs as energy changes from kinetic to potential within a system (e.g., car moving on rollercoaster track, child swinging, diver jumping off a board) (ME2Fa) • Relate the motion of springs to Simple Harmonic Motion (SHM) (Concept H) • Relate SHM to wave motion using the concept of the unit circle) (Concept H) • Describe light as a wave (Concept D) • Describe sound as a wave (Concept D)

Instructional Support

Student Essential Vocabulary					
Wavelength	Frequency	Displacement	Velocity	Amplitude	Period
Simple Harmonic Motion	Focus	Focal length	Resonance	Interference	Reflection
Refraction	Diffraction	Nodes			

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities	Sample Assessments
Learning Activity #1 : (See Appendix S) **Practice with Simple Harmonic Motion (SHM) -** This activity allows for practice with the various mathematical concepts related to pendulums, springs and other simple harmonic oscillators. The problems start with simple calculations of period and frequency and increase in difficulty. The final problem requires students to combine most of the concepts in problems 1-8, as well as concepts from previous physics units. It can be used for guided learning or as an extra practice assignment in support of the text.	**Assessment #1: (See Appendix T)** **SHM: 5-in-5 Quiz** This assessment consists of 5 multiple choice questions from the AP B Physics test. All of the problems relate to simple harmonic motion, waves, period, and frequency. It is recommended that the students be given 5 minutes to complete the assignment. Allowing students one minute per multiple choice question is excellent practice for developing the rapid reasoning skills required for success on the AP test.

Activity's Alignment	
CLE	FM2D, Concept H
CONTENT	SC6
PROCESS	1.6-Discover and evaluate Relationships
DOK	2 – Skill/Concept
INSTRUCTIONAL STRATEGIES	Homework and practice

Assessment's Alignment	
CLE	FM2D, Concept H
CONTENT	SC6
PROCESS	1.6-Discover and evaluate Relationships
DOK	2 – Skill/Concept
LEVEL OF EXPECTATION	70%

Student Resources	Teacher Resources
General: ● Giancoli Physics 6th edition ● *Physics*, Holt-Rinehart; textbook **Enrichment:** **Intervention:**	**General:** ● Giancoli Physics 6th edition ● *Physics*, Holt-Rinehart; textbook **Enrichment:** **Intervention:**

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Content Area: Science	Course: Physics Honors	Strand: Electricity & Magnetism

Learner Objectives:
- Energy has a source, can be stored, and can be transferred but is conserved within a system (ME2)
- Forces affect motion (FM2)

Concepts:

A. Most of the information we know about the universe comes from the electromagnetic spectrum (UN1C)
B. Magnetic forces are related to electrical forces as different aspects of a single electromagnetic force (FM2C)
C. Electromagnetic energy from the Sun (solar radiation) is a major source of energy on Earth (ME2C)
D. Electric circuits are the practical application of EM fields and are based on the principle of conservation of energy

Students Should Know	Students Should Be Able to
• Electromagnetic radiation propagates as particles called photons • Electromagnetic photons are particles of energy that oscillates between electric fields and magnetic fields and interact with charged particles such as electrons • Each photon is made of a fixed quantity of energy that is directly proportional to its frequency • The speed of electromagnetic waves is defined by $c = \lambda\nu$ • As frequency of an EM wave increases, energy increases, and the ability to harm living cells increases • Stars are producers of EM waves • EM waves are transverse waves created by the interaction of electric and magnetic fields in space and do not require a medium in which to travel • The full range of frequencies (energies) is called the EM spectrum • Within the spectrum are segments named according to their functions: radio, infrared, light, ultraviolet, x-radiation, gamma-radiation • Each segment of the spectrum can provide particular information about the structure of the universe	• Identify the forces produced by electric and magnetic fields (Concept B) • Calculate electric potential and electric potential difference (Concept A) • Analyze the relationship between voltage, current, and resistance in an electric circuit (Concept D) • Compare and describe the electrostatic force between two point charges. The strength of the force is proportional to the charges, and inversely proportional to the square of the distances between them. (Concept B) • **Physics II Content** Predict the effects of an electromagnetic force on the motion of objects (attract or repel) (FM2Cb) • **Physics II Content** Differentiate between the properties and examples of conductors and insulators of different forms of energy (i.e., thermal, mechanical, electromagnetic) (ME2Ac) • **Physics II Content** Recognize changing magnetic fields can produce electrical current and electric currents can produce magnetic forces (FM2Ca) • Identify stars as producers of electromagnetic energy (ME2Ca) • Describe how electromagnetic energy is transferred through space as electromagnetic waves of varying wavelength and frequency (ME2Cb) • Identify and evaluate advantages/disadvantages of using various sources of energy (e.g., wind, solar, geothermal, hydroelectric, biomass, fossil fuel) for human activity (ME2Ae)

	● Describe the effect of different frequencies of electromagnetic waves on the Earth and living organisms (e.g., radio, infrared, visible, ultraviolet, gamma, cosmic rays) (ME2Af) ● Identify information that the electromagnetic spectrum provides about the stars and the universe (e.g., chemical composition, temperature, age of stars, location of black holes, motion of celestial bodies) (UN1Ca) ● Evaluate the advantages/ disadvantages of using different tools (e.g., spectroscope, different types of telescopes, probes) to gather information about the universe (e.g., background radiation, magnetic fields, discovery of previously unknown celestial bodies) (UN1Cb)

Instructional Support

Student Essential Vocabulary					
Electric potential	Electric potential energy	Capacitance	Potential difference	Resistance`	Current
Fundamental charge	Coulomb force	Coulomb	Farad	Right hand rule	Faraday's Law

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA =** Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	SLA
Information, Media, & Technology Skills		Intervention Opportunity	SLA
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities	Sample Assessments

Learning Activity #1 : (See Appendix U)

Electrostatics

This activity gives students a side by side comparison of gravitational fields (students should be comfortable with gravitational fields at this point in the curriculum) and electric fields. This assignment also provides students with a collection of all of the equations and units relating to electric fields and an explanation of what the equations and units mean and where they come from. The assignment allows for 10 problems of guided practice and one homework problem or the assignment can be enriched by providing less guided practice and more homework. The assignment can be simplified by using it as guided practice in conjunction with the lecture.

Activity's Alignment	
CLE	FM2Cb, Concept B
CONTENT	SC6
PROCESS	1.6-Discover/Evaluate Relationships
DOK	DOK2-Skill/Concept
INSTRUCTIONAL STRATEGIES	Homework/practice

Assessment #1:

Electrostatics Exit Card: Compare and contrast the concept of the electric field and the gravitational field. Make sure your answer is in paragraph form with correct spelling and grammar.

KEY:

There are 5 key points students should have in their paragraph:

- Students should note the inverse square relationship in both equations;
- Students should discuss the similarity in the units for both fields;
- Students should describe the difference in the direction of each of the fields;
- Students should comment on the lack of acceleration as a concept in the electric field;
- And students should use correct spelling, grammar, and punctuation.

Allow one point for each of the concepts listed.

Assessment's Alignment	
CLE	FM2Cb, Concept B
CONTENT	SC6
PROCESS	Discover/Evaluate relationships
DOK	DOK3-Strategic Thinking
LEVEL OF EXPECTATION	85%

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills	SLA	Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #2 : (See Appendix)

Kirchoff's Rules -

This assignment allows students to practice using Kirchoff's Rules to solve more complex circuits. After solving the circuit, the student can then set up the circuit with the supplied circuit components and compare the actual results with the calculated results. It is very important for instructors to note: You will need to adjust the numbers in the circuits worksheet to allow for viable circuits in YOUR classroom. It takes a little extra preparation to do this activity because you have to go through your circuit supplies and establish working circuits similar to those in the worksheet. Then, change the numbers in the worksheet to match the circuits your students are able to construct. Being able to construct an actual circuit from a schematic is a skill that, if developed, will help students in certain careers and household repairs.

Activity's Alignment	
CLE	Concept D
CONTENT	SC1
PROCESS	3.5 – Reason logically (inductive/deductive)
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Non-linguistic representation

Sample Assessments

Assessment #2: (See Appendix)

Kirchoff's Rules:

This will assess student ability in solving multiple branch and multiple power source circuits. Kirchoff's Rules require strong algebraic and reasoning skills.

Assessment's Alignment	
CLE	Concept D
CONTENT	SC1
PROCESS	3.5 – Reason logically (inductive/deductive)
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level – 70%

Student Resources	Teacher Resources
General: ● http://www.aip.org/dbis/archive/sortcat.jsp?year=2010 ● Giancoli Physics 6th edition ● *Physics*, Holt-Rinehart; textbook **Enrichment:** **Intervention:**	**General:** ● http://www.aip.org/dbis/archive/sortcat.jsp?year=2010 ● Giancoli Physics 6th edition ● *Physics*, Holt-Rinehart; textbook **Enrichment:** **Intervention:**

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Content Area: Science	Course: Physics Honors	Strand: Thermodynamics

Learner Objectives:

- Energy has a source, can be stored, and can be transferred but is conserved within a system (ME2)
- Forces affect motion (FM2)
- Earth's Systems (geosphere, atmosphere, and hydrosphere) interact with one another as they undergo change by common processes (ES2)

Concepts:

A. Objects, and the materials they are made of, have properties that can be used to describe and classify them (ME1A)
B. Physical changes in states of matter due to thermal changes in materials can be explained by the Kinetic Theory of Matter (ME1D)
C. There are internal processes and sources of energy within the geosphere that cause changes in Earth's crustal plates (ES2B)
D. Climate is a description of average weather conditions in a given area due to the transfer of energy and matter through Earth's systems (ES2F)

Students Should Know	Students Should Be Able to
● Thermal energy is the sum of all the energy in all of the molecules that make up and object (a.k.a. internal energy) ● Heat is energy transferred between objects due to a difference in temperature ● The average translational kinetic energy of a system is directly proportional to the average temperature ● Conduction occurs through molecular collisions (examples are heat loss through a window, cold tile floors, warm rugs, spoon heating in cup of hot coffee) ● Convection occurs through a mass movement of molecules from one place to another (examples are wind, ocean currents, and forced air furnaces) ● Radiation differs from convection and conduction as it does not require a medium (examples are the sun, heat from a fire, infrared radiation) ● Convection is transfer of heat via the movement of massive amounts of particles in a fluid ● Substances with a greater density settle below those with less density ● $\rho = m/V$ ● Physical Properties are properties that can be observed without changing the composition of the matter such as: appearance, texture, color, odor, melting point, boiling point, density, solubility, polarity, and many others	● **Physics II Content** Differentiate between thermal energy (the total internal energy of a substance which is dependent upon mass), heat (thermal energy that transfers from one object or system to another due to a difference in temperature), and temperature (the measure of average kinetic energy of molecules or atoms in a substance) (ME2Aa) ● Compare the densities of regular and irregular objects using their respective measures of volume and mass (ME1Aa) ● **Physics II Content** Using the Kinetic Theory model, explain the changes that occur in the distance between atoms/molecules and temperature of a substance as energy is absorbed or released during a phase change (ME1Da) ● **Physics II Content** Predict the effect of a temperature change on the properties (e.g., pressure, density) of a material (solids, liquids, gases) (ME1Db) ● **Physics II Content** Predict the effect of pressure changes on the properties (e.g., temperature, density) of a material (solids, liquids, gases) (ME1Dc) ● **Physics II Content** Identify pure substances by their physical and chemical properties (i.e., color, luster/reflectivity, hardness, conductivity, density, pH, melting point, boiling point, specific heat, solubility, phase at room temperature, chemical reactivity) (ME1Ab)

• Chemical Properties describe the potential of a substance to undergo a chemical change, such as dissolving in acid, because of its composition • Kinetic Theory is the idea that all matter is made up of small constantly moving particles • The movement of subatomic particles determines the temperature and phase of a substance • Temperature is a measure of the average kinetic energy of molecules in a substance • PV=nRT • Boyle's Law states PV = constant • Charles' Law states volume is directly proportional to temperature • Gay-Lussac's Law states pressure is directly proportional to temperature • • Pressure is equivalent to force divided by area and can form geologic structures on the earth's crust • The mechanism for the Theory of Plate Tectonics and atmospheric change is derived from the Three Laws of Thermodynamics • The mechanism for atmospheric change is derived from thermodynamic laws	• **Physics II Content** Interpret examples (e.g., land and sea breezes, home heating, plate tectonics) of heat transfer as convection, conduction, or radiation (ME2Ag) • **Physics II Content** Describe the internal source of energy on Earth that results in uneven heating of the mantle (i.e., decay of radioactive isotopes) (ES2Ba) • **Physics II Content** Illustrate and explain the convection currents that result from the uneven heating inside the mantle and cause movement of crustal plates (ES2Bb) • **Physics II Content** Illustrate and explain the convection currents that result from the uneven heating inside the mantle and cause movement of crustal plates (ES2Bc) • **Physics II Content** Relate the densities of the materials found in continental and oceanic plates to the processes that result in each type of plate boundary (i.e., diverging, converging, transform) ES2Bd) • **Physics II Content** Describe the effects of the movement of crustal plates (i.e., earthquakes, sea floor spreading, mountain building, volcanic eruptions) at a given location on the planet (ES2Be) • **Physics II Content** Articulate the processes involved in the Theory of Plate Tectonics (i.e., uneven heating of the mantle due to the decay of radioactive isotopes, movement of materials via convection currents, movement of continental and oceanic plates along diverging, converging, or transform plate boundaries) and describe evidence that supports that theory (e.g., correlation of rock sequences, landforms, and fossils; presence of intrusions and faults; evidence of sea-floor spreading) (ES2Bf) • **Physics II Content** Explain how global wind and ocean currents are produced on the Earth's surface (e.g., effects of unequal heating of the Earth's land masses, oceans, and air by the Sun due to latitude and surface material type; effects of gravitational forces acting on layers of air of different densities due to temperature differences; effects of the rotation of the Earth; effects of surface topography) (ES2Fb)

Instructional Support

Student Essential Vocabulary					
Thermal Energy	Heat	Temperature	Thermodynamics	Energy Transfer	Internal Energy

Pressure	Volume	Solid	Liquid	Gas	Fluid
Avogadro's number	Ideal gas	Charles Law	Boyle's Law	Gay-Lussac's Law	

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #1 : (See Appendix V)

Thermal Energy Lab-

This lab has students repeat the work of James Joule in order to show the relationship between mechanical and thermal energy. This lab is best used with a unit on thermal energy as it familiarizes students with Joule's Law and heat transfer while reviewing topics covered in the previous work, energy, and momentum chapters in the Giancoli text.

Activity's Alignment	
CLE	ME2Aa, ME1Db
CONTENT	SC1
PROCESS	1.6-Discover/evaluate relationships 2.1-Plan and make presentations 3.5-Reason logically (inductive/deductive)
DOK	3-Strategic Thinking
INSTRUCTIONAL STRATEGIES	Nonlinguistic Representations Cooperative Learning Summarizing and note taking

Sample Assessments

Assessment #1: (See Appendix W)

Thermal Energy Quiz

This assesses student ability to define heat transfer, determine the units of heat and work with heat transfer equations.

Assessment's Alignment	
CLE	ME2Aa, ME1Db
CONTENT	SC1
PROCESS	1.6-Discover/evaluate relationships 3.5-Reason logically (inductive/deductive)
DOK	2-Skill/Concept
LEVEL OF EXPECTATION	80%

Student Resources	Teacher Resources
General: ● http://www.aip.org/dbis/archive/sortcat.jsp?year=2010 ● Giancoli Physics 6th edition ● *Physics*, Holt-Rinehart; textbook **Enrichment:** **Intervention:**	**General:** ● http://www.aip.org/dbis/archive/sortcat.jsp?year=2010 ● Giancoli Physics 6th edition ● *Physics*, Holt-Rinehart; textbook **Enrichment:** **Intervention:**

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Content Area: Science	Course: Physics Honors	Strand: Nuclear Physics
Learner Objectives: ● Changes in properties and states of matter provide evidence of the atomic theory of matter (ME1) ●		

Concepts:

A. The atomic model describes the electrically neutral atom (ME1E)
B. Nuclear energy is a major source of energy throughout the universe (ME2E)
C. Changes in the Earth over time can be inferred through rock and fossil evidence (ES2D)

Students Should Know	Students Should Be Able to
● The Bohr Model of the Hydrogen atom is a good working approximation of atomic structure ● Atomic number is the total number of protons in an atomic nucleus ● In an electrically neutral atom, the atomic number is also the number of electrons in the nucleus ● Atomic mass is the total mass of protons, neutrons, and electrons in the atom ● Mass number is the total number of protons and neutrons in a nucleus ● Electrons in an atom exist in fixed-energy orbitals ● As electrons shift from orbital to orbital, energy is released or absorbed in energy packets known as photons ● Each element has a signature set of orbital configurations and can, therefore, be identified by their emissions or their absorption characteristics ● Electron dot diagrams give a visual reference for valence electrons ● The periodic table is organized according to metals, non-metals, metalloids and noble gases which have specific properties in common ● Fusion emits energy according to $E=mc^2$ when mass is lost during the joining of two nuclei ● The only controlled fusion reactions occur in stars ● Fission emits energy according to $E=mc^2$ when mass is lost during the splitting of an atom's nuclei	● **Physics II Content** Describe the atom as having a dense, positive nucleus surrounded by a cloud of negative electrons (ME1Ea) ● **Physics II Content** Calculate the number of protons, neutrons, and electrons of an element (or isotopes) given its atomic mass (or mass number) and atomic number (ME1Eb) ● **Physics II Content** Describe the information provided by the atomic number and the mass number (i.e., electrical charge, chemical stability) (ME1Ec) ● **Physics II Content** Classify a substance as being made up of one kind of atom (element) or a compound when given the molecular formula or structural formula (introduce electron dot diagram) for the substance (ME1Ac) ● **Physics II Content** Compare and contrast the common properties of metals, nonmetals, metalloids (semi-conductors) and noble gases (ME1Ad) ● **Physics II Content** Describe how changes in the nucleus of an atom during a nuclear reaction (i.e., nuclear decay, fusion, fission) result in emission of radiation) (ME2Ea) ● Identify the role of nuclear energy as it serves as a source of energy for the Earth, stars, and human activity (e.g., source of electromagnetic radiation, thermal energy within mantle, nuclear power plants, fuel for stars) (ME2Eb)

● Fission is used for energy in nuclear power plants as well as nuclear powered submarines and super carriers ● Fission results in harmful radioactive waste ● Radioactive decay occurs at an inverse exponential rate that is measurable and gives off energy as heat ●	● **Physics II Content** Use evidence from relative and real dating techniques (e.g., correlation of trace fossils, landforms, and rock sequences; evidence of climate changes; presence of intrusions and faults; magnetic orientation; relative age of drill samples) to infer geologic history (ES2Da)

Instructional Support

Student Essential Vocabulary					
Atom	Electron	Proton	Neutron	Nucleus	Phase
Nuclear fission	Nuclear fusion	Binding energy			

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA =** Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities	Sample Assessments

Learning Activity #1 : (See Appendix X)

Nuclear Physics -

This assignment requires students to understand and demonstrate nuclear decay chains. An understanding of the basic structure of the atom is required before attempting the assignment. In addition, students should be able to work with the concept of half-life in order to complete the assignment.

Activity's Alignment	
CLE	ME2Ea
CONTENT	SC6
PROCESS	3.5-Reason logically (inductive/deductive)
DOK	3-Strategic Thinking
INSTRUCTIONAL STRATEGIES	Nonlinguistic Representations

Assessment #1: (See Appendix Y)

Nuclear Physics Assessment

This assesses student understanding of basic atomic structure, nuclear decay and half life. Students should work through the quiz without a Periodic Table or any other form of notes/definitions.

Assessment's Alignment	
CLE	ME2Ea
CONTENT	SC6
PROCESS	3.5-Reason logically (inductive/deductive)
DOK	2 – Skill/Concept
LEVEL OF EXPECTATION	75%

Student Resources	Teacher Resources
General: • Giancoli Physics 6th edition • *Physics*, Holt-Rinehart; textbook • http://hyperphysics.phy-astr.gsu.edu/hbase/nuccon.html • http://library.thinkquest.org/3741/nuclear_physics.html • www.aps.org/units/dnp	**General:** • Giancoli Physics 6th edition • *Physics*, Holt-Rinehart; textbook • http://hyperphysics.phy-astr.gsu.edu/hbase/nuccon.html • http://library.thinkquest.org/3741/nuclear_physics.html • www.aps.org/units/dnp

Enrichment: **Intervention:**	**Enrichment:** **Intervention:**

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Content Area: Science	Course: Physics Honors	Strand: Science and Technology

Learner Objectives:

- The nature of technology can advance, and is advanced by, science as it seeks to apply scientific knowledge in ways that meet human needs. (ST1)
- Historical and cultural perspectives of scientific explanations help to improve understanding of the nature of science and how science knowledge and technology evolve over time. (ST2)
- Science and technology affect, and are affected by, society. (ST3)
- Human activity is dependent upon and affects Earth's resources and systems (ES3)

Concepts:

D. Advances in technology often result in improved data collection and an increase in scientific information ST1B
E. People of different gender and ethnicity have contributed to scientific discoveries and the invention of technological innovations ST2A
F. Scientific theories are developed based on the body of knowledge that exists at any particular time and must be rigorously questioned and tested for validity ST2B
G. Social, political, economic, ethical and environmental factors strongly influence, and are influenced by, the direction of progress of science and technology ST3B
H. Scientific ethics require that scientists must not knowingly subject people or the community to health or property risks without their knowledge and consent ST3C
I. Scientific information is presented through a number of credible sources, but is at times influenced in such a way to become non-credible ST3D
J. Earth's materials are limited natural resources affected by human activity (ES3A)

Students Should Know	Students Should Be Able to
• The relationships linking technology and science (e.g., how technological problems may create a demand for new science knowledge, how new technologies make it possible for scientists to extend research and advance science) (ST1Ba, DOK 2) • Contributions to science are not limited to the work of one particular group, but are made by a diverse group of scientists representing various ethnic and gender groups (ST2Aa, DOK 1) • Gender and ethnicity of scientists often influence the questions asked and/or the methods used in scientific research and may limit or advance science knowledge and/or technology (ST2Ab, DOK 1) • A non-renewable resource is a resource that can not be replaced within a human life span	• **Physics II Content** Identify and describe how explanations (laws/principles, theories/models) of scientific phenomena have changed over time as a result of new evidence (e.g., model of the solar system, basic structure of matter, structure of an atom, Theory of Plate Tectonics, Big Bang and nebular theory of the Universe, explanation of electric current) (ST2Ba, DOK 2) • Identify and analyze current theories that are being questioned, and compare them to new theories that have emerged to challenge older ones (e.g., theories of evolution, extinction, global warming) (ST2Bb, DOK 3) • Analyze the roles of science and society as they interact to determine the direction of scientific and technological progress (e.g., prioritization

	of and funding for new scientific research and technological development is determined on the basis of individual, political and social values and needs; understanding basic concepts and principles of science and technology influences debate about the economics, policies, politics, and ethics of various scientific and technological challenges) (ST3Ba, DOK3) ● **Physics II Content** Identify and describe major scientific and technological challenges to society and their ramifications for public policy (e.g., global warming, limitations to fossil fuels, genetic engineering of plants, space and/or medical research) (ST3Bb, DOK 3) ● Analyze and evaluate the drawbacks (e.g., design constraints, unintended consequences, risks), benefits, and factors (i.e., social, political, economic, ethical, and environmental) affecting progress toward meeting major scientific and technological challenges (e.g., use of alternative energies to reduce the use of carbon fuels, use of satellite communications to gather information, nuclear energy, computer technology) (ST3Bc, DOK 3) ● Identify and evaluate the need for informed consent in experimentation (ST3Ca, DOK 1) ● Identify the ethical issues involved in experimentation (i.e., risks to organisms or environment) (ST3Cb, DOK 1) ● Identify and evaluate the role of models as an ethical alternative to direct experimentation (e.g., using a model for a stream rather than pouring oil in an existing stream when studying the effects of oil pollution) (ST3Cc, DOK 1) ● Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an "eye witness," a scientist speaking within or outside his/her area of expertise) (ST3Da, DOK 3) ● Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society (ST3Db, DOK 1) ● Distinguish between renewable and nonrenewable energy resources (ES3Aa) ● Identify human activities that may adversely affect the composition of the atmosphere, hydrosphere, or geosphere (ES3Ab)

Instructional Support

Student Essential Vocabulary					
Quantum mechanics	Electron	Photon	Waves	Probability	Wave model
Particle model	Electron interference	Photon interference	Quantum wave	Interference	Wave-particle duality
Modern physics	Magnetism	Induction			

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA =** Sample Assessments			
21st Century Themes	SA	Non Fiction Reading & Writing	SLA
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities	Sample Assessments

Learning Activity #1 : (See Appendix Z)
Ethics Research Paper
This should be a 3 to 5 page paper discussing the place of ethics within scientific research. This assignment allows students to research new technology being developed and discuss the ethical implications of its development.

Activity's Alignment	
CLE	ST3Cb
CONTENT	SC8, CA3
PROCESS	2.2-Revise Communications 1.5-Comprehend/evaluate resources 1.1-Develop research questions/ideas
DOK	4-Extended Thinking
INSTRUCTIONAL STRATEGIES	Summarizing and note taking

Assessment #1: (See Appendix ZZ)
Aftermath of Chernobyl -
Students will read a scientific article related to an ethical situation and respond to the prompt. This is a similar skill found in ACT assessments.

Assessment's Alignment	
CLE	ST2Bb
CONTENT	SC8
PROCESS	1.5-Comprehend/evaluate resources
DOK	3-Strategic Thinking
LEVEL OF EXPECTATION	75%

Student Resources	Teacher Resources
General: • Giancoli Physics 6th edition • *Physics*, Holt-Rinehart; textbook • http://www.aip.org/dbis/archive/sortcat.jsp?year=2010 **Enrichment:**	**General:** • Giancoli Physics 6th edition • *Physics*, Holt-Rinehart; textbook • http://www.aip.org/dbis/archive/sortcat.jsp?year=2010 **Enrichment:**

Intervention:	**Intervention:**

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Appendix
Learning Activities and Assessments

A Scientific Journal Item Analysis

B	**Rubric – Tennis Ball Lab**
C	**Relative Motion**
D	**Relative Motion Assessment**
E	**2-Dimensional Motion**
F	**2-Dimensional Motion Assessment**
G	**Newton's 2nd Law Lab**
H	**Newton's Laws Test**
I	**Force Diagrams**
J	**Force Diagrams and Statics Assessment**
K	**Effect of Distance on Gravitational Force**
L	**Deriving Kepler's Third Law**
M	**Energy Transfer - Hot Wheel Lab**
N	**Energy Transfer Graphical Assessment**
O	**Energy Pie Charts**
P	**Work – Energy Theorem Assessment**
Q	**Rotational Motion**
R	**Rotational Motion Assessment**
S	**Practice with Simple Harmonic Motion (SHM)**
T	**SHM: 5-in-5 Quiz**
U	**Electrostatics**
U1	**Kirchoff's Rules Activity**
U2	**Kirchoff's Rules Assessment**
V	**Thermal Energy Lab**
W	**Thermal Energy Quiz**
X	**Nuclear Physics**
Y	**Nuclear Physics Assessment**
Z	**Ethics Research Paper**
ZZ	**Aftermath of Chernobyl**