PLANNED INSTRUCTION

A PLANNED COURSE FOR:

AP Physics 1

Curriculum writing committee:

Robert E. Curtis, Jr. P.E.

Grade Level:

11 & 12

Date of Board Approval: _____2021_____

Course Weighting: AP Physics 1

Major Assessments (Tests, Common Assessments)	45 % (3-4 per marking period)
Skills Application (Labs, Quizzes)	30 % (16-20 per marking period)
Skills Practice (Activities, Homework)	20 % (20-25 per marking period)
Participation	5 %
Total	100 %

Curriculum Map

Overview:

AP Physics 1 is an algebra-based, introductory college-level physics course. Students cultivate their understanding of physics through inquiry-based investigations as they explore these topics: kinematics, dynamics, circular motion and gravitation, energy, momentum, simple harmonic motion, torque, and rotational motion. Other topics discussed are modern physics, mechanical waves and sound, electric charge and electric force, DC circuits, and optics. AP Physics 1 is a full-year, 1 credit course that is the equivalent of a first-semester introductory college course in algebra-based physics.

Goals:

The AP Physics 1 course reflects a commitment to what physics teachers, professors, and researchers have agreed is the main goal of a college-level physics course: to help students develop a deep understanding of the foundational principles that shape classical mechanics. By confronting complex physical situations or scenarios, the course is designed to enable students to develop the ability to reason about physical phenomena using important science practices, such as explaining relationships, applying and justifying the use of mathematical routines, designing experiments, analyzing data, and making connections across multiple topics within the course. To foster this deeper level of learning, the AP Physics 1 course defines concepts, science practices, and understandings required by representative colleges and universities for granting college credit and placement. Students will practice reasoning skills used by physicists by discussing and debating, with peers, the physical phenomena investigated in class, as well as by designing and conducting inquiry-based laboratory investigations to solve problems through first-hand observations, data collection, analysis, and interpretation.

Specifically, the concepts to be covered by marking period are as follows:

MP1: Introducing Physics; Kinematics: Motion in One Dimension; Newtonian Mechanics; Applying Newton's Laws

MP2: Circular Motion; Impulse and Linear Momentum; Work and Energy

MP3: Extended Bodies at Rest; Rotational Motion; Vibrational Motion

MP4: Modern Physics; Mechanical Waves; Electric Charge and Electric Force; DC Circuits; Optics; Real World Project

Big Ideas:

BIG IDEA 1: SYSTEMS (SYS) Objects and systems have properties such as mass and charge. Systems may have internal structure.

BIG IDEA 2: FIELDS (FLD) Fields existing in space can be used to explain interactions.

BIG IDEA 3: FORCE INTERACTIONS (INT) The interactions of an object with other objects can be described by forces.

BIG IDEA 4: CHANGE (CHA) Interactions between systems can result in changes in those systems.

BIG IDEA 5: CONSERVATION (CON) Changes that occur as a result of interactions are constrained by conservation laws.

BIG IDEA 6: WAVES (WAV) Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.

Textbook and Supplemental Resources:

Etkina, E., Planinšič G., & Heuvelen, A. V. (2019). College physics: explore and apply. 2nd Edition. AP Edition. New York, NY: Pearson.

Pearson. "Personalize the Teaching and Learning Experience." *Pearson*, www.pearsonmylabandmastering.com/masteringphysics/.

Wolfe, G., et al (2020). College Physics for AP Courses. Openstax.org. https://openstax.org/details/books/college-physics-ap-courses?Book%20details

Openstax.org. "Instructor Resources for College Physics for AP Courses". https://openstax.org/details/books/college-physics-ap-courses?Instructor%20resources

Openstax.org. "Student Resources for College Physics for AP Courses". https://openstax.org/details/books/college-physics-ap-courses?Student%20resources

Jacobs, G. (2020). 5 Steps to a 5 AP Physics 1: Algebra Based. McGraw-Hill Education.

PhET Interactive Physics Simulations, University of Colorado Boulder. https://phet.colorado.edu/en/simulations/category/physics

The Physics Classroom. https://www.physicsclassroom.com/

College Board. "AP Physics 1 and 2 Inquiry-Based Lab Investigations: Teacher's Manual". New York, NY: College Board.

PASCO scientific. (2014). Advanced Physics 1 through Inquiry Experiment Guide. Roseville, CA: Pasco

AP Physics 1 Challenging Concepts. Edge.edx.org

Curriculum Plan

Unit 1: Introducing Physics Time/Days (Summer Work + 1 day)

Standards (by number): 3.2.10.B6, 3.2.P.B7, CC.3.5.11-12.A, CC.3.5.11-12.B, CC.3.5.11-12.C, CC.3.5.11-12.D, CC.3.5.11-12.E, CC.3.5.11-12.F, CC.3.5.11-12.G, CC.3.5.11-12.H, CC.3.5.11-12.I, CC.3.5.11-12.J, CC.3.6.11-12.A, CC.3.6.11-12.B, CC.3.6.11-12.C, CC.3.6.11-12.D, CC.3.6.11-12.E, CC.3.6.11-12.F, CC.3.6.11-12.G, CC.3.6.11-12.H, CC.3.6.11-12.I, CC.3.6.11-12.J

Anchors: A1.1.1.1, A1.1.1.2, A1.1.1.3, A1.1.1.4, A1.1.1.5, A1.1.2.1, A1.1.2.2, A1.2.1.1, A1.2.1.2, A1.2.2.1, A1.2.2.2, A1.2.3.1, A1.2.3.2

Eligible Content: Chapter 1 of textbook: What is physics? , Modeling, Physical quantities, Making rough estimates, Vector and scalar quantities, How to use this book to learn physics.

Objectives: Students shall:

- Understand the nature of physics and the process for developing new understandings in physics. (DOK Level 2)
- Appreciate the necessity and value of modeling real-world situations in physics in order to reasonably analyze a physical situation. (DOK Level 3)
- Identify how to describe physical quantities accurately and precisely, including units of measure, measuring instruments, and significant digits. (DOK Level 2)
- Appreciate the usefulness of making rough estimates in applying physical concepts to real-world situations. Students will then conduct their own rough estimates to approximate solutions to real-world problems. (DOK Levels 3 and 4)
- Differentiate between the two types of physical quantities (vectors and scalars). (DOK Level 3)
- Understand the resources available to students with this textbook and the associated online resources. (DOK Level 1)

Core Activities and Corresponding Instructional Methods:

- Reading of Chapter 1 in Textbook
- Direct Instruction (video lecture and fill-in note pages to complete)
- Online Chapter 1 Independent Practice through the Pearson Mastering Physics website

Assessments:

- Diagnostic: Math assessment to determine student math knowledge level and to identify required remediation work, if any, to ensure student is ready for study of Physics
- Formative: student responses to independent practice
- Summative: Unit 1 Test (during first week of school)

Unit 2: Kinematics: Motion in One Dimension Time/Days (Summer Work + 11 days)

Standards (by number): 3.2.P.B1, 3.2.10.B6, 3.2.P.B7, CC.3.5.11-12.A, CC.3.5.11-12.B, CC.3.5.11-12.C, CC.3.5.11-12.D, CC.3.5.11-12.E, CC.3.5.11-12.F, CC.3.5.11-12.G, CC.3.5.11-12.H, CC.3.5.11-12.I, CC.3.5.11-12.J, CC.3.6.11-12.A, CC.3.6.11-12.B, CC.3.6.11-12.C, CC.3.6.11-12.D, CC.3.6.11-12.E, CC.3.6.11-12.F, CC.3.6.11-12.G, CC.3.6.11-12.H, CC.3.6.11-12.I, CC.3.6.11-12.J

Anchors: A1.1.1.1, A1.1.1.2, A1.1.1.3, A1.1.1.4, A1.1.1.5, A1.1.2.1, A1.1.2.2, A1.2.1.1, A1.2.1.2, A1.2.2.1, A1.2.2.2, A1.2.3.1, A1.2.3.2

Eligible Content: Chapter 2 of textbook: What is motion?, A conceptual description of motion, Operations with vectors, Quantities for describing motion, Representing motion with data tables and graphs, Constant velocity linear motion, Motion at constant acceleration, Displacement of an object moving at constant acceleration, Skills for analyzing situations involving motion.

Objectives: Students shall:

- Understand the ideas of motion, reference frames, and how to model motion. (DOK Level 2)
- Use motion diagrams to represent motion. (DOK Level 3)
- Understand how to perform basic mathematical operations with vectors. (DOK Level 2)
- Describe motion using precise scientific language. (DOK Level 2)
- Represent motion using data tables and graphs. (DOK Level 4)
- Analyze constant velocity linear motion situations using precise mathematical techniques and scientific language. (DOK Level 4)
- Analyze constant acceleration linear motion situations using precise mathematical techniques and scientific language. (DOK Level 4)

Core Activities and Corresponding Instructional Methods:

- Reading of Chapter 2 in Textbook
- Direct Instruction (video lecture and in-class lectures with fill-in note pages to complete)
- Online Chapter 2 Independent Practice through the Pearson Mastering Physics website
- Selected questions from AP Classroom Unit 1 Kinematics Progress Checks for independent review
- Laboratory Investigation: One Dimensional Motion Lab (Pasco Graphical Analysis: Motion Lab) utilizing a dynamics cart, a constant velocity cart, and data collection system with motion sensor – or equivalent.

Assessments:

- Diagnostic: Teacher observations and questioning
- Formative: student responses to independent practice, quizzes
- Summative: Unit 2 Test; Lab

Unit 3: Newtonian Mechanics Time/Days (17 days)

Standards (by number): 3.2.10.B1, 3.2.10.B6, 3.2.P.B7, CC.3.5.11-12.A, CC.3.5.11-12.B, CC.3.5.11-12.C, CC.3.5.11-12.D, CC.3.5.11-12.E, CC.3.5.11-12.F, CC.3.5.11-12.G, CC.3.5.11-12.H, CC.3.5.11-12.I, CC.3.5.11-12.J, CC.3.6.11-12.A, CC.3.6.11-12.B, CC.3.6.11-12.C, CC.3.6.11-12.D, CC.3.6.11-12.E, CC.3.6.11-12.F, CC.3.6.11-12.G, CC.3.6.11-12.H, CC.3.6.11-12.I, CC.3.6.11-12.J

Anchors: A1.1.1.1, A1.1.1.2, A1.1.1.3, A1.1.1.4, A1.1.1.5, A1.1.2.1, A1.1.2.2, A1.2.1.1, A1.2.1.2, A1.2.2.1, A1.2.2.2, A1.2.3.1, A1.2.3.2

Eligible Content: Chapter 3 of textbook: Describing and representing interactions, Adding and measuring forces, Conceptual relationship between force and motion, Inertial reference frames and Newton's first law, Newton's second law, Gravitational force law, Skills for applying Newton's second law for one-dimensional processes, Forces come in pairs: Newton's third law, Seat belts and air bags.

Objectives: Students shall:

- Describe and represent interactions between objects using force diagrams (DOK Level 4)
- Apply vector mathematical techniques to force analysis (DOK Level 4)
- Explain the conceptual relationship between force and motion (DOK Level 4)
- Compare and contrast inertial and noninertial reference frames (DOK Level 2)
- Recognize the connections between mass, forces, and acceleration in Newton's Second Law and apply Newton's Second Law to various situations (DOK Level 2)
- Understand and use a simplified version of the gravitational force law for objects near Earth's surface (DOK Level 3)
- Recognize and apply the idea that forces always occur in pairs as described in Newton's Third Law (DOK Levels 2 and 4)
- Apply the concepts of Newton's Laws to real-world situations like seat belts and air bags. (DOK Level 4)

Core Activities and Corresponding Instructional Methods:

- Reading of Chapter 3 in Textbook
- Direct Instruction (lecture with fill-in note pages to complete)
- Online Chapter 3 Independent Practice through the Pearson Mastering Physics website
- Selected questions from AP Classroom Unit 2 Dynamics Progress Checks for independent review
- Introductory Activity: Investigate the factors that determine whether a washer placed on a card above the opening of a cup will fall into the cup when the card is moved.
- Laboratory Investigation: Newton's Second Law Lab (Pasco or College Board AP Physics 1 Lab Investigation) utilizing a dynamics cart, a hanging mass, and data collection system with motion sensor – or equivalent.

Assessments:

- Diagnostic: Teacher observations and questioning
- Formative: student responses to independent practice, quizzes
- Summative: Unit 3 Test; Lab

Unit 4: Applying Newton's Laws Time/Days (15 days)

Standards (by number): 3.2.10.B1, 3.2.10.B6, 3.2.P.B7, CC.3.5.11-12.A, CC.3.5.11-12.B, CC.3.5.11-12.C, CC.3.5.11-12.D, CC.3.5.11-12.E, CC.3.5.11-12.F, CC.3.5.11-12.G, CC.3.5.11-12.H, CC.3.5.11-12.I, CC.3.5.11-12.J, CC.3.6.11-12.A, CC.3.6.11-12.B, CC.3.6.11-12.C, CC.3.6.11-12.D, CC.3.6.11-12.E, CC.3.6.11-12.F, CC.3.6.11-12.G, CC.3.6.11-12.H, CC.3.6.11-12.I, CC.3.6.11-12.J

Anchors: A1.1.1.1, A1.1.1.2, A1.1.1.3, A1.1.1.4, A1.1.1.5, A1.1.2.1, A1.1.2.2, A1.2.1.1, A1.2.1.2, A1.2.2.1, A1.2.2.2, A1.2.3.1, A1.2.3.2

Eligible Content: Chapter 4 of textbook: Vectors in two dimensions and force components, Newton's Second Law in component form, Friction, Skills for analyzing processes involving forces in two dimensions, Projectile motion, Starting and stopping a car.

Objectives: Students shall:

- Use mathematical techniques to resolve vectors into components (DOK Level 2)
- Use Newton's second law to analyze two dimensional forces and motion and apply this skill to various situations, including inclined surfaces and linked objects (DOK Levels 3 and 4)
- Compare and contrast static and kinetic friction and calculate these forces mathematically (DOK Level 2)
- Develop a qualitative and quantitative understanding of two-dimensional projectile motion (DOK Level 2)
- Apply Newton's laws and types of friction to the analysis of real-world objects, such as starting and stopping a car (DOK Level 4)

Core Activities and Corresponding Instructional Methods:

- Reading of Chapter 4 in Textbook
- Direct Instruction (lecture with fill-in note pages to complete)
- Online Chapter 4 Independent Practice through the Pearson Mastering Physics website
- Selected questions from AP Classroom Unit 2 Dynamics Progress Checks for independent review
- Introductory Activity: Investigate the relationship between the horizontal and vertical motions of a projectile, such as a tennis ball, using video analysis software, such as Tracker (or AP Physics 1 Investigation 1: 1D and 2D Kinematics).
- Laboratory Investigation: Atwood's Machine Lab (Pasco) utilizing a dynamics cart, a hanging mass, and data collection system with motion sensor – or equivalent.

Assessments:

- Diagnostic: Teacher observations and questioning
- Formative: student responses to independent practice, quizzes
- Summative: Unit 4 Test; Lab

Unit 5: Circular Motion Time/Days (13 days)

Standards (by number): 3.2.10.B1, 3.2.P.B1, 3.2.10.B6, 3.2.P.B7, CC.3.5.11-12.A, CC.3.5.11-12.B, CC.3.5.11-12.C, CC.3.5.11-12.D, CC.3.5.11-12.E, CC.3.5.11-12.F, CC.3.5.11-12.G, CC.3.5.11-12.H, CC.3.5.11-12.I, CC.3.5.11-12.J, CC.3.6.11-12.A, CC.3.6.11-12.B, CC.3.6.11-12.C, CC.3.6.11-12.D, CC.3.6.11-12.E, CC.3.6.11-12.F, CC.3.6.11-12.G, CC.3.6.11-12.H, CC.3.6.11-12.I, CC.3.6.11-12.J

Anchors: A1.1.1.1, A1.1.1.2, A1.1.1.3, A1.1.1.4, A1.1.1.5, A1.1.2.1, A1.1.2.2, A1.2.1.1, A1.2.1.2, A1.2.2.1, A1.2.2.2, A1.2.3.1, A1.2.3.2

Eligible Content: Chapter 5 of textbook: Qualitative dynamics of circular motion, Analyzing velocity change for circular motion, Radial acceleration and period, Skills for analyzing processes involving circular motion, The law of universal gravitation.

Objectives: Students shall:

- Develop a qualitative and quantitative understanding of circular motion, including how velocity change and circular motion are related (DOK Level 2)
- Define and calculate radial acceleration and period for an object in circular motion (DOK Level 2)
- Analyze various situations involving circular motion (DOK Level 4)
- Understand and apply the law of universal gravitation, especially as it relates to circular motion, Newton's third law, and Kepler's laws (DOK Level 4)

Core Activities and Corresponding Instructional Methods:

- Reading of Chapter 5 in Textbook
- Direct Instruction (lecture with fill-in note pages to complete)
- Online Chapter 5 Independent Practice through the Pearson Mastering Physics website
- Selected questions from AP Classroom Unit 3 Circular Motion & Gravitation Progress Checks for independent review
- Introductory Activity: Using a coat hanger and a penny, investigate the requirements for an object to undergo circular motion.
- Laboratory Investigation: Circular Motion Lab (College Board AP Physics 1 Lab Investigation) utilizing a flying toy hanging from the classroom ceiling that undergoes circular motion.

Assessments:

- Diagnostic: Teacher observations and questioning
- Formative: student responses to independent practice, quizzes
- Summative: Unit 5 Test; Lab

Unit 6: Impulse and Linear Momentum Time/Days (20 days)

Standards (by number): 3.2.10.B1, 3.2.10.B6, 3.2.P.B7, CC.3.5.11-12.A, CC.3.5.11-12.B, CC.3.5.11-12.C, CC.3.5.11-12.D, CC.3.5.11-12.E, CC.3.5.11-12.F, CC.3.5.11-12.G, CC.3.5.11-12.H, CC.3.5.11-12.I, CC.3.5.11-12.J, CC.3.6.11-12.A, CC.3.6.11-12.B, CC.3.6.11-12.C, CC.3.6.11-12.D, CC.3.6.11-12.E, CC.3.6.11-12.F, CC.3.6.11-12.G, CC.3.6.11-12.H, CC.3.6.11-12.I, CC.3.6.11-12.J

Anchors: A1.1.1.1, A1.1.1.2, A1.1.1.3, A1.1.1.4, A1.1.1.5, A1.1.2.1, A1.1.2.2, A1.2.1.1, A1.2.1.2, A1.2.2.1, A1.2.2.2, A1.2.3.1, A1.2.3.2

Eligible Content: Chapter 6 of textbook: Mass accounting, Linear momentum, Impulse and momentum, The generalized impulse-momentum principle, Skills for analyzing problems using impulse and momentum, Jet propulsion, Collisions in two dimensions.

Objectives: Students shall:

- Compare and contrast isolated and non-isolated systems and develop the idea of constancy of mass in an isolated system (DOK Level 2)
- Develop a qualitative and quantitative understanding of the impulse, momentum, and the relationship between them. (DOK Level 2)
- Apply the impulse-momentum principle to two-dimensional systems using equations and bar charts (DOK Level 4)
- Apply the concepts of impulse and momentum to real-world situations such as jet propulsion (DOK Level 4)

Core Activities and Corresponding Instructional Methods:

- Reading of Chapter 6 in Textbook
- Direct Instruction (lecture with fill-in note pages to complete)
- Online Chapter 6 Independent Practice through the Pearson Mastering Physics website
- Selected questions from AP Classroom Unit 5 Momentum Progress Checks for independent review
- Introductory Activity: Using balls of various sizes and materials, investigate the types of collisions between the balls, the floor, and each other.
- Laboratory Investigation: Impulse and Momentum Lab (College Board AP Physics 1 Lab Investigation or Pasco Conservation of Momentum Lab) utilizing a cart that impacts a force sensor. A data collection system measures the velocities of the cart before and after the collision using a motion sensor and the force sensor measures the impulse.

Assessments:

- Diagnostic: Teacher observations and questioning
- Formative: student responses to independent practice, quizzes
- Summative: Unit 6 Test; Lab

Unit 7: Work and Energy Time/Days (21 days)

Standards (by number): 3.2.10.B2, 3.2.P.B2, 3.2.12.B2, 3.2.10.B6, 3.2.P.B7, CC.3.5.11-12.A, CC.3.5.11-12.B, CC.3.5.11-12.C, CC.3.5.11-12.D, CC.3.5.11-12.E, CC.3.5.11-12.F, CC.3.5.11-12.G, CC.3.5.11-12.H, CC.3.5.11-12.I, CC.3.5.11-12.J, CC.3.6.11-12.A, CC.3.6.11-12.B, CC.3.6.11-12.C, CC.3.6.11-12.D, CC.3.6.11-12.E, CC.3.6.11-12.F, CC.3.6.11-12.G, CC.3.6.11-12.H, CC.3.6.11-12.I, CC.3.6.11-12.J

Anchors: A1.1.1.1, A1.1.1.2, A1.1.1.3, A1.1.1.4, A1.1.1.5, A1.1.2.1, A1.1.2.2, A1.2.1.1, A1.2.1.2, A1.2.2.1, A1.2.2.2, A1.2.3.1, A1.2.3.2

Eligible Content: Chapter 7 of textbook: Work and energy, Energy is a conserved quantity, Quantifying gravitational potential and kinetic energies, quantifying elastic potential energy, Friction and energy conversion, Skills for analyzing processes using the work-energy principle, Collisions, Power, Improving our model of gravitational potential energy.

Objectives: Students shall:

- Apply the concept that work done on a system changes its energy (DOK Levels 2 & 4)
- Use the idea of conservation of energy along with employing work-energy bar charts to solve a variety of problems (DOK Level 4)
- Recognize systems that have kinetic energy and gravitational and spring potential energies and use equations to mathematically quantify these energies (DOK Level 3)
- Apply the concept of work to analyze friction's effect on a system's energy (DOK Level 3)
- Analyze collisions using both energy and momentum principles (DOK Level 4)
- Apply the concept of power to determine the rate of energy changes in systems (DOK Level 3)
- Apply an improved model of gravitational potential energy based on universal gravitation law to astronomical situations (DOK Level 4)

Core Activities and Corresponding Instructional Methods:

- Reading of Chapter 7 in Textbook
- Direct Instruction (lecture with fill-in note pages to complete)
- Online Chapter 7 Independent Practice through the Pearson Mastering Physics website
- Selected questions from AP Classroom Unit 4 Energy Progress Checks for independent review
- Introductory Activity: Describe the motion of small poppers in terms of Newton's laws and energy concepts.
- Laboratory Investigation: Conservation of Energy Lab (College Board AP Physics 1 Lab Investigation or Pasco Conservation of Mechanical Energy Lab) utilizing a cart on an inclined ramp connected to a spring. Energies of the cart at various points in the motion are analyzed to confirm energy conservation. A data collection system measures the velocities of the cart using a motion sensor and a video analysis system such as Tracker is used to measure the distances and heights.

Assessments:

- Diagnostic: Teacher observations and questioning
- Formative: student responses to independent practice, quizzes
- Summative: Unit 7 Test; Lab

Unit 8: Extended Bodies at Rest Time/Days (7 days)

Standards (by number): 3.2.P.B1, 3.2.12.B1, 3.2.10.B6, 3.2.P.B7, CC.3.5.11-12.A, CC.3.5.11-12.B, CC.3.5.11-12.C, CC.3.5.11-12.D, CC.3.5.11-12.E, CC.3.5.11-12.F, CC.3.5.11-12.G, CC.3.5.11-12.H, CC.3.5.11-12.I, CC.3.5.11-12.J, CC.3.6.11-12.A, CC.3.6.11-12.B, CC.3.6.11-12.C, CC.3.6.11-12.D, CC.3.6.11-12.E, CC.3.6.11-12.F, CC.3.6.11-12.G, CC.3.6.11-12.H, CC.3.6.11-12.I, CC.3.6.11-12.J

Anchors: A1.1.1.1, A1.1.1.2, A1.1.1.3, A1.1.1.4, A1.1.1.5, A1.1.2.1, A1.1.2.2, A1.2.1.1, A1.2.1.2, A1.2.2.1, A1.2.2.2, A1.2.3.1, A1.2.3.2

Eligible Content: Chapter 8 of textbook: Extended and rigid bodies, Torque: a new physical quantity, Conditions of Equilibrium, Center of mass, Skills for analyzing situations using equilibrium conditions, Stability of equilibrium.

Objectives: Students shall:

- Expand their understanding of forces and static equilibrium to extended and rigid bodies (DOK Level 2)
- Calculate torques and determine their effect on a body's equilibrium status (DOK Level 4)
- Calculate the center of mass of a system consisting of multiple objects and use the center of mass to solve equilibrium problems (DOK Level 3)
- Examine the stability of various types of equilibrium (DOK Level 3)

Core Activities and Corresponding Instructional Methods:

- Reading of Chapter 8 in Textbook
- Direct Instruction (lecture with fill-in note pages to complete)
- Online Chapter 8 Independent Practice through the Pearson Mastering Physics website
- Selected questions from AP Classroom Unit 7 Torque and Rotational Motion Progress Checks for independent review
- Introductory Activity: Investigate how to balance stacks of pennies placed on opposite ends of a ruler supported by a pencil.
- Laboratory Investigation: Rotational Statics Lab (Pasco Lab) utilizing two force sensors connected to a hanging mass on a string to measure string tensions and compare them to theoretical values.

Assessments:

- Diagnostic: Teacher observations and questioning
- Formative: student responses to independent practice, quizzes
- Summative: Unit 8 Test; Lab

Unit 9: Rotational Motion Time/Days (14 days)

Standards (by number): 3.2.P.B1, 3.2.12.B1, 3.2.P.B2, 3.2.10.B6, 3.2.P.B7, CC.3.5.11-12.A, CC.3.5.11-12.B, CC.3.5.11-12.C, CC.3.5.11-12.D, CC.3.5.11-12.E, CC.3.5.11-12.F, CC.3.5.11-12.G, CC.3.5.11-12.H, CC.3.5.11-12.I, CC.3.5.11-12.J, CC.3.6.11-12.A, CC.3.6.11-12.B, CC.3.6.11-12.C, CC.3.6.11-12.D, CC.3.6.11-12.E, CC.3.6.11-12.F, CC.3.6.11-12.G, CC.3.6.11-12.H, CC.3.6.11-12.I, CC.3.6.11-12.J

Anchors: A1.1.1.1, A1.1.1.2, A1.1.1.3, A1.1.1.4, A1.1.1.5, A1.1.2.1, A1.1.2.2, A1.2.1.1, A1.2.1.2, A1.2.2.1, A1.2.2.2, A1.2.3.1, A1.2.3.2

Eligible Content: Chapter 9 of textbook: Rotational kinematics, Physical quantities affecting rotational acceleration, Newton's second law for rotational motion, Rotational momentum, Rotational kinetic energy, Tides and Earth's day.

Objectives: Students shall:

- Expand their understanding of kinematics to rotational systems (DOK Level 2)
- Analyze the physical quantities that affect rotational acceleration (DOK Level 2)
- Expand their understanding of Newton's second law to rotational systems and apply this understanding to various situations (DOK Levels 3 and 4)
- Expand their understanding of momentum to include rotational momentum and apply this understanding to various situations (DOK Levels 3 and 4)
- Calculate the kinetic energy of rotating objects (DOK Level 2)
- Apply the ideas of rotational motion to everyday phenomena, such as the tides and Earth's day. (DOK Level 4)

Core Activities and Corresponding Instructional Methods:

- Reading of Chapter 9 in Textbook
- Direct Instruction (lecture with fill-in note pages to complete)
- Online Chapter 9 Independent Practice through the Pearson Mastering Physics website
- Selected questions from AP Classroom Unit 7 Torque and Rotational Motion Progress Checks for independent review
- Introductory Activity: Students construct a spinner from cardboard, pennies, and a pencil to spin as long as possible.
- Laboratory Investigation: Rotational Dynamics Lab (Pasco Lab) utilizing the introductory rotational apparatus to investigate rotational inertia and conservation of energy for rotational systems.

Assessments:

- Diagnostic: Teacher observations and questioning
- Formative: student responses to independent practice, quizzes
- Summative: Unit 9 Test; Lab

Unit 10: Vibrational Motion Time/Days (17 days)

Standards (by number): 3.2.P.B1, 3.2.10.B6, 3.2.P.B7, CC.3.5.11-12.A, CC.3.5.11-12.B, CC.3.5.11-12.C, CC.3.5.11-12.D, CC.3.5.11-12.E, CC.3.5.11-12.F, CC.3.5.11-12.G, CC.3.5.11-12.H, CC.3.5.11-12.I, CC.3.5.11-12.J, CC.3.6.11-12.A, CC.3.6.11-12.B, CC.3.6.11-12.C, CC.3.6.11-12.D, CC.3.6.11-12.E, CC.3.6.11-12.F, CC.3.6.11-12.G, CC.3.6.11-12.H, CC.3.6.11-12.I, CC.3.6.11-12.J

Anchors: A1.1.1.1, A1.1.1.2, A1.1.1.3, A1.1.1.4, A1.1.1.5, A1.1.2.1, A1.1.2.2, A1.2.1.1, A1.2.1.2, A1.2.2.1, A1.2.2.2, A1.2.3.1, A1.2.3.2

Eligible Content: Chapter 10 of textbook: Observations of vibrational motion, Kinematics of vibrational motion, Dynamics of simple harmonic motion, Energy of vibrational systems, The simple pendulum, Skills for analyzing processes involving vibrational motion, Including friction in vibrational motion, Vibrational motion with an external driving force.

Objectives: Students shall:

- Understand the meaning of vibrational motion and the related terms period, frequency, and amplitude (DOK Level 2)
- Use the kinematic equations of vibrational motion to solve problems (DOK Level 4)
- Investigate the dynamics of simple harmonic motion and develop equations describing this motion. Apply this understanding to various situations (DOK Levels 3 and 4)
- Expand their understanding of energy to include energy of vibrating systems and apply this understanding to various situations (DOK Levels 3 and 4)
- Apply these concepts to the analysis of simple pendulums (DOK Level 4)
- Determine how friction and an external driving force affects vibrational motion (DOK Level 4)

Core Activities and Corresponding Instructional Methods:

- Reading of Chapter 10 in Textbook
- Direct Instruction (lecture with fill-in note pages to complete)
- Online Chapter 10 Independent Practice through the Pearson Mastering Physics website
- Selected questions from AP Classroom Unit 6 Simple Harmonic Motion Progress Checks for independent review
- Introductory Activity: Students construct a simple pendulum and vary the length and mass of the pendulum to determine their effect on the pendulum's period.
- Laboratory Investigation: Periodic Motion Lab (Pasco Periodic Motion: Mass and Spring Lab) utilizing a mass attached to a spring to determine the effect of spring length, spring constant, and mass on the period.

Assessments:

- Diagnostic: Teacher observations and questioning
- Formative: student responses to independent practice, quizzes
- Summative: Unit 10 Test; Lab

Note that the pacing of the remainder of the units in the course may change depending on date of the AP Test

AP Test Review Time/Days (10 days)

Eligible Content: Practice Tests from AP Classroom, targeted supplemental instruction of concepts as needed.

Unit 11: Modern Physics Time/Days (4 days)

Standards (by number): 3.2.10.B6, 3.2.P.B7

Anchors: n/a

Eligible Content: Chapter 26 of textbook: Ether or no ether?, Postulates of special relativity, Simultaneity, Time dilation, Length contraction, Spacetime diagrams, Velocity transformations, Relativistic momentum, Relativistic energy, Doppler effect for EM waves, General relativity, Global Positioning System (GPS).

Objectives: Students shall:

- Develop an appreciation as to how modern understanding of physics modifies the classical ideas of physics studied in the course to date, especially with our understanding of gravity and astronomical phenomena such as black holes (DOK Level 4)
- Develop a basic conceptual understanding of some of the major ideas of modern physics regarding special and general relativity (DOK Level 4)

Core Activities and Corresponding Instructional Methods:

- "Interstellar" theatrical film
- Direct Instruction (lecture)

Assessments:

- Diagnostic: Teacher observations and questioning

Unit 12: Mechanical Waves Time/Days (5 days)

Standards (by number): 3.2.10.B5, 3.2.P.B5, 3.2.10.B6, 3.2.P.B7, CC.3.5.11-12.A, CC.3.5.11-12.B, CC.3.5.11-12.C, CC.3.5.11-12.D, CC.3.5.11-12.E, CC.3.5.11-12.F, CC.3.5.11-12.G, CC.3.5.11-12.H, CC.3.5.11-12.I, CC.3.5.11-12.J, CC.3.6.11-12.A, CC.3.6.11-12.B, CC.3.6.11-12.C, CC.3.6.11-12.D, CC.3.6.11-12.E, CC.3.6.11-12.F, CC.3.6.11-12.G, CC.3.6.11-12.H, CC.3.6.11-12.I, CC.3.6.11-12.J

Anchors: A1.1.1.1, A1.1.1.2, A1.1.1.3, A1.1.1.4, A1.1.1.5, A1.1.2.1, A1.1.2.2, A1.2.1.1, A1.2.1.2, A1.2.2.1, A1.2.2.2, A1.2.3.1, A1.2.3.2

Eligible Content: Chapter 11 of textbook: Observations: pulses and wave motion; Mathematical descriptions of a wave; Dynamics of wave motion: speed and the medium; Energy, power, and intensity of waves; Reflection; Superposition principle and skills for analyzing wave processes; Sound; Standing waves on strings, Standing waves in air columns, The Doppler effect.

Objectives: Students shall:

- Identify the types and components of waves and wave behavior such as reflection (DOK Level 2)
- Describe wave behavior mathematically (DOK Level 3)
- Analyze and calculate the factors that determine wave speed (DOK Level 3)
- Calculate the energy, power, and intensity of waves given the wave characteristics (DOK Level 2)
- Qualitatively understand the wave behavior of reflection (DOK Level 2)
- Use the superposition principle to determine the wave resulting from two interfering waves (DOK Level 4)
- Understand the unique characteristics of sound waves, such as pitch and beats and use mathematics to describe and calculate them (DOK Level 3)
- Analyze the behavior of standing waves on strings and in air columns mathematically (DOK Level 4)
- Use the Doppler Effect to calculate the effect of a moving source on the wave's frequency (DOK Level 2)

Core Activities and Corresponding Instructional Methods:

- Reading of Chapter 11 in Textbook
- Direct Instruction (lecture with fill-in note pages to complete)
- Introductory Activity: Students construct transverse and longitudinal waves using slinkys, springs, and dominoes. Students construct standing waves on a string using variable standing wave generators.
- Practice sheets
- Laboratory Investigation: Resonance and Standing Waves Lab (Pasco) utilizing a graduated cylinder and resonance tubes with tuning forks to determine the speed of sound in air.

Assessments:

- Diagnostic: Teacher observations and questioning
- Formative: performance on practice sheets
- Summative: student responses to activity and lab

Unit 13: Electric Charge and Electric Force Time/Days (5 days)

Standards (by number): 3.2.P.B4, 3.2.12.B4, 3.2.10.B6, 3.2.P.B7, CC.3.5.11-12.A, CC.3.5.11-12.B, CC.3.5.11-12.C, CC.3.5.11-12.D, CC.3.5.11-12.E, CC.3.5.11-12.F, CC.3.5.11-12.G, CC.3.5.11-12.H, CC.3.5.11-12.I, CC.3.5.11-12.J, CC.3.6.11-12.A, CC.3.6.11-12.B, CC.3.6.11-12.C, CC.3.6.11-12.D, CC.3.6.11-12.E, CC.3.6.11-12.F, CC.3.6.11-12.G, CC.3.6.11-12.H, CC.3.6.11-12.I, CC.3.6.11-12.J

Anchors: A1.1.1.1, A1.1.1.2, A1.1.1.3, A1.1.1.4, A1.1.1.5, A1.1.2.1, A1.1.2.2, A1.2.1.1, A1.2.1.2, A1.2.2.1, A1.2.2.2, A1.2.3.1, A1.2.3.2

Eligible Content: Chapters 17 & 18.1-18.2 of textbook: Electrostatic interactions, Explanations for electrostatic interactions, Conductors and insulators (dielectrics), Coulomb's force law, Electric potential energy, Skills for analyzing processes involving E fields.

Objectives: Students shall:

- Describe electrostatic interactions in terms of forces (DOK Level 3)
- Compare and contrast conductors and insulators (DOK Level 3)
- Use Coulomb's force law to calculate and describe electrostatic forces between objects (DOK Level 3)
- Apply the concept of electric potential energy to solve various problems involving electric forces (DOK Level 4)
- Explain electrostatic interactions in terms of interaction with an electric field and apply this to various problems (DOK Levels 3 and 4)

Core Activities and Corresponding Instructional Methods:

- Reading of Chapters 17 and 18.1-18.2 in textbook.
- Direct Instruction (lecture with fill-in note pages to complete)
- Introductory Activity: Students investigate static electricity using a comb, cereal, and scotch tape.
- Practice sheets
- Laboratory Investigation: Electrostatics Lab utilizing Wimshurst machine, friction rod kits, and electroscopes to perform electrostatics experiments and analyze results.

Assessments:

- Diagnostic: Teacher observations and questioning
- Formative: performance on practice sheets
- Summative: student responses to activity and lab

Unit 14: DC Circuits Time/Days (5 days)

Standards (by number): 3.2.10.B4, 3.2.P.B4, 3.2.10.B6, 3.2.P.B7, CC.3.5.11-12.A, CC.3.5.11-12.B, CC.3.5.11-12.C, CC.3.5.11-12.D, CC.3.5.11-12.E, CC.3.5.11-12.F, CC.3.5.11-12.G, CC.3.5.11-12.H, CC.3.5.11-12.I, CC.3.5.11-12.J, CC.3.6.11-12.A, CC.3.6.11-12.B, CC.3.6.11-12.C, CC.3.6.11-12.D, CC.3.6.11-12.E, CC.3.6.11-12.F, CC.3.6.11-12.G, CC.3.6.11-12.H, CC.3.6.11-12.I, CC.3.6.11-12.J

Anchors: A1.1.1.1, A1.1.1.2, A1.1.1.3, A1.1.1.4, A1.1.1.5, A1.1.2.1, A1.1.2.2, A1.2.1.1, A1.2.1.2, A1.2.2.1, A1.2.2.2, A1.2.3.1, A1.2.3.2

Eligible Content: Chapter 19 of textbook: Electric current, Batteries and emf, Making and representing simple circuits, Ohm's law, Qualitative analysis of circuits, Joule's law, Kirchoff's Laws, Resistor circuits, Skills for solving circuit problems, Properties of resistors.

Objectives: Students shall:

- Understand electric current on an atomic level (DOK Level 2)
- Understand the role of batteries in DC circuits (DOK Level 1)
- Identify the basic components of simple DC circuits (DOK Level 1)
- Analyze DC circuits using Ohm's law, Joule's law, and Kirchoff's laws (DOK Level 4)
- Describe properties of resistors including superconductivity and semiconductivity (DOK Level 2)

Core Activities and Corresponding Instructional Methods:

- Reading of Chapter 19 in Textbook
- Direct Instruction (lecture with fill-in note pages to complete)
- Introductory Activity: Students create a simple DC circuit using a breadboard, wires, resistor, light bulb, and power supply.
- Practice sheets
- Laboratory Investigation: DC Circuits Lab (Pasco or Resistor Circuits Lab College Board AP Physics 1 Lab Investigation) utilizing a breadboard, wires, resistors, light bulbs, and power supply to construct and analyze series and parallel circuits.

Assessments:

- Diagnostic: Teacher observations and questioning
- Formative: performance on practice sheets
- Summative: student responses to activity and lab

Unit 15: Optics Time/Days (5 days)

Standards (by number): 3.2.10.B6, 3.2.P.B7, CC.3.5.11-12.A, CC.3.5.11-12.B, CC.3.5.11-12.C, CC.3.5.11-12.D, CC.3.5.11-12.E, CC.3.5.11-12.F, CC.3.5.11-12.G, CC.3.5.11-12.H, CC.3.5.11-12.I, CC.3.5.11-12.J, CC.3.6.11-12.A, CC.3.6.11-12.B, CC.3.6.11-12.C, CC.3.6.11-12.D, CC.3.6.11-12.E, CC.3.6.11-12.F, CC.3.6.11-12.G, CC.3.6.11-12.H, CC.3.6.11-12.I, CC.3.6.11-12.J

Anchors: A1.1.1.1, A1.1.1.2, A1.1.1.3, A1.1.1.4, A1.1.1.5, A1.1.2.1, A1.1.2.2, A1.2.1.1, A1.2.1.2, A1.2.2.1, A1.2.2.2, A1.2.3.1, A1.2.3.2

Eligible Content: Chapter 22.2-22.4, Chapter 23.1, 23.2, and 23.4, and Chapter 24.1 and 24.5 of the textbook: Reflection of light, Refraction of light, Total internal reflection, Plane mirrors, Qualitative analysis of curved mirrors, Qualitative analysis of lenses, Diffraction of light.

Objectives: Students shall:

- Understand and apply the basics of light sources, light propagation, and shadows. (DOK Level 2)
- Understand and calculate parameters relative to reflection, refraction, and total internal reflection. (DOK Level 3)
- Construct ray diagrams for plane and curved mirrors. (DOK Level 1)
- Construct ray diagrams for lenses. (DOK Level 1)
- Analyze Young's Double Slit experiment. (DOK Level 3)
- Qualitatively understand diffraction of light (DOK Level 3)

Core Activities and Corresponding Instructional Methods:

- Reading of 22.1-22.4, 23.1, 23.4, 24.1, 24.5 in Textbook
- Direct Instruction (lecture with fill-in note pages to complete)
- Practice sheets
- Optics Labs investigating performance of reflection, refraction, total internal reflection, mirrors, and lenses using Optics lab kits.

Assessments:

- Diagnostic: Teacher observations and questioning
- Formative: performance on practice sheets
- Summative: student responses to activity and lab

Unit 16: Real World Project Time/Days (10 days)

Standards (by number): all from course

Anchors: all from course

Eligible Content: all from course

Objectives: Students shall:

- Apply what they have learned in AP Physics 1 to investigating, researching, and presenting a real world physics problem of their own choosing (DOK Level 4)

Core Activities and Corresponding Instructional Methods:

- Student research, investigation, and presentation of their work on their chosen Real World Problem. Some examples of a Real World Problem investigation are as follows:
    - Torque and the Human Arm: this activity provides an opportunity for students to make an interdisciplinary connection to biological systems by investigating the structure and function of a major muscle (biceps) in the human body. Students will design and build an apparatus that replicates the forearm and biceps muscle system. The objective is to determine the biceps tension when holding an object in a lifted position. Required elements to be provided include design sketches, force diagrams, mathematical representations of translational and rotational equilibrium, and numerical calculations.
    - Toy Motion Analysis: students will use a video analysis program to analyze the motion of a toy as it moves. Students will provide the toy and do their own video. The motion must be analyzed both quantitatively and qualitatively, including graphs.
    - Everyday Accelerations: using an accelerometer app for a smartphone, students will analyze accelerations they experience every day. Data can be taken while moving down the hall between classes, while on a school bus, on an amusement park ride, etc. (but remember to always be safe!). Students will present a description of the motion they experienced, including acceleration, velocity, and displacement, both quantitatively ad qualitatively, including graphs.
    - Equilibrium Analysis: students will take two pictures – one of an object in translational equilibrium and one in rotational equilibrium. The objects also must have more than three forces acting on them. They will then construct free-body diagrams for each object and determine the magnitude of each force acting on each object. For the object in rotational equilibrium, the student will also find the magnitude of each torque acting on the object.
    - Science Olympiad Events: once the final event listing for this school year is released, an applicable physics or engineering competitive event that involves physics principles is a project option. Anticipated events include design and construction of rubber band airplanes, timekeeping device, balsa wood bridges, and compound machines.
    - Engineering Club Events: The DVHS Engineering Club has various competitive events that involve physics and physics principles.

- Musical Instruments: students create wind and/or string instruments from recycled materials. Instruments must play a 5-note scale. Students must compare and contrast the physics involved in the sound waves produced by their instruments.
- Pennsylvania Junior Academy of Science: an independent research project for the PJAS competition can fulfill this requirement. This includes, but is not limited to, projects involving the traditional subsets of physics (i.e. statics, dynamics, optics, acoustics, heat and electricity) and applied physics (i.e. mechanical, electrical, and civil engineering).

Assessments:

- Summative: Real World Project presentation

Checklist to Complete and Submit:

(Scan and email)

_____ Copy of the curriculum using the template entitled "Planned Instruction," available on the district website.

_____ The primary textbook form(s).

_____ The appropriate payment form, in compliance with the maximum curriculum writing hours noted on the first page of this document.

Each principal and/or department chair has a schedule of First and Second Readers/Reviewers. Each Reader/Reviewer must sign & date below.

First Reader/Reviewer Printed Name_____

First Reader/Reviewer Signature_____ Date_____

Second Reader/Reviewer Printed Name_____

Second Reader/Reviewer Signature _____ Date_____