Warren County School District

PLANNED INSTRUCTION

COURSE DESCRIPTION

Course Title: Advanced Placement Physics I

Course Number: 00356

Course Prerequisites: Appropriate algebra coursework

Course Description:
AP Physics 1 is an algebra-based, introductory college-level physics course that explores topics such as Newtonian mechanics (including rotational motion); work, energy, and power; mechanical waves and sound; and introductory, simple circuits. Through inquiry-based learning, students will develop scientific critical thinking and reasoning skills.

Suggested Grade Level: Grades 10-12

Length of Course: ☐ One Semester ☒ Two Semesters ☐ Other (Describe)

Units of Credit: 1 (Insert ***None*** if appropriate)

PDE *Certification and Staffing Policies and Guidelines* (CSPG) Required Teacher Certifications:
56 Physics

Certification verified by WCSD Human Resources Department: ☒ Yes ☐ No

TEXTBOOK AND SUPPLEMENTAL MATERIALS

Continue using Board approved textbook? ☒ Yes ☐ No (*If yes, then complete the information below.*)

Board Approved Textbooks, Software, Supplemental Materials:

Title: Physics Principles with Applications
Publisher: Pearson
ISBN #: 0-13-344768-5 teacher edition
ISBN #: 0-978-0-13-344768-2 student edition

Copyright Date: 2014
Date of WCSD Board Approval:

Title: Conceptual Physics
Publisher: Pearson

ISBN #: 10:0-321-90910-0 teacher edition
13:978-0-321-90910-7 student edition
Copyright Date: 2015
Date of WCSD Board Approval:

BOARD APPROVAL:

Date Written: February 2018

Date Approved: _____

Implementation Date: 2018-2019

SPECIAL EDUCATION AND GIFTED REQUIREMENTS

The teacher shall make appropriate modification to instruction and assessment based on a student's Individual Education Plan (IEP) or Gifted Individual Education Plan (GIEP).

COURSE OVERVIEW

Course Syllabus AP Physics 1

INSTRUCTIONAL STRATEGIES

The AP Physics 1 course is conducted using **inquiry-based instructional strategies** that focus on experimentation to develop students' conceptual understanding of physics principles. The students begin studying a topic by making observations and discovering patterns of natural phenomena. The next steps involve developing, testing and applying models. Throughout the course, the students construct and use multiple representations of physical processes, solve multi-step problems, design investigations, and reflect on knowledge construction through self-assessment rubrics.

In most labs, the students use probeware technology in data acquisition. In the classroom, they use graphing calculators and digital devices for interactive simulations, Physlet-based exercises, collaborative activities and formative assessments.

COURSE SYLLABUS

UNIT 1. KINEMATICS [CR2a]

- Kinematics in one-dimension: constant velocity and uniform accelerated motion
- Vectors: vector components and resultant
- Kinematics in two-dimensions: projectile motion

Big Idea 3
Learning Objectives: 3.A.1.1, 3.A.1.2, 3.A.1.3

UNIT 2. DYNAMICS [CR2b]

- Forces, types and representation (FBD)
- Newton's First Law
- Newton's Third Law
- Newton's Second Law
- Applications of Newton's 2nd Law
- Friction
- Interacting objects: ropes and pulleys

Big Ideas 1, 2, 3, 4
Learning Objectives: 1.C.1.1, 1.C.1.3, 2.B.1.1, 3.A.2.1, 3.A.3.1, 3.A.3.2, 3.A.3.3, 3.A.4.1, 3.A.4.2, 3.A.4.3, 3.B.1.1, 3.B.1.2, 3.B.1.3, 3.B.2.1, 3.C.4.1, 3.C.4.2, 4.A.1.1, 4.A.2.1, 4.A.2.2, 4.A.2.3, 4.A.3.1, 4.A.3.2

UNIT 3. CIRCULAR MOTION AND GRAVITATION [CR2c]

- Uniform circular motion
- Dynamics of uniform circular motion
- Universal Law of Gravitation

Big Ideas 1, 2, 3, 4
Learning Objectives: 1.C.3.1, 2.B.1.1, 2.B.2.1, 2.B.2.2, 3.A.3.1, 3.A.3.3, 3.B.1.2, 3.B.1.3, 3.B.2.1, 3.C.1.1, 3.C.1.2, 3.C.2.1, 3.C.2.2, 3.G.1.1, 4.A.2.2

UNIT 4. ENERGY [CR2f]

- Work
- Power
- Kinetic energy
- Potential energy: gravitational and elastic
- Conservation of energy

Big Ideas 3, 4, 5
Learning Objectives: 3.E.1.1, 3.E.1.2, 3.E.1.3, 3.E.1.4, 4.C.1.1, 4.C.1.2, 4.C.2.1, 4.C.2.2, 5.A.2.1, 5.B.1.1, 5.B.1.2, 5.B.2.1, 5.B.3.1, 5.B.3.2, 5.B.3.3, 5.B.4.1, 5.B.4.2, 5.B.5.1, 5.B.5.2, 5.B.5.3, 5.B.5.4, 5.B.5.5, 5.D.1.1, 5.D.1.2, 5.D.1.3, 5.D.1.4, 5.D.1.5, 5.D.2.1, 5.D.2.3

UNIT 5. MOMENTUM [CR2e]

- Impulse
- Momentum
- Conservation of momentum
- Elastic and inelastic collisions

Big Ideas 3, 4, 5
Learning Objectives: 3.D.1.1, 3.D.2.1, 3.D.2.2, 3.D.2.3, 3.D.2.4, 4.B.1.1, 4.B.1.2, 4.B.2.1, 4.B.2.2, 5.A.2.1, 5.D.1.1, 5.D.1.2, 5.D.1.3, 5.D.1.4, 5.D.1.5, 5.D.2.1, 5.D.2.2, 5.D.2.3, 5.D.2.4,5.D.2.5, 5.D.3.1

UNIT 6. SIMPLE HARMONIC MOTION [CR2d]

- Linear restoring forces and simple harmonic motion
- Simple harmonic motion graphs
- Simple pendulum
- Mass-spring systems

Big Ideas 3, 5
Learning Objectives: 3.B.3.1, 3.B.3.2, 3.B.3.3, 3.B.3.4, 5.B.2.1, 5.B.3.1, 5.B.3.2, 5.B.3.3, 5.B.4.1, 5.B.4.2

UNIT 7. ROTATIONAL MOTION [CR2g]

- Torque
- Center of mass

- Rotational kinematics
- Rotational dynamics and rotational inertia
- Rotational energy
- Angular momentum
- Conservation of angular momentum

Big Ideas 3, 4, 5
Learning Objectives: 3.F.1.1, 3.F.1.2, 3.F.1.3, 3.F.1.4, 3.F.1.5, 3.F.2.1, 3.F.2.2, 3.F.3.1, 3.F.3.2, 3.F.3.3, 4.A.1.1**,** 4.D.1.1, 4.D.1.2, 4.D.2.1, 4.D.2.2, 4.D.3.1, 4.D.3.2, 5.E.1.1, 5.E.1.2, 5.E.2.1

UNIT 8. MECHANICAL WAVES [CR2j]

- Traveling waves
- Wave characteristics
- Sound
- Superposition
- Standing waves on a string
- Standing sound waves

Big Idea 6
Learning Objectives: 6.A.1.1, 6.A.1.2, 6.A.1.3, 6.A.2.1, 6.A.3.1, 6.A.4.1, 6.B.1.1, 6.B.2.1, 6.B.4.1, 6.B.5.1, 6.D.1.1, 6.D.1.2, 6.D.1.3, 6.D.2.1, 6.D.3.1, 6.D.3.2, 6.D.3.3, 6.D.3.4, 6.D.4.1, 6.D.4.2, 6.D.5.1

UNIT 9. ELECTROSTATICS [CR2h]

- Electric charge and conservation of charge
- Electric force: Coulomb's Law

Big Ideas 1, 3, 5
Learning Objectives: 1.B.1.1, 1.B.1.2, 1.B.2.1, 1.B.3.1, 3.C.2.1, 3.C.2.2, 5.A.2.1

UNIT 10. DC CIRCUITS [CR2i]

- Electric resistance
- Ohm's Law
- DC circuits
- Series and parallel connections
- Kirchhoff's Laws

Big Ideas 1, 5
Learning Objectives: 1.B.1.1, 1.B.1.2, 1.E.2.1, 5.B.9.1, 5.B.9.2, 5.B.9.3, 5.C.3.1, 5.C.3.2, 5.C.3.3

LABORATORY INVESTIGATIONS AND THE SCIENCE PRACTICES

The AP Physics 1 course devotes over **25% of the time** to laboratory investigations **[CR5].**
The laboratory component of the course allows the students to demonstrate the seven **science practices** through a variety of investigations in all of the foundational principles.

The students use **guided inquiry (GI)** or **open inquiry (OI)** in the design of their laboratory investigations. Some labs focus on investigating a physical phenomenon without having expectations of its outcomes. In other experiments, the student has an expectation of its outcome based on concepts constructed from prior experiences. In application experiments, the students use acquired physics principles to address practical problems.

All investigations are reported in a **laboratory journal**. Students are expected to record their observations, data, and data analyses. Data analyses include identification of the sources and effects of experimental uncertainty, calculations, results and conclusions, and suggestions for further refinement of the experiment as appropriate. **[CR7]**

UNIT	LAB INVESTIGATION OBJECTIVE(S) CR6a (Investigation identifier: Guided Inquiry: **GI** Open Inquiry: **OI**) **[CR6b]**	SCIENCE PRACTICES [CR6b]
UNIT 1. KINEMATICS	**1. Meeting Point (OI)** To predict where two battery-powered cars will collide if they are released from opposite ends of the lab table at different times.	1.1, 1.2, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2
	2. Match the Graph (GI) To determine the proper placement of an air track, a glider, and a motion detector to produce a motion that matches a set of given graphs: position, velocity and acceleration versus time.	1.2, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
	3. Free-Fall Investigation (OI) To determine and compare the acceleration of two objects dropped simultaneously.	1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
	4. Vector Addition (GI) To determine the value of a resultant of several vectors, and then compare that value to the values obtained through graphical and analytical methods.	1.1, 1.2, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
	5. Shoot the Target (OI) To determine the initial velocity of a projectile, the angle at which the maximum range can be attained and predict where the projectile will land.	1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
	6. Chase Scenario (OI) *Lab Practicum:* Students use a battery- cart and a fan cart to recreate a chase scenario (police-thief) to predict the position where the "'thief"' will be caught and the final speeds of both cars.	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2
UNIT 2. DYNAMICS	**7. Inertial and Gravitational Mass (GI)** To determine the difference (if any) between inertial mass and gravitational mass.	1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
	8. Forces Inventory (GI) Qualitative and quantitative investigation on a variety of interactions between objects.	1,1, 1.4, 1.5, 2.1, 2.2, 3.3, 4.1, 4.2, 4.3, 5.1, 6.1, 6.2, 6.4, 7.2
	9. Static Equilibrium Challenge (OI) To determine the mass of a hanging object in a setup with three strings at various angles.	1.1, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
	10. Newton's Second Law (OI) To determine the variation of the acceleration of a dynamics cart in two scenarios: (1) the total mass of the system is kept constant while the net force varies, and (2) the net force is kept constant while the total mass of the system varies.	1.1, 1.4, 1.5, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2
	11. Coefficient of Friction (OI) To determine the maximum coefficient of static friction between a shoe and a wooden plank.	1.1, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2

	12. Atwood's Machine (GI) To determine the acceleration of a hanging mass and the tension in the string.	1.1, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
UNIT 3. CIRCULAR MOTION AND GRAVITATION	**13. Flying Toy (GI)** To determine the tension in the string and the centripetal acceleration of the flying toy.	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
UNIT 4. ENERGY	**14. Roller Coaster Investigation (OI)** To design a simple roller coaster using provided materials to test whether the total energy of the system is conserved if there are no external forces exerted on it by other objects.	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.2, 6.4, 7.2
	15. Work Done in Stretching a Spring (GI) To determine the work done on the spring from force-versus-distance graph of the collected data.	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
	16. Energy and Non-Conservative Forces (GI) To determine the energy dissipated by friction of a system consisting of a modified Atwood's machine.	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 6.5, 7.2
UNIT 5. MOMENTUM	**17. Bumper Design (OI)** To design a paper bumper that will soften the impact of the collision between a cart and a fixed block of wood. Their designs are evaluated by the shape of an acceleration-versus-time graph of the collision.	1.4, 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2
	18. Impulse and Change in Momentum (GI) To measure the change in momentum of a dynamics cart and compare it to the impulse received.	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
	19. Elastic and Inelastic Collisions (OI) To investigate conservation of momentum and conservation of energy using a ballistic pendulum to determine the type of collision.	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2
	20. Forensic Investigation (OI) *Lab Practicum:* Apply principles of conservation of energy, conservation of momentum, the work-energy theorem, and a linear model of friction to find the coefficient of kinetic friction.	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2
UNIT 6. SIMPLE HARMONIC MOTION	**21. Finding the Spring Constant (OI)** To design two independent experiments to determine the spring constants of various springs of equal length.	1.1, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
	22. Graphs of an Oscillating System (GI) To analyze graphs of position, velocity, and acceleration versus time for an oscillating system to determine how velocity and acceleration vary at the equilibrium position and at the endpoints.	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2

	23. Simple Pendulum Investigation (OI) To investigate the factors that affect the period of a simple pendulum and test whether the period is proportional to the pendulum's length, the square of its length, or the square root of its length.	1.2, 1.4, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
UNIT 7. ROTATIONAL MOTION	**24. Torque and the Human Arm (OI)** To design and build an apparatus that replicates the forearm and biceps muscle system to determine the biceps tension when holding an object in a lifted position.	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.1, 7.2
	25. Rotational Inertia (GI) To determine the rotational inertia of a cylinder from the slope of a graph of an applied torque versus angular acceleration.	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
	26. Conservation of Angular Momentum (GI) To investigate how the angular momentum of a rotating system responds to changes in the rotational inertia.	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
UNIT 8. MECHANICAL WAVES	**27. Mechanical Waves (OI)** To model the two types of mechanical waves with a spring toy to test whether or not these characteristics affect the speed of a pulse: frequency, wavelength and amplitude.	1.2, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.2, 6.4, 7.2
	28. Speed of Sound (OI) Design two different procedures to determine the speed of sound in air.	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
	29. Wave Boundary Behavior (GI) To compare what happens to the phase of a transverse wave on a spring toy when a pulse is reflected from a boundary and when it is reflected and transmitted from various boundaries (spring to string).	1.4, 3.1, 4.1, 4.2, 4.3, 5.1, 6.1, 6.4, 7.2
	30. Standing Waves (GI) Given a specified tension, students predict the length of the string necessary to generate the first two harmonics of a standing wave on the string. Then they perform the experiment and compare the outcome with their prediction.	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
UNIT 9. ELECTROSTATICS	**31. Static Electricity Interactions (GI)** Students use sticky tape and a variety of objects to make qualitative observations of the interactions when objects are charged, discharged, and recharged.	1.2, 3.1, 4.1, 4.2, 5.1, 6.2, 7.2
	32. Coulomb's Law (OI) To estimate the charge on two identical, equally charged spherical pith balls of known mass.	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
UNIT 10. DC CIRCUITS	**33. Brightness Investigation (GI)**	1.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2

	To make predictions about the brightness of light bulbs in a variety of series and parallel circuits when some of the bulbs are removed.	
	34. Voltage and Current (GI) To determine the relationship between the current through a resistor and the voltage across the resistor.	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
	35. Resistance and Resistivity (OI) To investigate the effects of cross-sectional area and length on the flow of current through a roll of Play-Doh.	1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1,5.3, 6.1, 6.4, 7.2
	36. Series and Parallel Circuits (OI) To investigate the behavior of resistors in series, parallel, and series-parallel circuits. The lab should include measurements of voltage and current.	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.4, 7.2

ASSESSMENT

Portfolio Assessment: ☐ Yes ☒ No

District-Wide Common Final Examination Required: ☒ Yes ☐ No

Course Challenge Assessment (Describe)**:** completion of the course final examination with a score of 80% or greater

WRITING TEAM: Warren County School District Teachers

WCSD STUDENT DATA SYSTEM INFORMATION

1. Is there a required final examination? ☒ Yes ☐ No
   Warren County School District Policy 9741 and9744 state, "All classes in grades 9-12 shall have a final exam."
2. Does this course issue a mark/grade for the report card? ☒ Yes ☐ No
3. Does this course issue a Pass/Fail mark? ☐ Yes ☒ No
4. Is the course mark/grade part of the GPA calculation? ☒ Yes ☐ No
5. Is the course eligible for Honor Roll calculation? ☒ Yes ☐ No
6. What is the academic weight of the course?

   ☐ No weight/Non credit ☐ Standard weight ☒ Enhanced weight